Digital Transformation of Incumbent Service Firms: Legacy Removal Strategies

Paul N. Gooderham
Professor, Middlesex University, London and Centre for Applied Research at NHH – Norwegian School of Economics
p.gooderham@mdx.ac.uk

Christine Meyer
Professor, NHH – Norwegian School of Economics
Christine.B.Meyer@nhh.no

Inger Stensaker
Professor, NHH – Norwegian School of Economics
inger.stensaker@nhh.no

Frank Elter
Associate Professor II, NHH – Norwegian School of Economics; and Director, Telenor Research & Innovation
frank.elter@telenor.com

Alexander Madsen Sandvik
Associate professor, NHH – Norwegian School of Economics
alexander.sandvik@nhh.no

Torben Pedersen
Professor, Copenhagen Business School
tp.si@cbs.dk

Abstract

For strategic leaders of incumbent service firms, the challenge of digital transformation involves the removal of legacy IT systems without sacrificing critical income streams. We argue that the removal of these is a distinct component of the third core constituent of dynamic capabilities – transforming. Employing two case studies, DNB and Telenor, we explore the micro-level processes through which strategic leaders attempted to remove

technology-related legacy to foster digital transformation. Both DNB and Telenor viewed legacy removal as critical for digital transformation. To theorize the micro-foundations of legacy removal, we examined the approaches top management either used or considered using to remove legacy. Our analysis revealed three distinctive approaches to legacy removal: *escaping*, *shrinking*, and *terminating* ('*big-bang*' versus '*step-by-step*').

Keywords

digital transformation, legacy removal, incumbent firms, strategic leadership

Digital transformation is an increasingly prevalent form of discontinuous technological change (Soluk & Kammerlander, 2021) that has "become a strategic imperative on leadership agendas … to protect incumbent advantages" (Warner & Wäger, 2019, p. 326/329). For the incumbent firm, successfully introducing digital technology can enable a fundamental transformation of products and services as well as the business strategies and business processes that underpin them (Bharadwaj et al., 2013). While digital transformation is driven by technology, Rogers (2016) argues that it is not just a technological issue – it is fundamentally about strategy, meaning that strategic leaders must use digital technology to introduce new services and revenue streams and to enhance the value proposition and customer interaction.

Liu et al. (2011) argue that a critical success factor for digital transformation entails the careful integration of new digital technologies and business processes. We argue that this understates the challenges that strategic leaders of incumbent firms face when engaging with digital transformation. Digital transformation in incumbent firms takes place in a context of entrenched legacy IT systems that have driven successful business models and that continue to generate critical income streams. Digital transformation means that top management – i.e.,

strategic leaders – must navigate the tension arising from the need to maintain income streams that rest on legacy technology while introducing new and unrelated technology. Thus, while all strategic transformations tend to involve legacy challenges tied to culture, identity, and resistance (Tripsas & Gavetti, 2000), for incumbent firms confronting digital transformation there is the distinct barrier of the tension between experimenting with new business models based on new digital technology and avoiding threats to the profitability of existing business that relies on legacy technology (Warner & Wäger, 2019).

Given the pressure strategic leaders are under to, on the one hand, maintain existing revenue streams that are based on legacy technology and, on the other, undertake digital transformation, our research question is: *what approaches do strategic leaders of incumbent firms employ to remove technology-related legacy to facilitate digital transformation?*

In terms of our theoretical framing, we locate our study within a stream of digital transformation scholarship that proposes that future research should examine the role of dynamic capabilities (Vial, 2019; Warner & Wäger, 2019). Dynamic capabilities have been defined as "the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (Teece et al., 1997, p. 516). At an aggregate level, dynamic capabilities can be bundled into three constituents: sensing, seizing, and transforming (Teece et al., 1997). Our rather novel argument is that legacy removal is a distinct component of the third core constituent of dynamic capabilities – transforming, which is a somewhat neglected aspect of the dynamic capability concept.

We draw on case studies of two Norwegian incumbent service firms, a bank (DNB) and a telco (Telenor), which share the general ambition of digital transformation in the context of legacy IT systems. Like many other service companies, both are on a journey of removing physical locations and successfully moving to a digital interface with customers, where they aim for a user-friendly digital interface offering all services in banking and

telecommunication without the involvement of humans in the transactions. In this way, they can offer a better value proposition to customers. However, this entails a significant challenge as the legacy systems have been built over decades as layers on layers to support the old business model and way of interacting with customers.

Our findings show some intriguing commonalities between the two companies in both the challenges they face and the strategic leadership approaches to the removal of technology-related legacy. Our findings suggest that when strategic leaders deem the 'big-bang' *termination* of legacy systems and capabilities as too hazardous, approaches to legacy removal involve '*step-by-step*' termination and *escaping* and *shrinking* legacy. Each has inherent benefits and challenges.

These findings contribute to existing research on digital transformation by addressing a fundamental challenge specific to digital technology – that of legacy removal. Our study illustrates the challenges of technology-related legacy and extends the growing research on digital transformation using a dynamic capabilities lens by adding to the *transformation* dimension. We show how digital transformation does not simply entail adding on new technologies and capabilities, but the transformational capability must also involve disentangling and removing old legacy systems and renewing capabilities. The removal of legacy is a particular challenge for incumbent firms that have a history and heritage where the foundation of business processes, routines, and ways of working were formed decades ago.

LITERATURE REVIEW

Digital technology and transformation

Digital technology such as artificial intelligence, cloud-computing, blockchain, and the Internet of Things (IoT) drives the transformation of established business models (Warner & Wäger, 2019). It enables new value propositions based on novel products, services, and price

models, and novel approaches to the creation of products or services (Barrett et al., 2015). Digital technology also has the potential to transform customer interaction including moving from physical to digital channels where customers access products or services online or through apps (Kane, 2014 Liu et al., 2011; Yeow et al., 2017). When introducing digital channels there is a potential for transforming customer relations through analytics that generate automated personalized digital marketing (Sia et al., 2016; Porter & Heppelmann, 2014; Wulf et al., 2017). Further, digital technologies provide customers with "ubiquitous access to information and communication capabilities" so that they become "active participants" in a dialogue with the company (Vial, 2019, p. 122).

