Restructuring Digital Infrastructures: Architectural Transformation through Sociotechnical Interplay in large-scale incumbent organizations

Egil Øvrelid[1], Zhiyi Wang [1]

[1] Department of Informatics, University of Oslo, Gaustadalléen 23B, 0373 Oslo

Abstract. Large incumbent organizations are increasingly compelled to modularize their IT architecture to stay competitive. This architectural transformation entails navigating technical, organizational, and managerial dimensions, warranting a socio-technical perspective. Although extensive research has been conducted on this topic, a deeper understanding of how incumbent organizations manage this complex process, and its outcomes remains necessary. Our research question thus explores *how Digital Infrastructures can be restructured to support architectural transformation in large-scale incumbent organizations*. We conceptualize digital infrastructures as multilayered sociotechnical entities, characterized by greater complexity than standalone IT systems and more diversity than digital platforms. Our study focuses on a prominent Norwegian bank undergoing architectural transformation. We identify three restructuring activities integral to the architectural transformation of incumbent organizations: bundling business and IT, modularizing the operational foundation, and fostering a learning culture. Restructuring activities constitute a multidimensional framework that encapsulates the sociotechnical interplay essential for performing architectural transformation.

Keywords: Architectural Transformation, Digital infrastructure, Restructuring,

1 Introduction

The modern digital economy requires an efficient infrastructure to facilitate effective digital business interactions. Consequently, the financial system is recognized as a critical infrastructure [1], and therefore highly regulated [2]. Since several regulatory considerations must be considered, the transformation of this infrastructure is recognized as particularly challenging [3], [4]. Research has investigated these issues from several viewpoints such as changes in business models [2], organizational change [3], and digital transformation [4].

Our focus is architectural transformation [5], and we have a socio-technical perspective on the issue [6], framing modern digitalized organizations as digital infrastructures [6]. We define IT architecture as 'the structure and organization by which modern system components and subsystems interact to form systems' [7, p. 23]. Using the term *architectural transformation*, we focus on how these systems and subsystems undergo a radical renewal where old monolithic and tightly coupled systems are replaced with modular system elements [8]. IT Architecture is the digital core of the modern enterprise, and architectural transformation thus involves modernization towards a more flexible digital form that can interact more effectively with other ecosystems, companies, and users [9]. This transformation is particularly complex for many companies since the existing IT portfolio and its architecture are configured for a different context and time [9], because of old and new regulations, the companies will have limited opportunities to go offline during the transformation process, so things must be built while protecting critical income streams [10], [11].

To focus our research consistently on architectural transformation, we ask

how can Digital Infrastructures be restructured to support architectural transformation in large-scale incumbent organizations?

By restructuring we refer to the gradual and careful replacement of monolithic systems, as well as the extensive socio-technical implications for the organization [12]. We contribute to the information systems literature on architectural transformation by emphasizing the complex socio-technical interplay between restructuring activities in digital infrastructures. Secondly, within digital infrastructure studies, we bring IT architecture to the forefront of the discussion, enabling a more detailed understanding of the outcomes resulting from architecture transformation. We proceed by aligning our research interests with earlier literature.

2 Architectural transformation and socio-technical implications

Our research is about how digital technology alters socio-technical structures [13] . By socio-technical we refer to the interaction between the technical and the social in the maintenance and change of the IT portfolio [14]. We frame our studies within digital infrastructure studies, occupied with the socio-technical implications of architectural change.

2.1 Architectural change in Digital Infrastructure studies

Digital infrastructures (DI) are a system-oriented perspective that focuses on socio-technical interaction [6], [15]. An important transition that actualized DI was the emergence of the internet, which enabled large organizations to operate in networks, rather than through single applications [15]. The subject of study for DI was the organizational portfolio of IT systems made at different times for different purposes and gives empirical insight from several sectors such as healthcare, aviation, and finance Digital Infrastructures are more than single systems, they are dense, consisting of a complex web of relationships [15]. Through a literature review, we categorized DI literature on IT Architecture into four streams, *the cultivation stream, complexity stream, platformization stream, and management innovation stream*.

