The emergence of a national collaborative digital ecosystem. A study of one-citizen-one-health-record in Norway

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Abstract. Developing national e-health solutions has proved to be quite challenging in most countries. However, the coming of digital ecosystems have changed our understanding of how to deal with this type of large-scale socio-technical complexity. Platform ecosystem is not only a technical structure, but a new organisational form, which builds on a particular governance-architecture configuration. How can these insights contribute to improve the national e-health structures? How can we transform a fragmented e-health infrastructure into a national collaborative ecosystem?

Our framework is the idea of a collaborative digital ecosystem, characterised by collaborative architecture and collaborative governance. Our empirical evidence is the gradual emergence of the e-health ecosystem of Norway, which we studied for over a decade, from 2011 to 2022. We offer two contributions. First, we discuss how to orchestrate a collaborative architecture-governance configuration, focusing on complementary roles, the need for a self-reinforcing process, and the balance of control and autonomy. Second, we point to the role of attractors, i.e., architectural and governance elements that work as gravitational forces, in the shaping of the ecosystem.

Keywords: e-health, collaborative digital ecosystem

1 Introduction

In 2012 the Norwegian Ministry of Health issued a white paper called *One-citizen-one-health-record* [1]. The white paper described the current health record situation as problematic, characterised by fragmented patient information over various geographical and sectorial divides, and called for a national solution with three aims:

- Health personnel should have access to patient information, regardless of source
- All citizens in Norway should have access to good digital services
- Patient data should be available for quality improvement, health monitoring, management, and research

The white paper was short and compelling, was well received, and sanctioned by the National Assembly in 2013. There was only one problem – it described a vision but offered little advice on how to reach it. The problem with fragmented patient information was not unique for Norway; rather it described the general state of e-health

in most European countries [2]. Research had long documented the particular challenges of e-health; the complexity of the domain, the fragmented installed base of systems, and the conflicting interests of various professions [3], [4]. No doubt, the aims of easy access to all patient information were indeed very challenging.

Traditionally, such grand challenges in e-health were resolved by large, "suite" systems such as EPIC or Cerner. However, as IS research progressed after 2012, it became clear that the structure and services of digital ecosystems, illustrated by the fast rise of platform companies [5], was an alternative approach. The general discourse in the international and national e-health arenas was increasingly influenced by the ecosystem perspective. Even the large Electronic Patient Record (EPR) vendors [2] announced that they aimed to become platforms in open ecosystems, allowing for 3.party innovation. However, while this discourse offered exciting opportunities several issues arose. One important question was related to the governance model; who should have the overall responsibility to decide the digital structure and the user services? There were three alternatives; (i) the government and its agencies (ii) the hospitals and municipalities, or (iii) the EPR vendors.

To study these issues, we explore and theorise the concept of *collaborative digital ecosystems*. While commercial platform ecosystems focus on profits, collaborative digital ecosystems aim to resolve problems that the actors cannot deal with alone [6]. The two most important dimensions of digital ecosystems are *IT architecture* (from now, *"architecture")*, i.e., the digital structures, and *governance*, the institutional arrangements to ensure the overall functioning and value creation [7]. In collaborative digital ecosystems both architecture and governance have to be collaborative; to some degree they should be self-organizing, robust and scalable environments where various stakeholders interact to solve complex problems [8].

Creating a collaborative national ecosystem in e-health is therefore quite demanding. It challenges hierarchical governance, procurement regulations, the role of the present EPR systems, and planning frameworks. Our research question is, therefore, *how can we transform a fragmented e-health infrastructure into a national collaborative ecosystem?*

To investigate this issue, we build on the research on the reciprocal relationship of architecture and governance [7], [9], the idea that the technical structure and the governance of it, are mutually reinforcing each other. Our empirical evidence is a longitudinal study of the Norwegian e-health sector over a decade, including cases at national, regional and local levels. We offer two contributions; First, we show how to orchestrate a collaborative architecture-governance configuration, focusing on complementary roles, the need for a self-reinforcing process, and the balance of control and autonomy. Second, we point to the enabling role of attractors, the architectural and governance elements that work as gravitational forces in the shaping of the ecosystem.