Vial (2019, p. 12) defines digital transformation as "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, and connectivity technologies." Digital transformation differs from other strategic and organizational transformations through the scale, scope, and speed associated with the technology (Vial, 2019). Furthermore, digital transformation typically takes place in a much more volatile, complex, and uncertain environment as compared with other types of organizational change and transformation (Loonam et al., 2018).

Technology-related legacy

A key challenge for incumbents embarking on the digital transformation journey has to do with balancing the exploitation of existing resources with the exploration of digital technology. Another factor is that of "tensions arising from the misalignment between a firm's existing resources and its emergent digital business strategy" (Vial, 2019, p. 124). In a similar vein, Svahn et al. (2017) have observed a major challenge for incumbent firms in being able to handle the tension between retaining the existing capabilities for delivering extant services while building new digital capabilities. Legacy systems were created based on

5

analog "operational backbones" (Sebastian et al., 2017, p. 201) with layer upon layer of interdependent systems and features being added over the years. Not only do these analog operational backbones fail to support digital strategies, but they also require fundamentally different management practices (Sebastian et al., 2017, p. 205). For example, Sebastian et al. (2017) found that whereas the delivery of the legacy operational backbone involves a "waterfall" approach, delivering a digital platform requires an "agile" approach.

In essence, incumbents have well-established production and delivery processes that rely on legacy systems they cannot readily reconfigure for the purpose of digital transformation (Vial, 2019). What were core capabilities are now core rigidities (Leonard-Barton, 1992). However, the necessity of maintaining revenues makes scrapping legacy systems unviable in the short term.

By 'legacy system' we refer to any IT system, hardware, or software that has been superseded but is difficult to replace due to its widespread use and tight integration with existing practices and business model(s). Thus, typically, they are "core systems that have been proven to work correctly in a production environment for decades" (Khadka et al. 2014, p. 38). A common legacy system comprises monolithic IT systems established as long ago as the 1970s. Still functional, they contain important business rules and processes that represent essential business capabilities such as billing, service commissioning, order management, and product inventory. Large service companies (such as our two case companies) have built their own unique systems to automate their business processes. Naturally, technological capabilities are tied to the legacy system, but in addition, the core business capabilities are embedded in these old, tightly coupled, multi-layered, and complex systems – capabilities that are essential for the current business model and the revenue that flows from it.

In the context of digital transformation, legacy systems generally become outdated because many if not all will be entirely unsuited to support the business opportunities

generated by the new digital technologies that enable 24/7 interaction and servicing of customers anywhere. Further, they are unrenewable. To illustrate some challenges, legacy systems might not allow for real-time updating. The systems must be shut down and rebooted every time new features are added to the system, or the system needs technical upgrading, which is a source of negative user experiences. In addition, oftentimes legacy systems treat the information in batches (overnight) and data are not updated in real time. Thus, customer apps accessing such systems cannot provide real-time information to the customers. Furthermore, the systems contain hard-coded interdependencies between technical sub-systems to exchange and process data, resulting in inflexible solutions, in contrast to today's use of Application Programable Interfaces (APIs) where sub-systems are developed as modularized systems that exchange data through standard APIs. Developing large systems in modules using APIs allows the solution to be evolved by adding, exchanging, or removing modules to cater for new business processes, business rules, or development of services, rather than replacing the whole system.

Dynamic capabilities and strategic leadership

One proposed approach to elucidating the capacity of incumbent firms to succeed with digital transformation is that of dynamic capabilities (Warner & Wäger, 2019; Vial, 2019) consisting of sensing, seizing, and transforming. Warner & Wäger (2019) tied these overarching capabilities to the context of digital transformation and identified nine micro-foundations: sensing incorporates digital scouting, scenario planning, and crafting mindset while seizing involves rapid prototyping, balancing digital portfolios and strategic agility and transformation has to do with navigating innovation ecosystems, redesigning internal structures and improving digital maturity (Warner & Wäger, 2019). While this specification of the micro-foundations of dynamic capabilities within digital transformation is valuable and

useful, Teece (2007, p. 1327) noted that even if an incumbent firm senses an opportunity, path dependencies such as legacy IT systems mean that incumbents "tend to eschew radical competency-destroying innovation, in favor of more incremental competency-enhancing improvements." Thus, Teece (2007, p. 1327) recognizes the criticality of legacy removal and argues that "an important class of dynamic capabilities emerges around a leader's ability to override certain 'dysfunctional' features of established decision rules and resource allocation processes."

Therefore, we contend that "legacy removal" is a distinct aspect of transforming the incumbent firm that needs to be further developed and integrated into the concept of dynamic capabilities (Elter et al., 2019). Rather than taking an enterprise-level view, as Teece primarily does, there is a need for studies of legacy removal to adopt the micro-foundations approach of strategic leadership and entrepreneurship (Felin & Foss, 2009). Strategic leaders have an impact on organizational strategies and outcomes through their decision-making and allocations of resources and commitment in organizations (Hambrick & Mason, 1984).

Although strategic leaders of incumbent firms may sense that digital transformation has the potential to confer a significant advantage, it constitutes a disruptive, unproven innovation that involves removing legacy capabilities and established business models. This may require drastic, expensive, and politically challenging shifts in underlying technologies and competencies (Kammerlander et al., 2018). Equally, it may involve the managerially skillful escaping of legacy. Strategic leaders who delay making strategic decisions on legacy removal because of potential difficulties or potential outcomes (Samimi et al., 2022) are impeding the transforming aspect of the concept of dynamic capabilities.

Similarly, strategic entrepreneurship locates "the primary responsibility for mobilizing, orchestrating, and fusing strategic and entrepreneurial dimensions … with the top management team" (Simsek et al., 2017, p. 12). It embraces examining, "how the attributes

and activities of leaders at different levels shape and negotiate strategic and entrepreneurial imperatives" in relation to firm performance" (Simsek et al., 2017, p. 16) and provides an approach to investigating the leadership skills involved in effectively tackling escaping what Teece (2007, p. 1334) refers to as "incumbent constituencies." Consequently, for the incumbent firm, strategic entrepreneurship is not just about creating; it is also about overcoming legacy and organizational inertia whether that means sidelining, terminating, or destroying its causes (Christensen, 1997).

