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An attempt to understand complexity in a government digital transformation project

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Abstract:
Digital transformation projects will become one of the dominating tools for mastering digital transformation in governments. Studies show that such projects are complex undertakings and increasingly difficult to manage. The purpose of the paper is to provide a better understanding of the factors that cause complexity in government digital transformation projects. The authors use an in-depth case study approach to investigate factors of complexity in an ongoing digital transformation project. The results indicate that complexity in this project is rooted in dynamic relationships between multiple dimensions of organization, technologies, and innovation. The authors conclude that when organizational structuring, the introduction of new technology, and efforts to innovate and create added value for citizens and businesses operate in tandem, the pervasive complexity associated with delivering government digital transformation projects becomes increasingly difficult to manage.

Keywords:
digital transformation projects; government; project complexity; digital technology; case study.

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1. Introduction

Project complexity has received much attention from practitioners and academics alike during recent decades [1],[2], and significant progress has been made in understanding the different aspects of complexity in projects [3]. Although extant studies provide useful insights into project complexity in a number of industries such as engineering and information technology (IT)/information systems (IS) [4],[5], we still know very little about complexity factors in government digital transformation projects, and what may cause complexity in these projects. Drawing upon the emerging body of literature on project complexity and an in-depth case study approach, we attempt to explore the nature of complexity in a government digital transformation project in Norway.

Digital transformation projects typically involve aspects of information technology, innovation, and organizational change, and therefore require the integration of multiple perspectives [6],[7],[8]. In a government context, the projects require particular treatment due to the extensive size and scope of most of them in terms of time, context, and users [9]. Furthermore, digital transformation project are often referred to as complex, involving a multitude of stakeholders, novelty, bureaucratic organization structures, and political constraints [9],[10]. Despite strong ambitions regarding the potential of government digital transformation, researchers report high project failure rates, cost and time overruns, and unmet functional specifications [9],[11],[12]. Lack of understanding of the complexity of digital transformation and the relationships between technologies, information use, organizational contexts, and institutional arrangements are reported as factors that explain the failures in transforming government organizations [13].

To enable digital transformation, the capabilities of digital technologies should be coupled with factors such as culture, strategy, and human capital [14]. Kohnke [15] found that organizations were investing in digitalization without trying to push the necessary changes, because they underestimated the organizational implications and the human dynamics of the digitalization process, which includes the need to align people, processes, organizational structures, and culture. This indicates a lack of awareness of the interconnections between the important features of digital transformation, and the necessity to consider them in alignment rather than individually. With regard to the use of different digital technologies and various forms of value creation, structural changes are often needed to provide an adequate basis for new operations [11],[16],. This indicates that there is an alliance between the dimensions of technology, innovation, and management.

The purpose of this paper is to provide a better understanding of complexity in government digital transformation projects. In order to investigate the complexities in such projects, our research was based on the following postulate:

> *Complexity in government digital transformation projects is rooted in the interplay between the factors of organizational structuring, technologies, and efforts to innovate. With these factors operating in tandem, the pervasive complexity associated with delivering digital transformation projects becomes increasingly difficult to manage.*

The research was performed in Norway in 2019/2020. The method was a qualitative, in-depth case study, based primarily on interviews, and supplemented with observations and document studies. The selected case is an ongoing digital transformation project in Norway that includes collaboration between several government agencies and sectors with the aim to produce seamless, digital services for citizens and businesses. We used a thematic analysis approach, and qualitative data analysis software was applied to organize the data and explore potential relationships between the themes that emerged.

This paper offers one approach to understanding the complexity of governmental digital transformation projects. We explore the relationships and the interconnections between core dimensions, including the organization, technologies, and innovation. By investigating the root causes of the complexity of digital transformation projects, we aim to raise awareness of the difficulties of embracing and managing such complexities.

In the next section, we introduce the theoretical background with reference to related work on digital transformation projects and project complexity. In Section 3, we outline a conceptual framework (a Venn diagram) for investigating the interplay between variables related to organization, technologies, and innovation. Thereafter, in Section 4, we describe the case and our research design and methods, and we include an explanation of how the case study was conducted and

the data analysis was undertaken. The main findings are presented and discussed in Section 5, including in relation to relevant literature. The paper is concluded with an explanation of the main research results, a description of the limitations of our research, and proposed themes for further research (Section 6).