First, in the *cultivation stream* the user-orientation is fundamental. Cultivation is an approach that 'acknowledges the existence of the installed base, and ..seeks to address change in an incremental and gradual manner' [16, p. 200]. Cultivation is a metaphor that 'contrasts the predominant, techno-rational approach of a planning-based ''construction'' approach' [17, p. 162]. This work is based on empirical studies of healthcare systems from a use perspective (clinicians or patients), ultimately to provide important feedback for IT firms.

Second, the *complexity stream* is occupied with infrastructure development, and the tensions between freedom and control, openness, and structure. Infrastructures are open and heterogeneous and must be governed to maintain this diversity [15], [18]. While stability is desirable, infrastructures are inherently unstable. Identifying a balance between architecture and governance will therefore be useful. Such governance practice will be oriented towards stabilization and destabilization as processes, rather than characteristics of the infrastructure [18], [19].

Third, the *platformization stream* is concerned with the transformation of the fragmented installed base to a more ordered and consolidated form of architecture [5]. The inspiration is three-layered platform models from Apple and Amazon, with a platform core, boundary resources, and apps that can be built both internally and externally [5], [19]. At the same time, it is recognized that incumbent organizations such as healthcare and finance are different from born-digital platform companies. Monolithic systems are demanding to configure for today's context. However, the IT architectural complexity of platformization is only briefly described, and the architectural work becomes secondary to the goal of platformization or ecosystemization.

Lastly, the central issue in *the management and innovation stream* is the role of IT architecture in obtaining and maintaining competitivity [6], [20]. The stream extends infrastructure research from a pre-occupation of installed base and user environments to a view on process and innovation efficiency [21], [22]. A core novelty of this research is how architectures can be differentiated into lightweight (fast) and heavyweight IT (slow), and configured to obtain dual-speed innovation [20]. Lightweight and Heavyweight IT are not merely technologies, but knowledge regimes that can be combined to optimize performance in particular settings [21]

2.2 Restructuring Activities in Architectural Transformation

We have identified some commonalities in the streams above. *First*, the IT architecture fades into the background in favor of other objectives. This can be the user environment, the organization, business, or innovation. *Second*, even though the literature frames IT architecture as modular and agile, practical architectural work is often described using high-level terms such as cultivation, evolution, or platformization. The IT architecture disappears in a larger message. Digital infrastructure theory had the ambition to serve various practice environments. We intend to revitalize this intention. Hence, we need to understand the socio-technical implications of architectural transformation, i.e., the relationship between an organization and IT architecture from an architectural perspective. By using the concept of *restructuring* we aim to highlight the gradual and careful replacement of monolithic systems in favor of modular systems, as well as the extensive socio-technical implications this has on the organization [12].

3 Case and method

3.1 Case: BankCorp

To improve our understanding of architectural transformation we investigated a large financial institution. BankCorp is currently embarking on a digital journey to modernize its core systems. The digital infrastructure at BankCorp contains 100s of IT systems. Architectural transformation entails replacing millions of lines of Cobol code in legacy systems with modular code in modern programming languages, replacing old platforms with new ones, and putting everything into the cloud. More than 500 people have been involved in the transformation, over 10 years. The rationale for the

transformation is better control over the systems for strategic purposes and better transaction security. The transition to modular code, cloud computing, and DevOps also requires important investments in building in-house competency.

3.2 Data collection and data analysis

To investigate complex real-life phenomena, we performed a qualitative case study. The results are based on information gained from interviews, conversations, and documents between 2021 and 2024 [23]. A case study encourages a detailed analysis of a phenomenon, in a particular real-life context and may draw on multiple data collection sources [23]. We had 26 interviews and informal conversations with experts on the subject matter, including IT architects, developers, and managers from different departments in BankCorp. Through our collaboration with BankCorp, we gained access to several documents on regulations, strategies, design principles, and blogs from architects and business developers at BankCorp.

We used a coding technique based on [24] to analyze the data. Over 200 topics were developed into frequently appearing topics and core thematic categories. First, we created a timeline for the evolution of BankCorps IT portfolio and its architecture. Based on the data, we discussed the important business & IT novelties (such as digital retail banking, mobile banking, and cloud adoption). We detected an important shift around 2017 when BankCorp radically increased the speed of modernization with a comprehensive insourcing strategy. Central to this strategy was the effort to remove the constraints of the monolithic systems through a gradual transition process where older systems were replaced with modular structures. New development practices and learning activities supported the replacement. We created a model (figure 1) to illustrate how architectural transformation is a socio-technical interplay of several restructuring activities within a particular context.