Thus, while the dynamic capabilities approach focuses on how new opportunities and resources can be sensed, seized, and transformed, we argue that strategic leaders of incumbent firms must also deal effectively with the removal of legacy technologies and capabilities. Therefore, a critical part of the third constituent of Teece's (2007) conceptualization of dynamic capabilities – transforming – involves purposively eliminating legacy systems and capabilities. However, we have limited knowledge of how strategic leaders aiming for digital transformation handle legacy technological systems and capabilities.

METHODS

Our study was designed in an exploratory manner to gain a better understanding of how two large incumbent service firms in different industries (financial services and telecommunications) have managed the broader process of digital transformation. Through a collaborative research project, we gained unique access to study the two firms as they were embarking on their digital transformation journeys. Based on initial interactions and conversations in DNB (financial services) and Telenor (telecommunications), it became apparent that technological legacy and the know-how related to old technology were impeding digital transformation. The strategic leaders in both firms were sensing and seizing new opportunities and attempting to transform their organization in various ways, yet existing

technology and related capabilities were holding them back. In line with a phenomenon-driven approach (Schwarz & Stensaker, 2014), which argues that important contemporary phenomena can (and sometimes should) drive the research process rather than relying primarily on existing theory to drive research, we therefore focused our research on the phenomenon of technology-related legacy and how it impacts digital transformation. The goal was to develop a better understanding (Eisenhardt, 1989) of how and why technology-related legacy was holding the incumbents back and to identify what actions senior level management took to manage the situation. Given the emerging state of knowledge on legacy removal, an exploratory approach can reveal new insights.

Introducing the research settings

Our first case, DNB, is the largest financial institution in Norway. It is the result of multiple mergers between domestic banks, the first one of which was established in 1822. In December 2020, the bank had 1.5 million online customers and employed more than 11,000 employees. Since the deregulation of the financial industry in the 1980s, DNB has gone through three waves of change. The first period was characterized by multiple mergers and acquisitions with a focus on consolidating operations and IT systems. This period somewhat overlapped the second wave of change, where operations were digitalized, resulting in a considerable reduction in the number of branches. Online banking was introduced in the late 1990s, and by 2006, 60 percent of all retail banking transactions in Norway were conducted online. When a new CEO took over in 2007, the competitive landscape was fundamentally changing and the plan was to step up service innovation to combat new competitors and be more attuned to new customer requirements. However, as the bank was hit by the financial crisis, it took several years for this innovation strategy to be implemented.

At the turn of 2010, the top management team of DNB sensed radical changes in their environment that had the potential to become game-changers in the industry. One significant change was that of the emergence of 'fintechs' such as PayPal, Klarna, and Alipay. Facilitated by the new 'Payment Services Directive Two' (PSD2) regulation, these so-called 'neobanks' expanded rapidly. PSD2 required incumbent banks to hand over transactional data to third parties, provided the customer accepted. With the new fintechs, DNB feared that the grip on the banks' core asset, their customer relations, could slip. The newcomers could benefit from new technological advancements and agile ways of working whereas the incumbents were stuck with old technological platforms and cumbersome waterfall working processes. To be competitive, the top management team at DNB concluded that there was a need to adopt new technology and agile working processes to enable new and faster innovations.

Our second case, Telenor, is a 160-year-old multinational telecommunications company ('telco MNC') that currently has a strong footprint in the Nordic region and Southeast Asia. In 2022, Telenor had 14,000 employees and 158 million subscribers. Its core services are voice, messaging, and internet connectivity, which are embedded in the network technologies purchased from the telco equipment infrastructure vendors. While the company has introduced digital customer interaction, Telenor remains reliant on physical retail as its main sales channel to acquire new customers, and on call centers to deal with customer requests. In 2016, the top management team of Telenor recognized that customer pressure as well as the expense involved in selling through retail and running call centers meant that the company urgently needed to accelerate its digitalization of customer interactions.

Data collection and analysis

To obtain a better understanding of the phenomenon of legacy removal in the context of DNB, we collected data through interviews with strategic leaders and operative managers, deliberatively selecting those with designated roles in driving digital transformation. In the first phase of data collection in the fall of 2019 and spring of 2020, we conducted 19 interviews, each of which was of approximately 90 minutes in length. We did not ask specifically about legacy systems but rather probed key opportunities and challenges related to digital transformation. Technological legacy issues emerged as a key challenge through the interviews. In addition, data include PowerPoint presentations mapping the digital transformation initiatives, thus providing context and overview. Interview data were recorded, transcribed, and later analyzed inductively following a grounded theory approach where we strived to stay close to the informants' statements through first-order coding (van Maanen, 1998), aiming to identify key themes and then increasingly abstracting the first-order themes into categories through second-order coding (Gioia et al., 2013). For instance, we noted that strategic leaders were sometimes attempting to escape or shrink legacy technology rather than terminate it. In line with the grounded theory approach, we developed hunches and then returned to the field in spring 2021 to "test" our hunches and collect additional data. In this phase, we targeted 10 informants, six of whom we had interviewed in the first phase. Table 1 provides an overview of DNB informants.

Table 1: Overview of informants in DNB

Informant	Position	Phase 1 of data collection	Phase 2 of data collection
Strategic leader 1	CEO	X	X
Strategic leader 2	CEO		X
Top manager 1	Group executive vice president	X	
Top manager 2	Group executive vice president	X	
Middle manager 1	Executive vice president group technology	X	X
Middle manager 2	Head of division Corporate Banking	X	

Middle manager 3	Head of division Personal Banking	X	X
Middle manager 4	Executive vice president, head of corporate development	X	X
Middle manager 5	Executive vice president	X	
Middle manager 6	Executive vice president	X	
Middle manager 7	Executive vice president	X	
Middle manager 8	Head of technology and digitalization channels	X	
Middle manager 9	Head of people strategy	X	X
Middle manager 10	Head of innovation	X	X
Middle manager 11	Executive vice president		X
Middle manager 12	Senior vice president		X
Middle manager 13	Executive Vice President People Business Partner		X
Employee 1	Enterprise architect	X	
Employee 2	Enterprise architect	X	
Employee 3	Innovation manager	X	
Employee 4	Investment manager	X	
Employee 5	Senior business developer	X	
Employee 6	Senior project manager	X	

In Telenor, we conducted our research in a single phase in 2020–2022. In the period June–September 2020, we conducted initial interviews with 10 Telenor middle-level managers about digital transformation. These interviews revealed that legacy systems were a significant problem that hindered the effective implementation of new work processes. Then, from April to June 2021, we interviewed four strategic leaders to develop our understanding of the role of legacy removal in transforming the company. On 19 August 2022, to validate our understanding of the findings from our fourteen informant interviews, we organized a two-hour on-site workshop with eight Telenor employees involved in delivering the digital transformation who we had not previously interviewed. The workshop included the head of digital transformation, enterprise architects, and middle managers with product and market responsibilities. Four members of the research team attended, and the workshop was filmed and transcribed. As well as providing additional details on the unfolding operational practices of legacy removal, the workshop served to enable us to identify representative key statements

from our informant interviews that we include in our text. These key statements were derived

from three of the strategic leaders and one of the strategic middle managers: see Table 2.