2 Digital platform ecosystems

The digital platform ecosystem is a significant innovation of the 21st century that has changed the world economy through platform companies such as Google, Apple,

Facebook, Baidu and many others. Research has identified a number of powers and attributes related to digital platform ecosystems:

- They connect different actors (such as buyers and sellers) in n-sided markets [10], and grow through network effects [5].
- Their architecture consists of core components with low variety, and peripheral components with high variety [11], connected with boundary resources, such as APIs [12].
- Their value-creating mechanisms are transactions (for instance monetary) and innovations, the result of the recombination of digital components [13].
- There is a reciprocal relationship between the ecosystem architecture and governance mechanisms; the architecture specifies the main components and their interactions, and the governance mechanisms specify the decision rights related to these components and their interactions. Ecosystem governance is usually orchestrated by the platform owner, focusing on access to the ecosystem, and control of rules and architecture [7].
- They may be seen as a new organisational form (or meta-organisation) between hierarchy and market; they have more structure than a network but less structure than a supply chain [14].

The power of digital ecosystems is socio-technical; the ecosystem grows by orchestrating external actors in the value-creating process. This means that ecosystems scale better and faster than traditional systems: the central core supports standardisation and economy of scale, while the loosely connected periphery allows for innovation and required variety.

3 Collaborative digital ecosystems

In a practical sense, all ecosystems are collaborative, since they facilitate the interaction of different actors. However, most research focus on digital ecosystems with a dominating platform owner, and the strategies to maximise profits [5]. Our interest in this study is digital ecosystems without a dominant actor, a class of ecosystems that we find in the public sector, in industrial collaboration and in the sharing economy. The aim of these ecosystems is not to maximise profits but to resolve problems that the actors cannot deal with alone [6].

In line with this, we regard a *collaborative architecture* as a technical structure that is not designed top-down but evolves through adaptations and innovations [15], with components from several actors in interplay. Technically, this usually builds on the principles of service-oriented architecture; focusing on services, not systems, and based on loosely coupled components that can be reused from different applications over a network [16]. However, a collaborative architecture is not an unstructured network, rather it exploits the basic structure of ecosystems, i.e., central platforms, boundary resources, and loosely coupled user services [7].

Research on *collaborative governance* builds partly on the seminal works of Ostrom on scarce resource governance, and Ansell's in policy-making [17], [18]. Research on collaborative governance on digital ecosystems is still in its infancy, but important

insights have been offered. For instance, O'Mahoney and Karp studied how participants adapted their strategies when an ecosystem transitioned from proprietary to collaborative governance [19]. Collaborative governance broadly means that the governance rights are collective, often with both private and public stakeholders. Following Vabo and Røiseland, we define collaborative governance as the non-hierarchical process through which public and private actions and resources are coordinated and given a common direction and meaning [20].

With this foundation, we define a digital collaborative ecosystem as *a digital ecosystem with a collaborative architecture and collaborative governance,* illustrated in Figure 1. A collaborative ecosystem architecture will usually have one or more platforms, but the platform owner will not be dominant in the ecosystem.