4 Architectural Transformation and Restructuring Activities

BankCorp introduced its first generation of Cobol programmed core systems, in 1965. Operating in batch mode, these systems processed transactions on IBM mainframe computers. With the emergence of object-oriented programming in the late 1960s, SQL in the 1970s, and TCP/IP DNS in the early 1980s, BankCorp recognized the critical importance of online services. In 1985, the bank established its digital corporate bank, and five years later, in 1990, BankCorp extended its digital footprint by launching a digital retail bank, enabling customers to access banking services through digital channels. As BankCorp engaged in mergers and acquisitions with other banking institutions, the complexity of mainframe core systems increased. BankCorp accelerated its modernization approach in 2015 by launching an innovative payment application. Modernizing the payment application from on-premises to Microsoft Azure cloud architecture initiated a holistic transformation of BankCorp's IT architecture. BankCorp developed an API-centric model, operating directly within the AWS cloud platform. Rectifying old COBOL systems and employing tools like z/OS Connect, a set of APIs was exposed. From 2020 to 2023, BankCorp progressively rolled

out DevOps practices to all teams, and 40 core business processes were migrated to the cloud.

4.1 Restructuring activity 1: Bundling business and IT

Before the transformation, IT and business units operated in separate parts of the organization.

> "[...]30 years ago there was an incredible amount of business development that you could do without it involving IT. [...]when I started working at [BankCorp] in 2011-2014, we were in an old location at Beta, very far from the head office at Alpha." (Head of Architecture, 2023)

> "…we cannot achieve our goals without close collaboration between business and IT. We have established governance structures and metrics to ensure that we are aligned and working towards common goals." (enterprise Architect 2023)

Bridging the Business-IT Gap
BankCorp co-located business and IT, both physically and organizationally at a new head office:

> "The IT organization is repositioned to different business areas, with a focus on autonomous teams working with development and operation of IT solutions" (Enterprise Architect, 2023).

Inspired by Spotify's successful organizational model, BankCorp introduced agile teams, forming "tech families" mirroring the concept of Spotify Squad teams. Each tech family functions in a DevOps culture and is assigned to distinct products and services. As described by Solution Architect 1, 2023;

> "The purpose of establishing tech families is to create ownership and autonomy. The grouping helps define responsibilities…. Some tech families may be responsible for specific products, others may be responsible for shared infrastructure components used by various products. The main goal is to give teams ownership of what they produce and enable them to take responsibility for the products or services they develop."

Each tech family varies in size from two teams to more than fifteen teams, depending on project requirements and workload. These tech families connect expertise, including architects, product owners, operations engineers, DevOps engineers, and other specialists. Collaboration often happens between tech families working on different parts of the same app or service. Product managers facilitate collaboration between team members across tech families. By encouraging dynamic collaboration between members from business and IT units, the teams aim to break down traditional silos and foster a cohesive workflow.

Restructuring the organizational decision-making
An essential aspect of this restructuring activities concerns decentralizing decision-making processes and bringing technology, business logic, and functionality decisions

closer to the teams responsible for their development. The Lead Architect emphasized the importance of this approach.

> "The decision-making capabilities have been moved closer to the teams developing the functionalities, enhancing agility and ownership. Making teams autonomous and responsible for their functionalities encourages collaboration and innovation [...]."

Balancing Autonomy and Alignment

BankCorp has implemented certain guardrails to ensure consistency and alignment across the organization. Although IT resources have been distributed into business areas, the former IT and operations departments were not abandoned but transformed into a new department, "Technology and Services", responsible for the overall security, compliance, and stability of the organization's operations. One of our informants illustrated this concept using a metaphor;

> "[...]These autonomous teams are in the apartments, meaning you can renovate internally as you wish, but you can't start changing windows and infrastructure, as it is connected to all the other teams. So, I say, autonomous teams, that's only if you create a game or an app you launch on iOS, but in BankCorp, you depend on all the other teams." (Enterprise Architect, 2023)

The "Core Modernisation Incubator" team, consists only of architects, whose primary responsibility is to modernize the core systems of BankCorp. This process involves designing a target architecture that serves as a blueprint for the modernization efforts;

> "The architects in our team, are responsible for addressing the core systems, figuring out how they can be rebuilt with modern technology, and how they can best be broken down into smaller parts. So, we create a target architecture for that, and build an organization around each piece, which will then be responsible for implementing it." (Solution Architect, 2023)

Fragmentation occurs when implementation teams operate independently and in conflict with each other, which can happen if the teams do not follow the desired target architecture.