Table 2: Overview of Telenor informants that are cited in the text

Informant	Position
Tn-Strategic leader no. 1	CxO in Telenor Nordic organization
Tn-Strategic leader no. 2	CxO in Telenor Norway
Tn-Strategic leader no. 3	CEO of a Telenor Business unit in Nordics
Tn-Strategic middle manager no. 1	Director in strategy unit Telenor Norway

After finalizing our separate within-case analyses of DNB and Telenor, we conducted

a cross-case analysis where we searched for commonalities and differences. This led us to our

three categories of terminating, escaping, and shrinking technological legacy.

FINDINGS
Legacy removal in DNB

DNB's operations rest on a technological platform that was developed in the 1970s,

when data storage was expensive and processing capacity low. The norm was that new

products were launched no more than a couple of times a year. Removing this legacy is by no

means seen as straightforward among our informants. Besides its potential to disrupt daily

operations, the strategic leadership faces considerable technological uncertainty both in terms

of choosing the "right" technology and the costs of implementing a new technological

platform (including the direct investment costs and the costs of transforming the

organization).

We have grouped DNB's top management initiatives into *escaping legacy*, *shrinking

legacy*, and *terminating legacy*.

Escaping legacy

DNB's strategic leadership tried to escape legacy by outsourcing IT development and bypassing the existing platform. We outline three different attempts at escaping legacy in more detail below.

Outsourcing IT development

DNB's first step in dealing with legacy was to outsource IT development to India by signing sourcing contracts with major Indian IT firms in and around 2014. The strategic leaders argued that the IT department in DNB was too vested in maintaining the old systems and working in traditional ways. Outsourcing would speed up innovation development and add capacity in a cost-efficient way.

> *To be honest, the real innovation work did not start until we had in place an extensive outsourcing strategy.* (Strategic leader no. 1)
>
> *Although we succeeded in adding capacity and lowering the costs, the waterfall methods (adopted in the IT-development projects) took too long and there was an enormous number of people involved. As time passed, we understood that this was not agile enough.* (Strategic leader no. 1)

The sourcing contracts changed the character of the innovation work overnight by adding substantial (IT) development capacity. Meanwhile, problems associated with communicating with external contractors emerged, and rather than removing legacy, outsourcing simply added capacity on top of the legacy IT system.

Bypassing the existing platform

The CEO sensed the need to pursue service innovation and chose to invest heavily in developing DNB's innovation capacity. Traditional banking employees were replaced with tech-savvy employees, agile ways of working replaced waterfall methodology, a separate unit

dedicated to exploring new businesses was established, and employees were encouraged to launch their ideas and become internal entrepreneurs. To escape legacy, DNB's strategic leadership looked for ways to *bypass* the old monolithic IT systems by adopting new technology on top of them. In 2017 and 2018 several new measures were implemented, including the adoption of robotic technology or RPAs (Robotic Process Automation), cloud technology, and APIs to enable modularization of the IT systems.

Although the RPAs led to more efficient operations, the underlying legacy problem remained.

> *Today's infrastructure carries 10,000 products…. Now, we have tried to put robotic technology on top and tried to automate the processes, but what you do is replace people, not the systems. …So, we end up with a tremendous pyramid with an enormous number of solutions at the bottom for a very small value proposition at the top.* (Employee no. 2)

Internal entrepreneurs in DNB who were working at the periphery of DNB's product portfolio developed new product offerings independent of the old infrastructure. One example was IDMee in 2018 – a new identification product which allowed people to identify themselves without being physically present. This was one of the first product offerings that adopted cloud technology.

> *The way we wanted to set this up could be done independently of DNB's own systems – we built the solution in the cloud from scratch.*
>
> (Employee no. 3)

The application of cloud technology continued at a larger scale and was applied in the new mobile banking platform launched in January 2019. However, in contrast to IDMee, which could operate completely independently of the legacy IT systems, mobile banking remained connected to the legacy systems.

> *What we did with the mobile bank was to put it in a cloud and make a layer in*
>
> *between called shared service layer. (Middle manager no. 3, 2nd interview)*

A third way of bypassing the legacy IT system was to adopt APIs and open DNB to third parties, for example, by providing major newspapers with foreign exchange calculators. This development of APIs was aided by the new open banking unit established in 2018. Although APIs facilitated the communication and interaction between the parties, however, the core structure remained the same.

> *If you have a ramshackle house and you invest in fiber optics (to communicate with*
>
> *the outside world), then things do not fundamentally change. The API may be*
>
> *fantastic, but if no one wants to come visit or live in your house, it does not amount to*
>
> *much.*
>
> *(Employee 1, 2nd interview)*

As such, while cloud technology and APIs made it easier to temporarily deal with the outdated legacy IT system and bought DNB time, neither technology aided in solving the underlying issue of replacing the legacy IT systems.

Shrinking legacy

In addition to attempting to escape legacy, DNB's strategic leaders described how they worked on shrinking the legacy IT systems in two distinct ways: by setting up an entirely new venture, and the gradual dismantling of the legacy platform.

Setting up a new venture from scratch with new technology

The immenseness of the legacy platform led strategic leaders to question whether it was worthwhile engaging with change from the inside, or whether a less arduous approach would be to create an entirely new venture outside of DNB. By creating a new venture,

operations could be based entirely on digital platforms without having to deal with the legacy of the old technological systems. As the new venture was formed, DNB's customers could be migrated to the new bank.