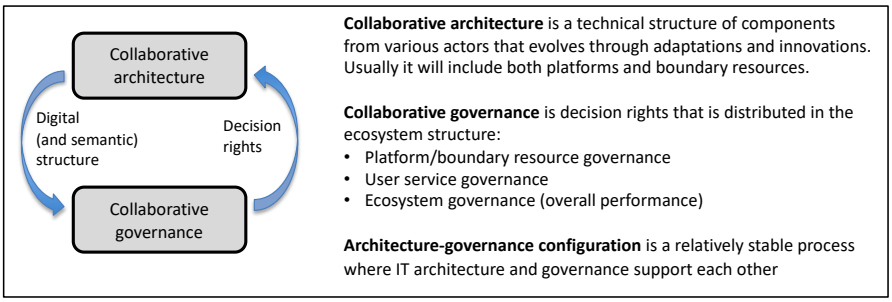

Figure 1. Framework for collaborative digital ecosystems

How do collaborative ecosystems evolve? While Tiwana (2014) described the reciprocal relationship of governance and architecture, much less in known about how this interaction folds out in a collaborative context. One contribution is Hanseth and Modol's conceptualisation of *architecture and governance configurations,* i.e., they are intrinsically related, and constitute a unified entity [9]. We build on this contribution, but we investigate some important aspects that is not dealt with, such as the formation of a more complex collaborative ecosystem with an interplay of top-down and bottom-up initiatives. We also focus on *attractors*, which is a concept from complexity science, and denotes organisational or technical elements, such as standards (for instance HL7 in e-health) and shared components, that work as gravitational forces in the ecosystem [21], [22]. Attractors can be planned, for instance in open data initiatives [23], or emerge in windows of opportunity.

4 Methods

We chose a longitudinal, qualitative approach, to investigate a complex set of interrelated events over time [24]. Figure 2 offers an overview of the process. The selection of cases was carefully done, we chose some of the largest and some of the most innovative projects in the period. The Akson and FKJ (Felles Kommunal Journal, Shared Municipal Journal) projects were direct follow-ups from the 2012 white paper.

The Digital Renewal program was the dominant initiative in Health South-East in the period, while the XDS solution was a connective link between the three health regions using the EPR system DIPS, and the HelseNorge app. The local cases were chosen because they were particularly innovative in an ecosystem context. See Figure 3 for an overview of cases and chronology.

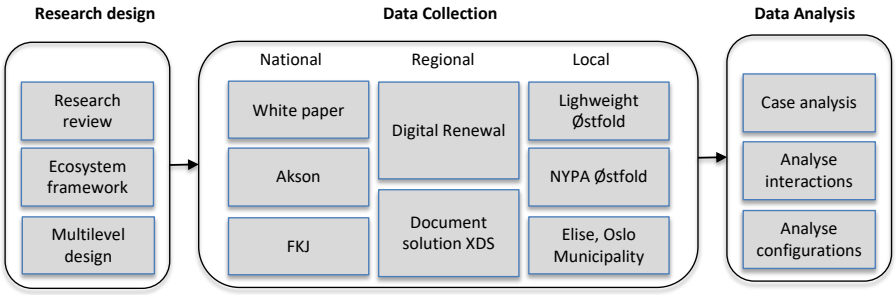

Figure 2. Overview of methods

4.1. Data Collection

Three types of data were collected; interviews, observations, and archival materials [24]. At the national level, we interviewed the key informants in the Ministry of Health in 2012 and analysed the White paper. The follow-up Akson project was conducted by the Directorate of eHealth, and we interviewed key personnel at intervals: managers, consultants and IT architects. We also analysed project documents and the extensive report from the Auditor General. In 2020 we followed the new project FKJ by interviewing the project manager, developers, and chief architect. A total of 25 interviews were conducted in this stream. We also followed the national discourses, which were conducted in the e-health press, and at conferences and workshops.

At the regional level, we followed the large program Digital Renewal of Health South-East, from start in 2014 to finish in 2018. We interviewed top managers, the CIO, project managers, IT architects, operation staff, and developers, many of them several times. In addition, we analysed project documents and the IT architecture. In 2020 Health South-East developed an XDS solution (a document-oriented access to DIPS), allowing patients to access their own journal from an app called HelseNorge. Health North and West followed. We interviewed the CIO of two health regions, two IT architects, and the project manager. In all, we conducted 75 interviews in this stream.