> "It's very important for us that people trust the target architecture we want to end up with. Because there's always a balance between centralization and autonomy, and in that regard, we have quite a bit of autonomy as well. So, a team might suddenly decide to create a domain that overlaps with the functionality of another domain, even though we don't want that to happen." (Solution Architect, 2023)

4.2 Restructuring Activity 2: Modularising the Operational Backbone and moving it to the cloud

> "If you imagine the biggest ball of yarn, you've ever seen, with some huge black cabinets inside, then you have what our architecture looked like before modernization" (Head of Section in Corporate Banking, 2023)

Before modernization, each system had distinct functions closely intertwined with a high degree of coupling and low cohesion. This reduced transactional security. It also made it difficult for BankCorp to respond to dynamic market demands, exposing it to substantial risk in a rapidly evolving financial environment. Modernization was crucial to enhance the bank's strategic agility, and transactional precision, according to the head of architecture:

> "There are two driving forces. One is about technical debt, and creating a platform for the future that is both scalable, and both scalable when it comes to performance, but also scalable when it comes to functionality. And manage a bit of that separation of concern, that you don't put everything together, you try to have more layers. It is the IT technical motivation. But then we have that customer motivation because customers have completely different demands on the pace of change and innovation today than they did 30 years ago"

Temporary strategy: Encapsulation. In 2015, when BankCorp began the development of a new mobile banking application, the potential risks of direct communication between new applications and monolithic systems and core databases were recognized;

> "The biggest challenge is probably trying to modernize the core. [...] We had to do it in steps. First, we encapsulated legacy on-premise systems that couldn't be modernized. Modernizing the legacy systems is very difficult unless you rewrite, them and replace them feature by feature, like what we're doing now with core modernization. But at that time, we didn't have time to do that, so we encapsulated a mainframe." (Integration Architect 2023)

According to Solution Architect 1 (2023) communication between services and mainframe systems, minimized the risk of service disruption and empowered the organization to implement internal changes without impacting end-users experience.

> "…the APIs around the core systems enabled us to separate the consumption and production of data. This made it possible to start making changes to the systems without disrupting customers. This work was done internally, so external customers wouldn't notice."

Developers no longer needed a comprehensive understanding of the complex mainframe systems, and the process became more streamlined, making further migration work more effective.

Long-term strategy: Decoupling. While encapsulation offers benefits, it also presents new challenges, such as increased complexity due to the deployment of new API gateways as intermediaries, which was emphasized by the Integration Architect (2023);

> "You won't get the benefits you think you will, as long as you have to make changes to all the layers you have. You can get longer value chains because you have to encapsulate existing services."

Decoupling allows developers to gradually disassemble monolithic functionalities into smaller, independently controlled components, and separate them from the old infrastructure. Decoupling reduces the interdependence between system components making it easier to modify or replace individual components without affecting the entire system.

> " [...] We plan to gradually replace the old systems. This takes time, especially because some systems can have many dependencies that are not well documented." (Solution Architect)

Gradual transition from old to new backbone implied running both systems in parallel and conducting regular comparisons to ensure accuracy and consistency, as mentioned by Enterprise Architect (2023);

> "The old plans shall live side by side for a while. Because you can't just introduce the new in a big bang and delete the old. Both because you want to know if the new system works optimally from day one because the old communicates with other old systems."

Building Shared Services with APIs

At the core of BankCorps process is the principle of API-fication [25], where new APIs follow predefined internal standards, including naming conventions, language standards (ISO), and header usage. API layering is fundamental in architectural transformation, facilitating the management of API functionality at different levels. As explained by Solution Architect 1 (2023);

> “The purpose of having different API levels is to structure and customize our numerous systems. We do not want mobile apps or our internal systems to communicate directly with the core databases, as this could result in too tight coupling.”