> *If we are going to stay a traditional, universal bank in five to 10 years, then we will not survive with the current technology infrastructure…. I think we should copy others and build up a new bank on the side, spin it out as a new company and start to build up services from scratch built on modern technology. And then migrate the customers as the solutions are ready…. The core infrastructure is so rotten that it will take years and years if we are going to modularize this.* (Middle manager no. 1)

However, in contrast to the more liberal UK regulatory regime, the regulatory Norwegian regime put formidable restrictions on new ventures, as one bank can only have one operating license. Thus, establishing and operating a separate bank would not be permissible under DNB's license with a single report to the financial authorities. As such, this option was dropped by DNB's strategic leadership.

Dismantling the legacy platform piece by piece

As an alternative approach, the strategic leadership of DNB opted to gradually dismantle systems and products from its core legacy IT systems. Virtual teams across the IT and business units were set up in dedicated product areas, and IT resources and systems were transferred to the divisions to reduce legacy dependencies and to pave the way for innovative ways of working.

> *(In the last couple of years), IT … has been an integrated part of the business units…. I'm not really a technology person, (but) you got much better insights and discussions*

... in our management teams, not being a client of the IT department, but managing the resources ourselves. *(Middle manager no. 2)*

Dismantling reduced legacy as some systems, for example in the markets division, were run independently from the legacy infrastructure. However, overall, most systems remained semi-dependent on the legacy IT systems, with new structures put on top. Furthermore, the most interdependent systems still reside in the IT department.

In IT we work a lot on trying to separate the different systems from one another to be able to work autonomously and to free up capacity…. Ideally, we want people to have full autonomy, but we have a platform where this is not possible, so we are left with a number of interdependencies. *(Middle manager no. 4, 2nd interview)*

Terminating legacy

We now turn to the various ways DNB's strategic leaders have attempted to terminate legacy. Our informants described two options for termination: a big-bang replacement and a step-by-step approach. Both involve dilemmas and challenges, which we elaborate on below.

Big-bang replacement of the entire platform

One obvious way to remove the legacy of old platforms would be to change the entire core structure. This big-bang approach was chosen by one of DNB's closest competitors, Nordea, but this alternative was never seriously considered by DNB's strategic leaders.

There were many reasons why we did not follow in the tracks of Nordea and many other banks (which replaced their core technological infrastructure with a new one).

However, our main concern was spending billions of kroner on something that could

turn out to be outdated by the time it was launched.   (Strategic leader no. 1)

Besides the costs involved in such an investment, a key consideration was also the

detrimental effects on IT development in the period the new platform was to be developed.

The big-bang replacement has proven to be a risky and costly strategy. But the worst

thing in my mind is that you need to freeze all activities around it and set a stop to all

development for a long period of time. I would not dare to pursue such as strategy.

(Strategic leader no. 2)

Building a new platform inside the firm step by step

In 2021, DNB's strategic leaders decided to remove legacy by gradually replacing the

old systems step by step in a modularized approach. However, the path to reaching this

decision was protracted. It started with two internal entrepreneurs who had worked in their

spare time to come up with a viable alternative to big-bang.

Too often, new systems come on the top of the already existing systems…. Our aim is

to build something new from scratch to try to replace the old systems that date from

the 1970s…. What we plan to do is to tidy up, delete, turn off, and then we can

increase the pace of innovation and do all the cool stuff…. By implementing this piece

by piece … the cost is marginal compared to a full-fledged change of the tech

infrastructure. There is the potential that this doesn't work, but that is sunk cost. If it

works, there is a tremendous upside.   (Employee no. 1, 1st interview)

As it had the potential to considerably disrupt daily operations, the idea met

substantial internal resistance from operative managers. However, the CEO allowed the two

"enthusiasts" to run their project provided they kept it under the radar.

Change is risky. Let's say you are responsible for an area which concerns unsecured

credit. Everything is in order, the employees are satisfied and the earnings are good.

But if you change the system, there is a likelihood that something could go wrong.

(Employee no. 1, 1st interview)

There are groups of experts that disagree on the direction, and although the CEO does not have the technological competence, they (and their teams) have a strategic authority that sometimes needs to be activated.   (Top manager no. 1)

In 2018, the two intrapreneurs teamed up with a newly established UK fintech company called 11:FS to create the joint venture, Foundry. The idea behind Foundry was to turn the rationale for DNB's infrastructure on its head. Instead of a large and complex infrastructure with numerous limitations and interdependencies, the plan was to build a small platform with the capacity to generate large amounts of value propositions on the top. In 2019, DNB's Group Executive Vice President for New Business acclaimed the initiative:

"DNB is very pleased with the partnership with 11:FS and the development process of Foundry. Our development teams have worked closely together over the past six months, and based on a successful proof of concept, we are now ready to move to the next milestone of beginning early-stage implementation. Implementing Foundry in DNB's systems will give us valuable insight in better understanding how we can use this technology going forward."   (Glyptis, 2019)

Entering a partnership with a young, rapidly growing fintech company was not without risk. In the end, the partnership with 11:FS was deemed too risky, and DNB's strategic leaders decided to pull out of the partnership. Nonetheless, the process with 11:FS meant that the step-by-step alternative to legacy removal had obtained a stronger foothold.

The board and the strategic leadership decided on a step-by-step solution. We are not going for the massive transformation program few succeed in, and which has a tendency to substantially exceed the budget.   (Strategic leader no. 1)

To give this alternative more traction, a new unit under the leadership of the New Business unit was established in 2021, but while the decision was made it would take many years to implement.

Summing up DNB's legacy removal

The DNB case illustrates the uncertainty and complexity involved in the bank's digital transformation journey and how technology-related legacy was holding the incumbent back. It also illustrates the various ways strategic leaders attempted to deal with technological legacy; each approach involving both benefits and challenges. Although the strategic leadership took measures to escape and shrink the legacy, the pressure to innovate and become more customer-oriented ultimately led management toward attempts to remove legacy more directly through a step-by-step termination.

Legacy removal in Telenor

For Telenor, the digital transformation challenge lies in the legacy mainframe IT systems, and its associated organizational culture and capabilities it has developed since the 1970s. These IT systems have been at the core of its approach to managing customers and span order fulfillment, commissioning of services, customer relation systems, and billing. It relies on sales and customer support employees functioning as a "human buffer" toward the customer, mitigating any friction in customers' experience in making their transactions. The legacy systems were designed and developed to run on computers with limited storage, memory, and processor capacity, and were never intended to support direct interaction with customers. The limitations inherent in Telenor's legacy systems are a barrier to the digitalization of customer interaction and the further digitalization of its portfolio of services.