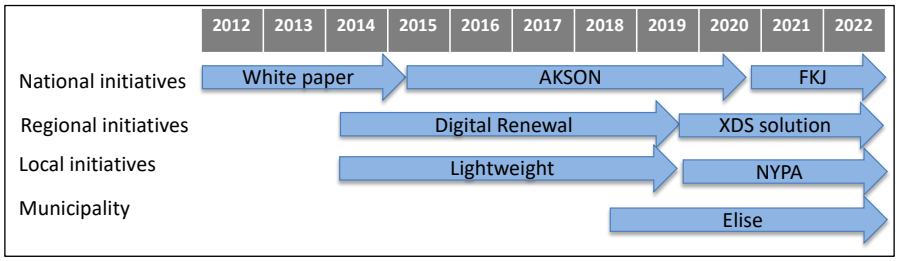

Figure 3. Cases and chronology

At the local level, we followed an innovative lightweight logistics project at the Østfold Hospital in 2014-18, interviewing project managers, vendor representatives, designers, IT architects, doctors, and nurses. From 2019 to 2022, we studied the NYPA project, providing support to home-based cancer patients, and interviewing managers, vendors, doctors, and operations staff. In Oslo Municipality we investigated the Elise project, interviewing managers and developers, and analysing architecture descriptions. In all, we interviewed 45 informants in this stream.

4.2 Data Analysis

We analysed the data in three steps [25]. First, we analysed each stream of cases, focusing on themes and trends. Second, we investigated the interplay of levels, and how results influenced the thinking of key stakeholders. Third, we analysed the interplay of governance and architecture, in order to understand the self-reinforcing dynamics. Following Hanseth and Rodon (2021) we analysed the configurations, and assessed the influence of attractors.

Overall, data collection and analysis were iterative over a long period, and the process was to a large degree solving a puzzle, where we identified gaps in the evidence and tried to identify the necessary pieces. For instance, when analysing the attractors, we tried to map when the XDS technology had first been used, where the idea of its usefulness had spread, and how it had developed into an attractor.

5 Findings

During the decade from 2012 to 2022, there was a gradual and unplanned change in thinking and solutions, moving from centralised and negotiated to collaborative governance, and from monolithic and improvised architecture to collaborative architecture. Se Figure 4 for an overview.

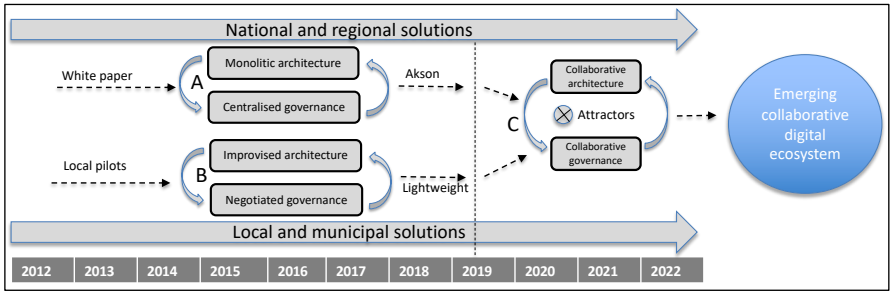

Figure 4. Converging architecture-governance configurations

5.1 National and regional levels 2012-18: monolithic architecture with centralised governance

National level: The White paper One-citizen-one-health record from 2012 was generally accepted as a vision. The Directorate of Health was mandated to investigate possible technical and organisational solutions. A 2015 Report focused on the benefits

of one large solution (possibly the American EPR solution EPIC) that could provide both a national EPR and various user services for both primary and secondary care. In the meantime, the Directorate of e-Health had been established, and produced in 2018 a *road map*, which recommended a three-part strategy: (i) continuing the existing EPR solutions for the hospitals in health regions North, West, and South-East, (ii) a suite solution (EPIC) in region Mid-Norway, and (iii) a national solution for primary care in the municipalities, called Akson.

The Akson project was quite extensive, involving many stakeholders and consulting firms, and producing loads of documentation (a total of around 5000 pages for the reports). The architecture-governance configuration was type A (see figure 4), a monolithic architecture with centralised governance, estimated at 11 bn NOK. The Akson proposal was rather heatedly discussed in both the health sector and the IT community, and also engaged national media. The critique focused on the monolithic approach, i.e., the idea that one big system, instead of ecosystem thinking, the high costs and contested benefits, and also the extensive use of consultants (Aftenposten 4. Sept 2020). The Auditor General assessed in 2021 the progress of Akson, the one-citizen-one-health-record initiative, and found it quite unsatisfactory, pointing to slow progress, poor governance, and lack of platform thinking [26].