Several different APIs are given the role of serving and protecting the architecture.

System APIs are linked to the core databases and are essential for retrieving critical data in old formats like flat CSV files that don’t follow BankCorp’s internal standards. They require additional adaptation.

Domain APIs encapsulate business logic and domain-specific functionalities on the Shared Service layer, through API contracts for business services. Communicating with the System API layer, data stored in old formats is transformed to a modern format, such as JSON, and stored in domain-based databases.

Experience API is the API gateway to user-centric applications, bridging back-end functionalities and customer-facing applications like mobile and web banking. By abstracting the complexities of data retrieval and integration in back-end systems, these APIs enable customers to access information through interfaces, that remain uninterrupted despite internal changes.

External API facilitates collaboration with external partners and customers, enabling access to BankCorp’s services and data while adhering to regulatory requirements and security standards. There are two types of External APIs. Open APIs comply with regulatory mandates such as Payment Service Directive 2, making BankCorp's services

accessible to third-party providers and ensuring interoperability. Partner APIs are tailored to specific partner needs to address requirements and security challenges and enable seamless integration with partner systems while safeguarding sensitive data.

All APIs implemented by BankCorp facilitate data transmission through REST APIs or event streaming. REST-APIs offer a standardized approach to synchronous communication, allowing for real-time interactions and request-response patterns. Event-driven systems that log events through Kafka platforms enable asynchronous communication between services and a loosely coupled infrastructure.

Cloud computing. AWS and Azure are cloud platforms that may provide flexible, scalable, and reliable services to help reduce risk and improve efficiency. By leveraging various cloud services, including PaaS and SaaS, BankCorp managed data, events, APIs, and documentation, streamlining operations and enhancing productivity, as mentioned by Solution Architect 1, 2023;

> "We have adopted several services that run on cloud platforms. We use platforms as a service (PaaS) and software as a service (SaaS) to manage data, events, APIs, and documentation. This has helped us build and scale our systems more efficiently."

In addition, cloudification played a key role in the bank's transformation from an incumbent to a data-driven company. By establishing a data lake on Amazon's platforms, BankCorp has gained deeper insights into its operations and customer behaviors and accelerated its development cycles. Leveraging this data lake, BankCorp introduced a money management module within its mobile banking app, enabling comprehensive analysis of customers' financial data and delivering personalized advice.

4.3 Restructuring Activity 3: Fostering a learning culture

In addition to new technology and tools, relevant competencies are essential for success.

> "When we build new systems on new technology, we have to ensure that the organization also changes, the skill sets that we have, the resources that are taken care of in that process." (Chief Staff Engineer)

In this context, fostering a culture of continuous learning and knowledge sharing becomes a strategic priority.

> "[...] everything is a journey of change. You must build on existing knowledge.…[however]...even if you have many years in the industry, you must constantly learn new things and keep up with what's happening in the market." (Engineering Manager)

Principles of Fostering a Learning Culture

BankCorp's strategy for creating a learning culture can be summed up in three key principles: encouraging continuous learning, promoting a constructive feedback culture, and fostering knowledge-sharing (Lead Architect, 2023).

#Continuous learning.

> "First, you must think that everything is a journey of change. You must build on the knowledge you have from earlier. You can't stop and think that now I can do everything. Even if you have many years in the industry, you must constantly learn new things." (Head of Architecture, 2023)

BankCorp acknowledged that learning is a lifelong journey, ensuring adaptation and improvement. Several measures have been implemented to secure this.

Internal Courses. BankCorps employees can access the Motimate learning platform, which hosts over 900 internally produced courses, such as the "AWS academy." Participants will learn how to implement security measures such as encryption, access control, and threat monitoring to ensure that BankCorp's data and applications are always protected in the cloud. Using agile techniques such as Scrum and Kanban as part of a DevOps culture is prioritized.

Internal Guidelines. Beyond formal courses, technical upskilling also happens through knowledge-sharing initiatives. According to the Head of Corporate Banking, BankCorp made an internal document (2023);

> "So we've prepared over 500 pages of documentation in 10 different areas, on what the technical aspects should look like on AWS and Azure for the respective functions, what the transition plan should be for lifting systems, data, integrations, how big teams we need, what kind of expertise, all of this has been mapped out. [...]"