2. Related work

2.1 The core dimensions of digital transformation projects

To investigate complexity in government digital transformation projects, we choose to focus on factors related to the dimensions of organizational structuring, technologies, and innovation, as several authors refer to them as being the core of digital transformation projects [6],[7],[11],[17],[18]. The three mentioned dimensions have been reported as important elements that pose challenges for the management of digital transformation projects [19].

Organizational structuring in digital transformation projects include factors such as project planning and management, coordination of the project team and the tasks, stakeholder management, governance, and organizational power and politics [10],[18]. All of the factors influence the project execution and management process. In other words, the organizational dimension concerns the "how" and the "who" of the project in terms of *how* the project is organized and executed, and *who* is involved.

In addition to co-creation of value and cross-jurisdictional networks, typical features of government digital projects are the increased use of inter-organizational, cross-sector collaboration [20],[21],[22]. Inter-organizational collaborations are motivated partly by new opportunities afforded by digital technologies [23] and partly by organizational redesign sparked by processes related to new public management (NPM) and public value management (PVM) [24],[25]. The resulting organizational configurations imply that digital transformation projects have to deal with increasing numbers of stakeholders and increased complexity [26]. This situation presents specific challenges for a project's delivery of consistent public value with respect to efficiency, transparency, and accountability [27].

Technology is a fundamental element of any digital transformation project, and therefore it is important to understand the current state of technology being used in a project [10],[13],[17],[18]. In digital transformation projects, technologies are typically defined as combinations of *social*, *mobile*, *analytics*, *cloud*, and the *Internet of Things* (IoT), often referred to as the SMACIT technologies [28],[29]. The use of SMACIT technologies distinguishes digital transformation from previous IT-enabled transformations. The adoption of the technologies is a new venture for many governments, as the scale and scope of the changes associated with their use are unclear [30]. Additionally, *platforms* are cited as an important category of technology used in government digital transformation efforts [18].

Innovation—or *digital innovation*—is regarded as constituting one of the core elements of digital transformation [6],[31]. The use of digital technology during the process of innovating is referred to as digital innovation [32]. Digital innovation concerns, among other things, radical changes in the nature and structure of new products and services, resulting in novel value creation. Since, in most cases, digital transformation is realized through projects, the characteristics of digital innovations will impact management of digital transformation projects [6]. Authors have reported that the intersection between digital transformation and innovation is multifaceted and multidimensional, and thus challenging to manage [18],[31].

2.2 Project complexity

The rapid technological advancements and rapidly changing organizational environments have contributed to projects becoming increasingly complex [33]. Baccarini states that project complexity consists of "many varied interrelated parts and can be operationalized in terms of differentiation and interdependency" [34]. This definition has been further developed by the inclusion of organizational complexity and technological complexity [35]. Subsequently, Geraldi and Adlbrecht [36] expanded the complexity concept by including the softer aspects that can be found at the intersection between people and organization, such as politics, ambiguity and empathy. A further element that is considered a dimension of project complexity is *uncertainty*, which concerns uncertainties in goals and methods [35].

According to Browing [37], a complex project comprises multiple and multidimensional activities that are interrelated in various ways, thus enabling the achievement of a shared goal or objective. Following the work by Browning, Oehmen et al. [38] identified four characteristics of complexity in projects: (1) it contains multiple components; (2) it processes a number of connections between the components; (3) the interactions between components are dynamic, and (4) the behavior of the project resulting from the interplay among the components cannot be explained as the simple sum of the components. The four characteristics are interconnected in dynamic and extensive relationships that impact the behavior of the project. Therefore, project complexity models should take on a holistic approach and be able to capture the important types of variables, and assist in describing and understand their relationships [33].

The project complexity literature differentiates between *structural* and *dynamic* complexity [4],[35],[39]. Structural complexity refers to the number and types of elements and their relationships in a project, whereas dynamic complexity refers to the "behavior" of the project. *Structural* complexity, which is also known as descriptive complexity, is defined as consisting of several interrelated or interacting elements, of which interdependence is a strong characteristic [34]. It also refers to organizational and technical complexity [35]. The organizational complexity consists of the structure of the project organization, including the project's stakeholders and their relationships, as well as the project processes. According to Marle and Vidal, ca. 70% of project complexity factors are linked to organizational aspects [3]. Technical complexity concerns the technical structures of the main deliverables [38] and "softer" aspects such as knowledge and familiarity with advance technologies [34], as well as technology-based project innovation [36], [40], and expertise and skills needed to handle technical risks and requirements [33]. Organizational and the technical complexity are closely interrelated [38].