The most common issue (facing Telenor) is that there are huge monolithic platforms that are not supporting fast-moving development, and we are not able to move fast enough in the market.   *(Tn-Strategic leader no. 2)*

In addition, the complexity of the legacy IT systems raises the cost of innovation and makes it more cumbersome to adopt new security measures.

In developing our current strategy, we agreed that we need to modernize IT because it is killing us slowly. Year-on-year project costs have gone up just because of the increasing complexity…. (Furthermore) some of these (legacy) systems do not have the required built-in security to expose the system to customers, allowing them 24/7 online access.   *(Tn-Strategic leader no. 3)*

Moreover, many of the employees who operate the legacy IT systems are approaching retirement and younger employees do not view their operation as an attractive career move.

Some of these platforms are 20–30 years old. The people who really know these platforms are retiring and we are losing the skills to manage these platforms.

(Tn-Strategic leader no. 2)

To illustrate how technology-related legacy has hampered innovation and digital transformation in Telenor in more detail, we now turn to two attempts at digitalizing customer interaction, "MyTelenor" and an attempt to introduce agile work processes. The first initiative failed in its original scope, while the second was postponed at the last minute.

MyTelenor

In mid-2017, the strategic leadership of Telenor launched an attempt to accomplish digital customer interaction through digital channels on apps and the web in its four Nordic business units that would offer a "single self-service application for Telenor customers." The vision of the "MyTelenor" app was that it was to be "one app used by all" where Nordic

customers would be able to buy and manage their mobile subscriptions. While the app itself would be relatively easy to develop, it required interfaces with the company's core IT systems to allow customers to purchase subscriptions and make changes on the fly.

Telenor's strategic leadership viewed this as a "flagship" project and the CEO undertook to chair its steering committee. Nevertheless, as early as January 2018 the strategic leadership concluded that the project had no chance of succeeding and it was abandoned. Instead, each of the Nordic business units was charged with developing their own local apps that could be integrated with their local idiosyncratic legacy IT systems. Thus, no digital scale advantages were captured. An internal evaluation of the failure concluded that in addition to the technical challenge, Telenor lacked the necessary organizational capabilities and governance.

The agile project

In 2019, Telenor's strategic leadership decided to initiate an agile project in the Norwegian business unit labeled "Digital Channel Marketing." The aim was to develop new digital customer interaction capabilities without affecting the running of the extant business model. The inter-disciplinary, cross-functional agile team was to be empowered to focus on "maximizing the effectiveness of marketing through digital channels" so that evolving customer demands could be responded to in a timely manner. Processes were to be streamlined and many handovers between functional departments were to be removed. Cross-functional teams with an end-to-end responsibility were established, and they adopted agile ways of working, including Kanban portfolio planning and two-week sprints (Scrum). The team was also empowered to make their own decisions independent of Telenor's management.

> *Telenor is trying to establish a new set of Agile related values – such as "always explore" and "create together" – that underpin an "experimental mindset."*
>
> <div align="right">

(Tn-Strategic Middle manager no. 1)
</div>

However, just before the project was due to start in the fall of 2020, the strategic leadership decided to put it on hold. What had become clear to Telenor's strategic leaders was that many of the changes in business processes that the project was set up to achieve were incompatible with the complex legacy IT systems. Consultations with the IT department revealed that each modification would have ripple effects on numerous technical IT functions. For example, the key legacy IT systems are batch systems doing updates outside office hours and thus unable to provide real-time status information directly to customers that the project was aiming for. Telenor's strategic leaders concluded that the IT department simply did not have the capacity to change its work practices to agile work methods while also maintaining the legacy IT systems. Changes to the legacy IT systems would require extensive analysis before any further attempts at agile development could be considered. In essence, the leadership put the agile project on hold because it was unable to draw sufficiently on the IT resources needed to secure rapid change.

The failure of Telenor's strategic leadership to implement new innovative practices and services is a product of the scale of the legacy removal challenge. It has triggered a reconsideration in the strategic leadership of its approach to dealing with the legacy IT systems.

> *We need to extend that discussion on how we deal with legacy and move toward being more business-focused. With digitalizing customer interactions, we need to understand what this means for the IT system, and how we work together with Business and IT.*
>
> <div align="center">

(Tn-Strategic leader no. 3)
</div>

In 2021, resolving the legacy issue was flagged as an acute leadership challenge at Telenor. Telenor's leaders had considered several approaches. We observed that these approaches fitted well with the terminology that emerged from the DNB case: *escaping*, *shrinking* and *terminating* legacy.

Escaping legacy

In terms of escaping legacy IT systems, strategic leaders at Telenor are experimenting with a form of escaping legacy that involves bypassing the existing platform. The core idea was to install API middleware to develop standard interfaces on top of the legacy systems. This approach isolated the legacy system and allowed the development of new functionality by using modern software techniques to develop innovative customer-centric services that utilize features in the legacy systems. Later the legacy systems can be gradually replaced by new modules. This approach allows the managers of the commercial departments in Telenor to commission the development of innovative digital customer interaction and new digital services.

> *Technology architecture needs to be designed and implemented to separate customer-facing systems from platforms and exchange information by using APIs, and this will create business value in short term. It is difficult to remove legacy and we won't be successful if we do it in a single jump, as there are too many business rules, it's too risky and too difficult. Now there is technology with more middleware API that allows us to make the separation and take out slices into a new system, and the old system gradually dies.*
>
> *(Tn-Strategic leader no. 3)*

However, the introduction of APIs to develop innovative customer solutions on top of legacy systems did not resolve the legacy challenge as such. Legacy remained intact.

Shrinking legacy

Telenor's strategic leadership has also experimented with shrinking its legacy through outsourcing. Thus, it has initiated assessments of what parts of a future IT system Telenor could outsource, thereby enabling its internal software engineers to focus on developing the most differentiating business-critical systems.