Regional level: While the national solutions were relatively few and tidy, the four health regions, in contrast, had a large number (more than 1.000) of fragmented systems, which represented high costs and barriers to innovation. The largest region, Health South-East, launched in 2014 an ambitious standardisation initiative, Digital Renewal, aiming to standardise both technology and work processes. The overall architecture was an advanced solution with enterprise bus middleware and more than 200 integrations. The program was tightly structured with a large steering group and sub-programs for EPR (DIPS), radiology, lab systems and financials. Although the technical solutions were quite different, the architecture governance configuration (A) was basically the same as for the national program.

After spending 7.3 bn NOK the results were somewhat disappointing; the DIPS system was standardised in the region, but neither radiology nor the lab projects were successful, and work processes were not standardised.

5.2 The local level 2013-18: Improvised architecture, negotiated governance

During 2014-18 the Østfold Hospital, in the Health South-East region, conducted an innovative project. To improve patient flow, an electronic whiteboard solution from Imatis was extensively implemented. This lightweight solution was connected to the large regional systems and exploited data from them to manage clinical logistics [27]. We regard this solution as an *embryo* for a digital ecosystem, because it showed how innovative 3rd party solutions could satisfy user needs that the large clinical systems could not. The solution also suggested to redefine the role of the large systems as platforms, i.e., 'platformisation'. The solution was awarded a HIMSS (an international agency for e-health) level 6, and received much attention.

The architecture-governance configuration (B) combined an improvised architecture with negotiated governance, which was rather demanding for the actors. It illustrated the governance challenges of collaborative solutions; the co-operation between the

local project, the regional IT operations centre, and the key large vendors, was difficult and prone to conflicts. When approaching one of the large clinical vendors to ask for an API to access the system, the Imatis project manager received the reply: "First, we do not provide an API in our system, and second, there is nothing in our contract that includes the use of our data from a 3rd party vendor!" In the end, the problems were solved, and the Imatis solution was generally recognised. It was clear, however, that this configuration was expensive and hard to scale.

5.3 Ecosystem convergence 2019-22: Attractors

We observed a somewhat surprising and relatively fast convergence of technologies and governance from 2019. The general discourse on ecosystems (including a national digitalisation strategy), the disappointing results of Akson and Digital Renewal programs, and the successful platformisation in Østfold - all pointed in the same direction, i.e., towards a more collaborative approach. A triggering factor was the emergence (or maybe discovery) of *attractors;* architectural and governance elements that work as gravitational forces in the ecosystem [22]. We identified these attractors, shown in Table 1.

Level	**Attractors**
National, FKJ	Summary Care Record, e-prescription platform
Regional	IHE XDS technology
Local	EPR database used as platforms
Municipal	Various EPR databases used as platforms

Table 1. Attractors

National level: The Akson debate led to a new CEO in the Directorate and a redefinition of the initiative to Felles Kommunal Journal (FKJ), "shared municipal journal", which was transferred to the Municipal Association KS. The new project was more oriented towards ecosystem thinking and co-operation with the vendors. The chief architect commented, "FKJ will provide a platform with storage and API based on open standards, and with some native applications. But the solution will be hybrid, including the solutions from established EPR vendors. And 3rd party applications are part of the architecture." The platform would interact with the national platforms, such as the Summary Care Record (Kjernejournal) and the e-prescriptions database, which were transferred to Norwegian Health Network (Norsk Helsenett) in 2019. These attractors implied a collaborate governance, with several actors involved, both public and private. The project manager commented, "we will facilitate a process for application vendors by establishing a marketplace, providing access with APIs, with HL7 and FHIR standards, and test facilities. Of course, with the necessary security and privacy measures."