Dynamic complexity includes aspects that impact and "drive" the behavior of the project, such as uncertainty, ambiguity, and variability [39],[41]. Thus, dynamic complexity is not a "static" snapshot of a particular point in time, but rather a matter of evolving complexities. Consequently, control of the individual elements is not a guarantee of control over of the whole project or of the overall behavior of the project [42]. A typical feature of dynamic complexity is uncertainty in both goals and methods [35],[41],[43]. Dynamic complexity may also arise from ambiguity or uncertainty related to the tasks or the system [44]. A further aspect of dynamic complexity is its alignment with factors such as interdependence, unpredictability, and adaptiveness [45].

3. Building blocks for understanding complexity in digital transformation projects

3.1 The interrelated dimensions of digital transformation projects

In an attempt to understand complexity in a digital transformation projects, we chose to operationalize and map the three core dimensions (organization, technology, and innovation) of the studied digital transformation project in a Venn diagram (Fig. 1). Through the Venn diagram, we initially suggest that none of the three dimensions is prima facie more significant relative to the others. Further, we suggest that each of the dimension, in isolation, has some challenges that the project has to deal with. However, as these three dimensions operate within a system (a project), there are interconnections and relations between them [14],[46]. Our primary assumption is that additional challenges and the creation of complexities in a digital transformation project is rooted in the dynamic relations that are at play between the dimensions of organization, technologies, and innovation. The interplay between the variables will constitute the known challenges found in each singular dimension. In this paper, we use the case study and the qualitative data generated from the case to explore the relationships between the three dimensions of project complexity (i.e., organization, technologies, and innovation).

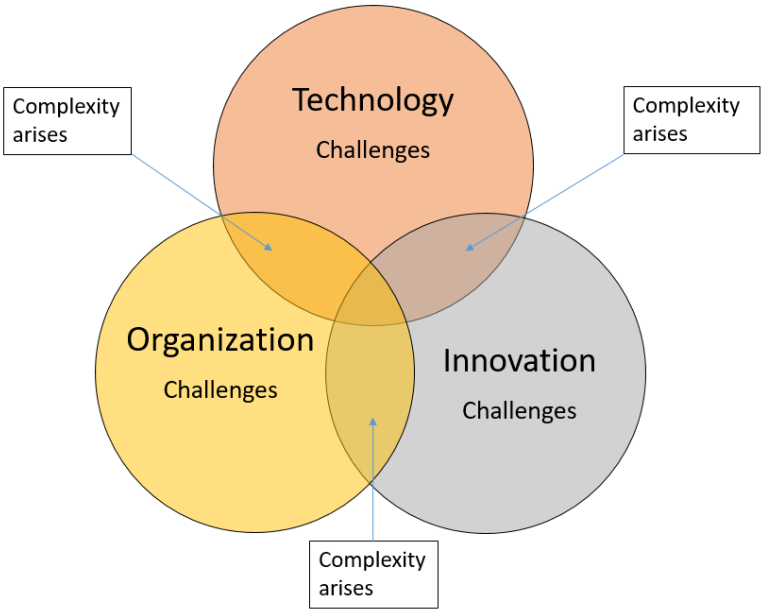

Fig. 1. The dimensions of government digital transformation projects.

4. The case

In 2016, the Norwegian Public Roads Administration (NPRA), together with three different government agencies, decided to collaborate in a digital transformation project with the aim of streamlining the ineffective bureaucratic practice of renewing driver's licenses for professional heavy truck drivers and the drivers aged 80 years or above. In Norway, as in several other European countries, it is mandatory for professional drivers of heavy trucks, buses and minibuses, and for the drivers aged 80 years or older wanting to renew their driver's license, to carry a valid health certificate. The process of obtaining a health certificate, which needs to be renewed regularly, is time-consuming for both professional drivers and drivers aged 80 years or above, as they have to visit their GP ((general practitioner) in person for a health examination, and then take the paper health certificate to the NPRA offices, where driver's licenses are renewed. Behind the "scene", the handling of the driver's license renewal process is ineffective and "tangled", involving coordination of several interrelated tasks between multiple public agencies.