> *Let us take billing as an example, which was very important 15 years ago, and it was a differentiator, to create bundles, make price plans and make quick changes, but today we don't care as billing is not as important anymore. We don't have to do it ourselves, as long as a vendor has a good API, it requires low attention as long as it does what it needs to.*   *(Tn-Strategic leader no. 3)*

Telenor's strategic leadership was aware that its outsourcing strategy had implications for the employees whose tasks are outsourced, but assessed these as relatively unproblematic:

> *We need to have a holistic view and discuss not only the new development but also have an active roadmap on legacy removal. Based on my experience, we have been changing one-third of the people, retraining one-third, and one-third have remained in the same activities. With changing one-third of the people, it is not through firing. When we take down systems or move the responsibility to contractors, the people usually move on or retire*   *(Tn-Strategic leader no. 1)*

Terminating legacy

Telenor's strategic leadership has also considered removing legacy more directly by terminating it either through a big-bang or a step-by-step approach.

Big-bang replacement of the entire IT legacy system

In 2018, Telenor's strategic leaders asked its IT engineers to explore a big-bang termination of legacy. The engineers responded that a complete replacement of Telenor's legacy IT system could take as long as three to five years. During that period, all incremental development activities would have to cease. Telenor's strategic leaders decided that this was unviable because it would severely compromise market share and profitability:

> *The main issue is that we don't want to lose significant revenues when doing legacy transition.*   *(Tn-Strategic leader no. 3)*

Building a new platform step by step

After rejecting a big-bang approach, Telenor's strategic leaders concluded that removing the legacy IT system step by step was significantly more feasible. The idea was to reduce complexity by slicing up the monolithic platforms into modules that simplify both the systems and the products.

> *The modernization project aims to slice up the system into modules, modernize and consolidate them into one modular IT stack from four. This drives the cost down, but also makes it easier to make good capabilities common across different businesses. When this happens, business rules and products are also simplified in the process.*
>
>   *(Tn-Strategic leader no. 3)*
>
> *It is better to have a modular architecture … with strong open API, and it can be played like Lego bricks, to remove what doesn't work well and keep what does.*
>
>   *(Tn-Strategic leader no. 2)*

Telenor is thus attempting to develop a new technology structure that gradually replaces the legacy IT system. The new structure is set to be developed module by module. For each new module that is developed, a part of the functionality from the legacy system can be migrated and customers can be transferred from the old to the new digital platform. Over time the new system will consist of a stack of modules that have taken over all the functionality of the old systems.

> *It is best to build a completely new stack on the side and then gradually increase the functionality of that platform, and when you have enough functionality, we start migrating customers from old platforms.*

> *(Tn-Strategic leader no. 2)*

While this alternative has the potential to solve rather than bypass the legacy problem, it is a slow process.

> *What we have done is we have sliced the problem up, and we took out the product catalog first and put that into the mobile version because there is a good product catalog there. Now we are taking out the order engine away and building that on new cloud infrastructure. Eventually that monolith will die because we kill it bit by bit, but it can take up to 20 years.*   *(Tn-Strategic leader no. 3)*

Summing up Telenor's legacy removal

Like the DNB case, the Telenor case illustrates the dilemmas and risks strategic leaders ponder as they attempt to handle the legacy challenge to succeed with digital transformation. As in the DNB case, the Telenor strategic leadership found a big-bang removal of legacy systems to be too uncertain, and is working on several alternatives for legacy removal, where outsourcing and step-by-step approach were viewed as the most viable

alternatives. We now draw on both cases to compare, contrast, and discuss the various approaches toward legacy removal.

A comparison of DNB and Telenor

Both DNB and Telenor viewed legacy removal as critical for digital transformation, and both view it as an extended process. Although we have aimed to analyze how strategic leaders of incumbent service firms attempt to remove legacy rather than to assess the degree of their success, some observations regarding the status of our two case firms are also of interest.

Based on our data, DNB appears rather successful in setting up an organizational structure that supports the development of the digital transformation of customer services. In addition, it also seems to successfully manage the tension between acquiring new digital capabilities while at the same time making progress in removing legacy capabilities. Nevertheless, replacing the infrastructure step by step was estimated by our informants to be a 10-year process. The sluggishness of this process makes it hard to reap the full benefit of the new digital opportunities that DNB's born-digital, legacy-free competitors can avail themselves of.

Similarly, in the case of Telenor, while its strategic leadership has gradually carved out parts of the legacy systems and replaced them with new digital technologies, the process is set to be protracted. Further, informants pointed out that because Telenor's Nordic operations have disparate legacy systems, Telenor has so far been unable to capture scale by replicating solutions across its operations.

DISCUSSION

Our above case analysis illustrates the complex interwoven nature of technology and business processes. Strategic leadership of incumbent service firms must balance the tension arising from introducing digital technology to build new customer interfaces and services while maintaining extant services built on old technology that generates today's revenues. Digital transformation thus involves not only sensing and seizing new opportunities, but also disentangling existing and new service deliveries and business processes from legacy systems and capabilities. The digital transformation of incumbent service firms will typically have to deal with interdependencies with older processes and systems. The goal in both DNB and Telenor has been to attempt to remove technology-related legacy as it had become overly complex, generated unforeseen consequences including security risks, and relied on outdated capabilities that could not support digital transformation. Yet, although the goal of legacy removal was clear, there was also an acute awareness among strategic leaders of the risks entailed in tampering with technological legacy. Strategic leaders therefore experimented with several different alternatives – each involving benefits as well as challenges (see Table 3). The ability to remove legacy thus appears to be a critical capability within the transformation component of dynamic capabilities. To theorize the micro-foundations of legacy removal, we discuss each of the approaches to legacy removal.

Table 3 Legacy removal approaches

REMOVING LEGACY by	DNB Financial Services	TELENOR Telecom Services	BENEFITS	CHALLENGES
Escaping Legacy	Outsourcing		Adds capacity	Does not solve legacy problem, but adds more need for communication
	Bypassing - API, Robots, Cloud - Internal entrepreneurs	Bypassing - API	Increases innovation pace Adds new products & services	Does not solve legacy problem, but adds another layer to the system Needs middleware
Shrinking Legacy		Outsourcing	Reduces legacy Reduces personnel problem	New dependencies toward new vendors must be handled

	Dismantling - Delegate internally		Reduces legacy Increases cooperation between business and IT	Needs increased internal coordination and communication
	Creating new ventures		Allows for developing new technology and services on the side	Slow process Legal constraints (banking)
Terminating Legacy	Big-bang	Big-bang	Faster than other alternatives	High risk & high cost Need to postpone development during implementation
	Step-by-step	Step-by-step	Modular structure more easily adaptable to future	Slow process – where different logics coexists

Escaping legacy

Rather than removing technological legacy altogether, strategic leaders may attempt to escape legacy. We observed two ways in which this was done: through outsourcing and bypassing. Both DNB and Telenor report that they use digital technology such as APIs and modularization to slice out and transform the old system into a new system over the years. While these approaches increase capacity and pace, they do not remove legacy. In other words, building new solutions on the top or side of the old legacy system does not eliminate legacy – it simply tries to circumvent it. The outcome might be one of even more layers and complexity, which may represent no more than a temporary solution to the legacy removal issue.