Regional level: A relatively small project, conducted in 2019-20, produced some interesting results for a minor cost, and demonstrating that one-citizen-one patient-record could be (partly) achieved by connecting existing resources in an ecosystem. The attractor was the IHE XDS, a technology suited for indexing and retrieving document objects, such as patient information. XDS had been used locally in Health South-East since 2014, but in 2019 the DIPS vendor and the three regions (South-East,

West and North) scaled up to a national solution. This allowed 80% of the Norwegian population to access their hospital records through an app called HelseNorge. This app was developed and operated by Norwegian Health Network, who now emerged as the centre of the ecosystem. In 2021 the same solution was developed to serve health personnel the same way (See Figure 5). The HSE project manager commented: "The XDS solution could later be extended to include data from the EPIC solution in the Health Mid region and also patient data from the EPRs in primary care".

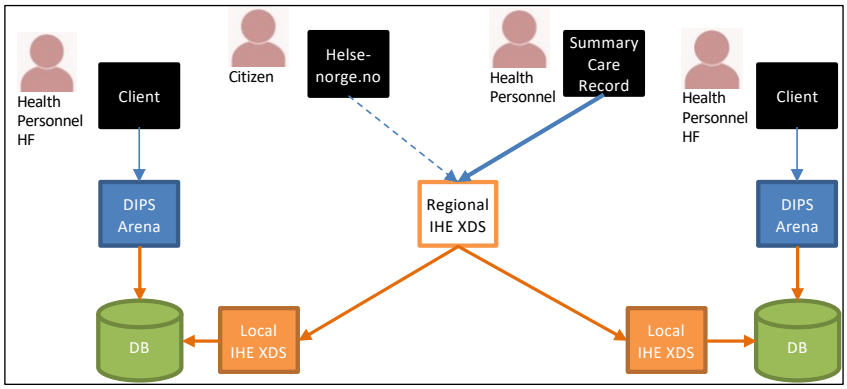

Figure 5. The XDS solution. (Source: Health South-East). Norwegian Health Network is the owner of HelseNorge and Summary Care Record.

Local level: The lightweight success in Østfold was followed up by an *innovation partnership* project NYPA ("Nyskapende pasientforløp"), where another start-up firm, Diffia, developed an innovative solution for remote care. The innovation partnership model was a new governance model instigated by the authorities in order to establish a more agile process than the traditional procurement regulation. It included a market dialogue with vendors and a competition between the firms. After winning the competition, Diffia prototyped the solution, which used the large clinical systems much the same way as the Imatis whiteboards. A final contract between Diffia and Østfold Hospital was agreed in November 2021.

The architecture institutionalised the ecosystem model, with 3rd party software for clinicians and patients, boundary resources (APIs), and using large clinical systems, at the regional IT Centre, as data platforms (and attractors). This was supported by the new governance model, which mitigated the potential conflicts better, but still included challenges. Seen from the vendor Diffia, the IT Centre spent too long time dealing with security and privacy issues.

Municipal level: In 2018-21 the City of Oslo developed and implemented *Elise*, an app for sharing patient information between various treatment units, and a new emergency unit, accessing several different systems. One manager commented: "For a time, it looked too complicated to integrate solutions with EPRs, but when APIs slowly became available at various systems, together with cloud databases, it occurred to us that a solution would be possible." The Agency for Health had a record of innovative IT solutions, but what was new with the Elise app, was that it accessed information from many sources. Supporting the information needs of the patient, the Elise project

developed a cloud solution, Pasinfo, that extracts and refines data from municipal EPR and remote care solutions, the municipal emergency unit, national GP register, and several others to the benefit of patients, admin and health professionals. Seen from the app, these information resources are part of the platform.