Recruiting new talents. BankCorp has made significant investments in recruiting IT talents directly from universities. Collaborating with UiO since 2018, BankCorp established the Greenhouse program, designed for master's students aspiring to become architects. The program focuses on building expertise in architectural design, a critical aspect of shaping the technical landscape of BankCorp's systems and applications.

#Constructive feedback culture

BankCorp emphasized fostering a culture of constructive feedback. By establishing regular feedback sessions, such as retrospectives and peer reviews, employees got the opportunity to share their experiences, challenges, and suggestions with their colleagues and managers. These sessions enabled employees to reflect on their performance and identify their learning needs while receiving guidance and support from others.

#Knowledge sharing

BankCorp leveraged different strategies to facilitate dialogue and knowledge sharing among employees. Employees were encouraged to share their insights with others, both within and across teams and departments, through various channels and platforms. For example, BankCorp organized internal events, such as hackathons and webinars, where employees could present their projects, learn from best practices, and network with other experts. BankCorp also leveraged digital tools, such as Workplace, which facilitates internal communications, and enables employees to document their knowledge and learn from others' experiences. The preliminary result of the bank's investment is that competence in business processes has improved, which results in

even closer cooperation between business and IT. Technology competence has also improved, and the rate of innovation has increased. There are some challenges to the governance of agile teams and the alignment between principles/policies and actual work.

5 Discussion: Architectural transformation as a socio-technical interplay between restructuring activities

This paper investigates restructuring activities in large-scale organizations transforming their IT architecture. We frame our research within digital infrastructure studies, occupied with the socio-technical implications of architectural change. Our research question was, *how can Digital Infrastructures be restructured to support architectural transformation in large-scale organizations?*

The DI literature [6], [15], [16] has successfully portrayed architectural change from various positions like the user environment, the organization, and digital innovation, rather than using the IT architecture as the unit of analysis. From the perspective of IT architecture, we argue that a deeper understanding of the socio-technical consequences of architectural transformation is needed. Building on previous work [5], [8], [9], we closely examine the distinct activities associated with architectural transformation. In 5.1, we summarize three restructuring activities, and in 5.2, we describe their socio-technical interplay within large digital infrastructures.

5.1 Restructuring activities in Architectural transformation

Inspired by [12] we frame restructuring activities as processes of differentiation where a homogenous structure (monolithic architecture) is divided, reshuffled, and rebuilt in a new form (modular architecture). In our case, these activities are associated with architectural transformation framed as replacing mainframe technology with modern modularized technology running on the cloud.

First, **bundling IT and business** involves moving resources from IT and business from their isolated position in the hierarchy and relocating to various agile teams. This leads to tight operational integration enabling seamless interaction between IT functions and business operations [26]. Agile teams are connected to a bounded (business) context and become active participants in continuous development and innovation [8]. While architecture development is about continuously modifying old features and developing new ones, architecture governance is about safeguarding principles and strategies based on a target architecture. This ensures a balance between autonomy and alignment [9].

Modularizing the operational backbone entails transforming the digital core from a monolithic silo-oriented and tightly coupled structure to a modular loosely coupled structure with modern interfaces [22]. It also includes moving the architecture from the mainframe to the cloud. To protect and secure the various layers in the IT architecture, APIs are used, while cloud platforms enable the standardization of processes and digital technology [22].

Fostering a new learning culture acknowledges the consequences of the demands for a more dynamic learning culture, where new knowledge is continuously acquired in

interaction with others and shared as it is obtained. This increases the responsibility for each individual and the organization to collectively share individual insights, utilizing new digital communication channels like Slack, and forums where knowledge is shared [27].

5.2 Sociotechnical interplay between restructuring activities

Figure 1 illustrates incremental architecture transformation as a core process in a socio-technical interplay between the three restructuring activities.

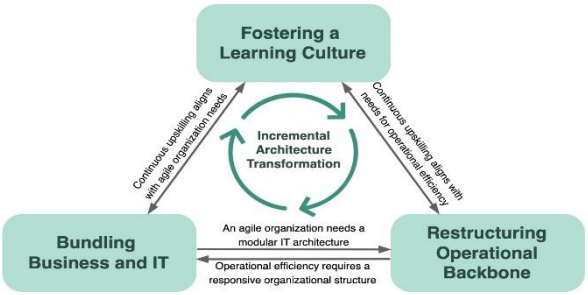

Figure 1 Architectural transformation as socio-technical interplay.