Shrinking legacy

A second way of attempting to deal with technological legacy challenges involves reducing it. Outsourcing not only allows the incumbent to escape legacy it can also reduce it, by sharing the risk and investment involved in developing new capabilities with an external vendor. While it reduces dependencies on legacy systems and capabilities, it increases dependencies on vendors and involves coordination and communication costs.

Terminating legacy

Legacy systems and capabilities can also be terminated and subsequently replaced – either through a radical big-bang approach, or step by step. Although other firms in DNB's and Telenor's respective industries have invested in entirely new digital systems and capabilities, this was not seen as a viable option in either DNB's or Telenor's case. The costs and risks were deemed too high. While the respective strategic leaderships at DNB and Telenor had concluded that a step-by-step approach would be more viable, this is a lengthy process. Some of the legacy systems cannot easily be reconfigured as there are interdependencies that hinder modularization. This implies that in the meantime, the management will have to find other solutions to bridge the gap between the new and the old infrastructures – which means bridging the new capabilities with the older capabilities. Terminating step by step thus requires finding a balance between two fundamentally different logics of analog versus digital, and the waterfall versus agile approach.

Selecting an approach to legacy removal

Apart from the big-bang approach, which involves replacing the legacy system and related capabilities in their entirety in a short space of time, the various other approaches to legacy removal can be adopted simultaneously. They are not mutually exclusive. In our two case firms, we observed how strategic leaders experimented with different approaches to removing legacy over time. They conceptualize digital transformation and legacy removal as a journey – a process that takes time. Each approach toward legacy removal has its inherent benefits and challenges, so it is not a matter of which is fundamentally the more successful, but rather which is more appropriate for the context and situation at hand.

A striking feature of the two cases is that it is typically the customer-facing units that demand digital transformation to be able to interact with customers in novel ways, while it is

the back-office functions, in particular IT services, that will have to deliver the technical solutions that enable the digital interface with customers. As such, the cost and benefits of digital transformation will likely not be evenly distributed across the various units in the firm. Consequently, unless strategic leaders ensure the alignment of internal interests in digital transformation, middle managers may resist digital transformation (Tripsas & Gavetti, 2000).

Conclusions

Teece and Leih (2016, p. 9) remark that, "with deep uncertainty, good management must include the art of imagining a future and endeavoring to build it." We agree, but in the case of digital transformation, in addition to building new capabilities it is also necessary to engage with legacy removal. Drawing on case studies of two incumbent service firms, we have shown how strategic leaders experiment with various approaches – escaping, shrinking, and step-by-step termination – to navigating the removal of technological legacy. In both of our cases, the process was slow and experimental, leading to sluggish digital transformation, yet the big-bang terminating alternative was viewed as significantly more hazardous.

Our findings contribute to existing literature on digital transformation by theorizing the critical role technology-related legacy plays in such processes. While others have argued that digital transformation is a strategic rather than a technological endeavor, technology is at the core of these transformations and can hamper the development of new services and business models. Previous research has identified the dynamic capabilities specific to digital transformation (Warner & Wäger, 2019), suggesting that the third core component of dynamic capabilities (transformation) is a matter of navigating innovation ecosystems, redesigning internal structures, and improving digital maturity. We add to this list by showing how a key component of transformation concerns removing legacy. Rather than

conceptualizing this at an abstract level, we describe and elucidate the micro-processes involved and their inherent benefits and challenges. The notion of legacy removal is important as it shows that succeeding with digital transformation is not simply adding new technology and new capabilities to develop customer-oriented services and business models – strategic leaders must also engage with removal.

A second theoretical contribution of our study is that it expounds on how managers can remove technological legacy. It draws attention to an understudied aspect of the transforming component of dynamic capabilities: in the context of incumbent firms engaged in digital transformation, transforming involves the complex task of legacy removal. Our study shows that because technology is at the core of digital transformation and is entangled in intricate ways with business models and business processes, strategic leaders engage in various ways with the removal of technology-related legacy. Building on the notion that the concept of dynamic capabilities comprises sensing, seizing, and transforming (Teece et al., 1997; Vial, 2019; Warner & Wäger, 2019), we suggest that legacy removal is a critical component of "transforming," and theorize three different approaches to such removal.

Legacy IT systems are a key feature that distinguishes incumbent firms from their born-digital competitors, meaning that they need specific transforming dynamic capabilities. This observation has clear implications for strategic leaders of incumbent service firms. They are involved in an extended balancing act of having to maintain revenue from the existing business processes that rely on legacy IT systems while introducing new digital solutions. The paper points to the benefits and challenges of a range of potential approaches for legacy removal. No one approach will fit all cases, meaning that strategic leaders will have to make their selections based on how they perceive specific benefits and challenges. Overall, we argue that our study is useful for strategic leaders dealing with the challenge of legacy removal in that it provides a critical typology of available approaches. This can be usefully

applied at an early stage to guide decisions and strategies for managing legacy removal during digital transformation.

Our study is not without some limitations. One is that it is restricted to in-depth studies of just two (Norwegian) incumbent service firms, which raises the issue of generalizability. Like most case studies, we have aimed for analytical generalization by building theoretical explanations, rather than statistical generalization across a population (Yin, 2018). Our findings contain some general properties that we expect to have a significant degree of transferability to other incumbent firms. However, we acknowledge that future research needs to be extended to other industries and countries. A further issue is that our qualitative analysis involves interviews with informants often looking back in time, meaning that there is the possibility that their accounts may be somewhat self-serving. Future research should aim to extend our study of the processes involved in legacy removal for incumbent firms. It should not only examine further cases but also aim for more detailed descriptions of the legacy removal aspect of transforming. Future research should also consider applying other methodologies including field experiments, vignette studies, and large-scale surveys to supplement the case-study methodology of this paper.

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