5.4 Summing up

The decade started with the visionary white paper and ended with an emerging ecosystem, but in between, the process was turbulent and conflict-ridden. The Akson project – which aimed at one large system for all municipalities – was abandoned before practical development was started. The Digital Renewal program – which spent 7.3 bn NOK to achieve regional standardisation – was terminated without reaching its goals. During the same period (2014-18), the lightweight Østfold project provided an embryo for an ecosystem, using the clinical systems as platforms. From 2019 the development at different levels seemed to converge; both in terms of architecture and governance, with increasing use of attractors. The result was certainly not a full collaborative ecosystem, and it might be somewhat misleading to speak about *one* ecosystem, in a quite heterogeneous structure of interlinked solutions. *The result is rather a shared perception of a collaborative architecture-governance configuration in the sector*, which includes a division of labour between public platforms and private services, with the key technical elements in place, as shown in figures 4 and 5 [1].

During the study, we observed that most of the key actors did not wish for a collaborative ecosystem. The public e-health leaders were used to take the most important decisions themselves, and the CIOs worried about security and privacy. The large EPR vendors felt that their business model (to provide all needed services within their domain), was threatened. Even the small vendors, who were expected to benefit most, worried about complex purchasing processes and intellectual property rights.

Why, then, did the collaborative ecosystem emerge? One answer, as far as our empirical data reach, was that the established practices of silo systems, centralised governance, and big vendor dominance, simply did not provide the necessary digital services to clinicians and patients; they could not provide the one-citizen-one-health-record solution. However, failed initiatives do not necessarily lead to better alternatives. In the next section we discuss what it takes to transform a fragmented digital infrastructure into a collaborative ecosystem.

6 Discussion

In this study our research question was, *how can we transform a fragmented e-health infrastructure into a national collaborative ecosystem?* As our case has shown, the

[1] It should, however, be noted that two of the three pillars of one-citizen-one-patient-record roadmap from 2018 were in trouble in 2022; the government cut the funding for FKJ from 2023, and the EPIC implementation in Health Mid-Norway was challenged by both hospital doctors and municipal GPs. These developments might be negative in the short run, but might even be beneficial for the overall direction of an ecosystem.

answer is not straightforward. Collaborative digital ecosystems are neither planned top-down nor totally emergent. Research has shown that top-down efforts tend to fail [3], [4] while decentralised approaches usually result in fragmentation [2].

In this study, we focused on architecture-governance configurations [9] as a key mechanism to structure a digital transformation on a national scale. *This means that we cannot design the solution, but we can facilitate the transformation.* The question, then, is how can we facilitate the transformation? We propose two answers to this: First, we need to orchestrate a collaborative architecture-governance configuration, and second, we need to recognise the importance of attractors.

6.1 Orchestrating a collaborative architecture-governance configuration

The process described in section 4 is complex and generative. It is complex because it involves a large number of actors and technologies at different levels. It is generative because specific governance-architecture configurations are self-reinforcing. In our case, the collaborative architecture-governance configuration emerged through a learning process, where the experiences with other configurations interplayed with the general discourse. The shift came somewhat unexpectedly in 2019, as many pieces fell into place. The new governance-architecture configuration was not formally defined, but it worked as a compass for the various actors, and as an organising principle for the ecosystem [7], in the sense that it defined the technical structure, and the possible governance levers. Based on our findings and previous research, we identify three key conditions required to make a collaborative ecosystem work.

First, a collaborative ecosystem requires a clear set of complementary roles related to the architecture, and the most important is to differentiate between those elements that are stable and those that are innovative [11]. The stable ones are large data repositories and platforms, characterised by integrity, performance, and a high degree of security. The innovative ones consist of user services for various groups, supplied by large and small vendors. Without the general acceptance of this division of roles, the ecosystem will not emerge. For health authorities, such as the Directorate and Health South-East in our case, this public-private co-operation can be hard to accept, because their role will change from planning to orchestrating.