Bundling business and IT requires a modular operational backbone and a responsive organizational structure that balances autonomy and alignment. Additionally, cultivating a new learning culture is essential for continuous upskilling in modular architecture and maintaining competitive advantage.

Implications for theory
Architectural transformation is about digitalizing the technical core and triggers additional organizational activities. We have observed that this is an incremental and continuous restructuring process, characterized by gradual changes. It is different from earlier forms of organizational change. Architectural transformation entails struggling with several digital structures – some modular, some monolithic - at once. We also see that when the digital core is increasing it needs to be governed differently than the former organisation. Architectural transformation encompasses both organizational change and digital governance. Additionally, it involves enhancing digital competency, as traditional learning methods are progressively replaced by more flexible forms of interaction and communication.

Implications for practice
Architectural transformation is comprehensive and requires the organization to support the change of architecture with agile organization which also entails the necessary replenishment of new technical and organizational competencies. This entails carefully balancing autonomy with alignment by creating standardized targets and goals that are continually monitored. The study has **limitations**, due to its relatively few interviews compared with the magnitude of the transformation. In **conclusion**, reflecting on the generalizability, we find that other incumbent firms in the private sector have similar

challenges. Examples are car companies [28], insurance [9] or hotels [20]. Also, the health sector in welfare societies has similar challenges, even though they have different obligations [5], [22].

6 References

[1] Kunnskapsdepartementet, "Styringsdokument for arbeidet med sikkerhet og beredskap i Kunnskapsdepartementets sektor." 2021. Accessed: Jul. 01, 2024. Available: https://www.regjeringen.no/no/dokumenter/styringsdokument-for-arbeidet-med-samfunns-sikkerhet-og-beredskap-i-kunnskapssektoren/id2512037/

[2] D. Broby, "Financial technology and the future of banking," *Financ Innov*, vol. 7, no. 1, p. 47, Jun. 2021, doi: 10.1186/s40854-021-00264-y.

[3] J. Baptista, M.-K. Stein, S. Klein, M. B. Watson-Manheim, and J. Lee, "Digital work and organisational transformation: Emergent Digital/Human work configurations in modern organisations," *The Journal of Strategic Information Systems*, vol. 29, no. 2, p. 101618, Jun. 2020, doi: 10.1016/j.jsis.2020.101618.

[4] L. Hughes, J. J. Seddon, and Y. K. Dwivedi, "Disruptive change within financial technology: A methodological analysis of digital transformation challenges," *Journal of Information Technology*, p. 02683962231219512, Nov. 2023.

[5] B. Bygstad and O. Hanseth, "Transforming Digital Infrastructures through Platformization," in *ECIS Proceedings*, 2018.

[6] O. Henfridsson and B. Bygstad, "The Generative Mechanisms of Digital Infrastructure Evolution," *2013*, vol. 37, no. 3, Art. no. 3, 2013.

[7] P. Kruchten, H. Obbink, and J. Stafford, "The Past, Present, and Future for Software Architecture," *IEEE Softw.*, vol. 23, no. 2, Art. no. 2, Mar. 2006.

[8] S. Newman, *Monolith to Microservices: Evolutionary Patterns to Transform Your Monolith*. O'Reilly Media, Inc., 2019.

[9] J. W. Ross, C. M. Beath, and M. Mocker, *Designed for Digital: How to Architect Your Business for Sustained Success*. MIT Press, 2019.

[10] W. L. Currie and J. J. Seddon, "Exploring technological instantiation of regulatory practices in entangled financial markets," *Journal of Information Technology*, vol. 37, no. 1, pp. 31–50, Mar. 2022.

[11] P. N. Gooderham, C. B. Meyer, I. Stensaker, F. Elter, A. M. Sandvik, and T. Pedersen, "Digital Transformation of Incumbent Service Firms: Legacy Removal Strategies," *Beta*, vol. 37, no. 1, pp. 1–22, Dec. 2023.