The case project's objective was to streamline and digitalize the analog processes, including the submission of health certificates issued by GPs to the NPRA, saving time and money for the groups of drivers involved, as well as for the GPs who fill out the health certificates and the NPRA, which handles the issuing of driver's licenses. By both developing a digital health certificate and enabling digital transmission of the health certificate from the GPs to the NPRA, the project would render drivers' attendance in person at the NRPA offices superfluous. Another objective of the project is the development of an app for drivers that informs them about the renewal of their license. Drivers could then choose to carry a fully digital driver's license or a physical one. The digitalization of the renewal process would also result in more effective operations at the NPRA and a reduction in the working hours spent on the process and the number of staff involved. In addition, GPS would be more effective, as the completion of health certificates would be less time-consuming.

In order to provide seamless digital services for citizens and businesses, and to streamline the ineffective bureaucratic handling of the process, the NPRA needed to collaborate with the health care sector and the police authority, both of which have important stakes in the management of the driver's license renewal process (see Fig. 2). The health care

sector includes the Directorate of Health and the Directorate for eHealth. The former is responsible for the medical supervision of the health certificate that GPs need to fill out, whereas the latter is the responsible for the digital transformation of the health care sector in Norway. The National Police Directorate, which is the driver's license enforcement body, has traditionally handled administrative tasks in relation to *breaches* of the *Road Traffic Act in cases where drivers' do not have their health certificates updated or in cases of non-compliance with the Act.* The incentives for the National Police Directorate to be a part of the case project were to the opportunity to transfer their administrative tasks and their authorities to the NPRA, reduce the number of public agencies involved, and contribute to streamlining the process of license renewal.

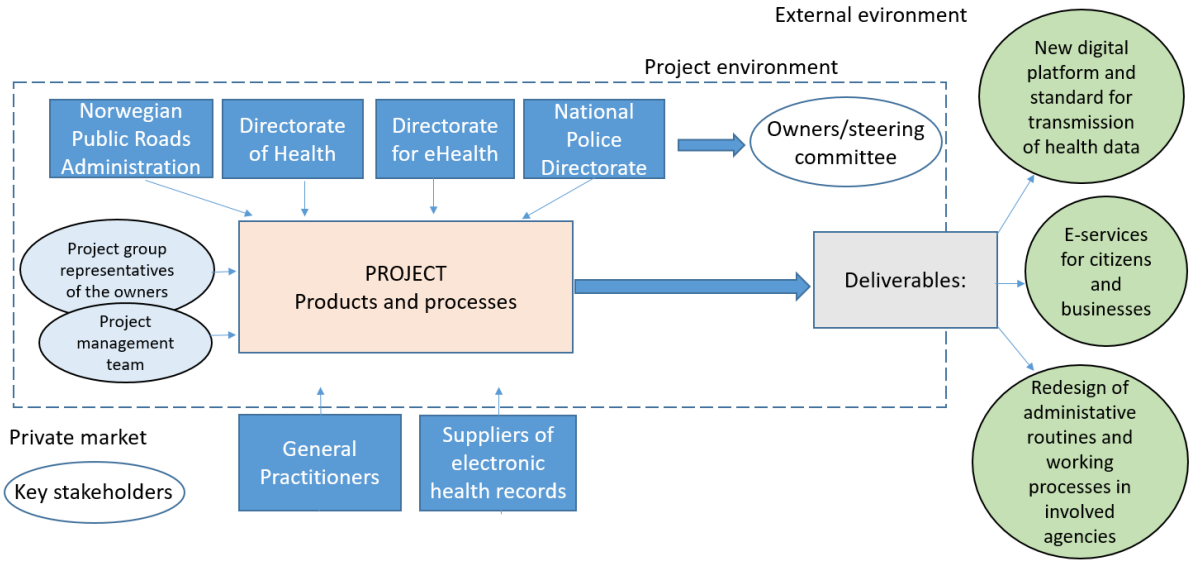

Fig. 2. Overview of the case project and the involved stakeholders.

4.2. The choice of the digital technology

The project's steering group decided to adopt and implement the framework named SMART on FHIR (SMART App Launch Framework), developed in the USA, to facilitate the digital transmission of health certificates from the GPs to the NPRA. The final choice of technology came late in the project life cycle and was a result of recommendations from the Directorate for eHealth, the member agency responsible for the digital development of the health care sector. The chosen digital framework will enable the shift from analogue systems of messages and receipts to real-time sharing of health data among health care institutions and between public agencies. The project was the first to adopt the new technology in the Norwegian market. The project management claims that the chosen digital framework is a "game changer" that may create substantial value for society if adopted by a number of health care organizations. Some of the project's member agencies envisioned this choice of technology as a step forward on the digital transformation journey of the health care sector, while others were wary about the choice, as it might lead to an expansion of project scope. However, all member agencies supported the final decision. A summary of the case-related to aspects of organization, technology, and innovation is presented in Table 1.