Second, in order to work effectively as a configuration, architecture and governance have to interlock in specific ways, i.e., to engage in a self-reinforcing process. To be self-reinforcing, a configuration needs to have a *fit* between governance and architecture, i.e., attributes of governance should interact easily with attributes of the architecture [9]. A monolithic architecture has a strong fit with a centralised governance regime, because the monolithic architecture is fully integrated, and requires that all decisions take this into consideration – which is only possible with a centralised governance. In contrast, a collaborative architecture requires a collaborative governance regime to work. For example, we observed the struggle in the Østfold lightweight project to establish a collaborative architecture without a collaborative governance regime, which generated much friction between the actors.

Third, the collaborative governance regime is a delicate balance between control and autonomy. Platform owners should control data structures and standards, security, and boundary resources, but not – with some possible exceptions - user services. In our

case, we observed that health authorities gradually matured to the idea of a vendor market, i.e., software companies that compete on positions in the peripheral parts of the ecosystem, and also institutionalised innovation partnerships. This might require such mechanisms as certification and sandboxes for testing, and also processes for conflict resolution [6]. Also, the relationship between large and small vendors needs to be dealt with, allowing the small to compete on equal terms.

Overall, orchestrating a collaborative ecosystem is quite challenging, since it includes non-hierarchical co-ordination. It is important to remember that a collaborative ecosystem is not an aim in itself, but a means. The aim is to support value creation in the domain, in our case the health sector. Thus, the orchestration should be the responsibility of the top managers of the sector, who should understand and recognise the dynamics of collaborative ecosystems.

6.2 The role of attractors in self-organising

In the process of collaborative ecosystems emergence, many forces are at work. Bonina and Eaton studied the importance of cultivating the relationships between platform owner and peripheral actors, focusing on resourcing tools and securing rules [23]. We concur with this insight, but in a fully collaborative ecosystem, such as our national e-health case, it is a more open landscape, where it is not predefined what constitutes a platform, or who owns it. For instance, we observed that platforms sometimes emerge through problem-solving, not through planned design. This was the case in the Lightweight project in Østfold Hospital, where the databases of the clinical systems were taken into use as platform resources for the lightweight apps.

We have analysed this phenomenon as attractors, i.e., architectural and governance elements that work as gravitational forces in the ecosystem [22]. A gravitational force in the ecosystem context should, theoretically, be understood more as a discursive term than a technical one; it denotes an object that key actors are aware of, and take into consideration in problem-solving situations. More technically, an attractor can be regarded as an element that can be recombined with others in digital innovation [28].

The role of attractors in collaborative digital ecosystems is important, and sometimes crucial. In line with complex adaptive systems theory, attractors enable ecosystems to self-organise; a collaborative ecosystem needs one or more focal points, and order emerges around attractors by feedback mechanisms [21]. In our case, we partly explained the dramatic shift in the evolution of the ecosystem with the discovery and use of attractors. The key attractor was the XDS initiative in health regions, which gradually emerged as a connective link between various solutions. The experience from the early solutions triggered new initiatives on a larger scale (such as the HelseNorge app accessing the EPR databases), and became structural elements in the ecosystem.

Many leaders and IT developers may feel uncomfortable with the idea of attractors – isn't this an invitation to chaos? We believe that the answer is no, because in a collaborative ecosystem there is continuous monitoring of the performance, through organisational forums and indicators. A possible attractor will thus be experimented with in a small scale, and evaluated through consensus processes.

7 Conclusion

While commercial platform ecosystems focus on profits, monetising network effects is not the aim of collaborative digital ecosystems; rather the aim is to resolve problems that the actors cannot deal with alone. In this study, we investigated the evolution of the national e-health ecosystem in Norway, based on the one-citizen-one-health-record vision. Empirically, we showed how large top-down initiatives did not succeed in transforming a fragmented digital infrastructure. We framed our approach with the concept of architecture-governance configurations and showed how the various initiatives and projects converged into an emerging collaborative digital ecosystem.

We offer two contributions. First, we discuss how to orchestrate a collaborative architecture-governance configuration, focusing on complementary roles, the need for a self-reinforcing configuration, and the balance of control and autonomy. Second, we point to the role of attractors, architectural and governance elements that work as gravitational forces, in shaping the ecosystem.

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