[12] J. Balogun, "The Practice of Organizational Restructuring:: From Design to Reality," *European Management Journal*, vol. 25, no. 2, pp. 81–91, Apr. 2007, doi: 10.1016/j.emj.2007.02.001.

[13] K. Osmundsen, J. Iden, and B. Bygstad, "Digital Transformation: Drivers, Success Factors, and Implications," *MCIS 2018 Proceedings*, 2018.

[14] S. Sarker, S. Chatterjee, X. Xiao, and A. Elbanna, "The sociotechnical axis of cohesion for the IS discipline: its historical legacy and its continued relevance," *MISQ*, vol. 43, no. 3, pp. 695–720, Sep. 2019.

[15] O. Hanseth and K. Lyytinen, “Design Theory for Dynamic Complexity in Information Infrastructures: The Case of Building Internet,” *Journal of Information Technology*, vol. 25, no. 1, Art. no. 1, Mar. 2010.
[16] M. Grisot, O. Hanseth, and A. Thorseng, “Innovation Of, In, On Infrastructures: Articulating the Role of Architecture in Information Infrastructure Evolution,” *Journal of the Association for Information Systems*, vol. 15, no. 4, Art. no. 4, Apr. 2014, doi: 10.17705/1jais.00357.
[17] M. Aanestad and T. B. Jensen, “Building nation-wide information infrastructures in healthcare through modular implementation strategies,” *The Journal of Strategic Information Systems*, vol. 20, no. 2, Art. no. 2, Jun. 2011.
[18] O. Hanseth and J. Rodon Modol, “The Dynamics of Architecture-Governance Configurations: An Assemblage Theory Approach,” *JAIS*, vol. 22, no. 1, Art. no. 1, 2022, doi: 10.17705/1jais.00656.
[19] J. Rodon and L. Silva, “Exploring the Formation of a Healthcare Information Infrastructure: Hierarchy or Meshwork?,” *JAIS*, vol. 16, no. 5, pp. 394–417, 2015.
[20] B. Bygstad and E. Øvrelid, “Managing two-speed innovation for digital transformation,” *Procedia Computer Science*, vol. 181, pp. 119–126, 2021.
[21] B. Bygstad, “Generative Innovation: A Comparison of Lightweight and Heavyweight IT,” *Journal of IT*, vol. 32, no. 2, Art. no. 2, 2017.
[22] B. Bygstad and E. Øvrelid, “Architectural alignment of process innovation and digital infrastructure in a high-tech hospital,” *European Journal of Information Systems*, vol. 29, no. 3, Art. no. 3, May 2020.
[23] D. Silverman, *Interpreting Qualitative Data*, 2nd ed. London, New Dehli: SAGE Publications Ltd, 2001.
[24] D. R. Thomas, “A General Inductive Approach for Analyzing Qualitative Evaluation Data,” *American Journal of Evaluation*, vol. 27, no. 2, pp. 237–246, Jun. 2006, doi: 10.1177/1098214005283748.
[25] J. Wettinger, U. Breitenbücher, and F. Leymann, “ANY2API – Automated APIfication - Generating APIs for Executables to Ease their Integration and Orchestration for Cloud Application Deployment Automation:,” presented at the 5th International Conference on Cloud Computing and Services Science, Lisbon, Portugal, 2015, pp. 475–486. Accessed: Jul. 08, 2024.
[26] J. B. Barney, D. J. Ketchen, and M. Wright, “Resource-Based Theory and the Value Creation Framework,” *Journal of Management*, vol. 47, no. 7, pp. 1936–1955, Sep. 2021, doi: 10.1177/01492063211021655.
[27] D. Smite, N. B. Moe, G. Levinta, and M. Floryan, “Spotify Guilds: How to Succeed With Knowledge Sharing in Large-Scale Agile Organizations,” *IEEE Software*, vol. 36, no. 2, pp. 51–57, Mar. 2019, doi: 10.1109/MS.2018.2886178.
[28] F. Svahn, L. Mathiassen, and R. Lindgren, “Embracing Digital Innovation in Incumbent Firms: How Volvo Cars Managed Competing Concerns,” *MISQ*, vol. 41, no. 1, Art. no. 1, Jan. 2017, doi: 10.25300/MISQ/2017/41.1.12.