Table 1. Overview of the case in relation to organization, technology, and innovation.

Organizational structures	**Technology (digital enabler)**	**Innovation**
Four owners representing three sectors: roads, health, and police	The framework Smart on FHIR (SMART App Launch Framework) facilitates the digital submission of health data.	Transformation from analogue systems for messages and receipts to sharing of real-time health data
Inter-organizational collaboration	Implementing the SMART framework will enable both implementation of, and updates to, electronic health records.	Developing a new application for use by citizens and representatives of businesses when renewing their driver's license
Three major, external stakeholder groups: GPs, suppliers of electronic health records, and citizens/businesses	New technology functionality in the electronic health record (through the use of FHIR) facilitates implementation of a digital health certificate.	Developing electronic health certificates by implementing new standards in the health care sector

5. Research design and method

The aim of our research was to understand complexity in government digital transformation projects. We used a case study as the method for collecting the data. According to Benbasat et al. [47], there are three key reasons why case study research is an appropriate research strategy in fields where information system and (digital) technology are involved. First, the researcher can study information systems and technology in their natural settings. Second, the case study method allows the researcher to answer "how" and "why" questions, in order to understand the nature and complexity of the processes taking place [48]. Third, the case study approach is an appropriate way to research an area in which new insights are sought due lack of previous studies. In this respect, an in-depth case study was considered appropriate for collecting the necessary data and analyzing complexity in digital transformation projects. Furthermore, the single-case study design is commonly used in digital government research [13],[49].

The selection of the case was made on the basis of high expectations about the information content it would provide. Often, a typical or extreme case will reveal more information than other types of cases because it involves several actors and basic mechanisms in the situation studied [50]. For our study, we sought an ongoing digital transformation project that was set up to produce high-end, seamless digital solutions for citizens and businesses. The second criterion was that the case should include collaboration between several public agencies and sectors. Studies have shown that digital transformation projects in the public sector tend to be more concerned with collaborative, inter-organizational strategies and value creation compared with traditional IT projects [51],[52]. A third and final criterion when selecting the case was that it that had been running for some time, thus having the potential to yield information about project experiences.

5.1 Data collection

Data were collected through a combination of semi-structured in-depth interviews, observations, and documentary searches. The findings from the interviews and observations constituted the primary data, while project reports, minutes from meetings, project evaluations, and government reports (e.g., on national digital transformation strategies), constituted the secondary data (Table 2). A total of 10 participants were interviewed (see Table 2).

Each interview was conducted face-to-face and lasted ca. 1 hour. The interviewees were asked to elaborate on the challenges and difficulties experienced in the project, with a focus on aspects of project organization, technologies, and innovation. An interview guide informing about the format and focus of the research study and the interview process was sent to the participants in advance of the interviews. The first author conducted the interviews between November and December 2019. The interviews were recorded and then transcribed verbatim.

The data were triangulated by applying multiple data collection techniques, including multiple interviews, observations, and a review of documents [53] (Table 2). Observations at meetings, document studies, and reviews of project reports, mandates, and evaluation reports were made to validate and provide context for the interviewees' views, thus enabling empirical triangulation. To increase reliability and enhance transparency, a case study protocol was created and a case study database compiled. The database, which was established using the software NVivo, included case study notes, documents, and the results of our analysis.

Table 2. Overview of the collected data.

Data sources	**Number/time used**	**Number, or time used**	**When**	**Type**
Primary data				
Interviews	10	Semi-structured, in-depth interviews with two project managers, the leader of the steering group, a member of the steering group, and six project group members	November – December 2019	Face-to-face interviews
Observations	7 hours	Observations made in two meetings: (1) of project members participating in project group meeting (4 hours), and (2) of steering group members participating in steering group meeting (3 hours)	September – October 2019	Observer at meetings

Data sources	Number/time used	Number, or time used	When	Type
		Secondary data		
Reports such as project mandate, project description, minutes from meetings, evaluations	10	Background information Evaluations of front-end phase, communication plans, budget and planning reports Risk-evaluation matrix Meeting agendas and decision points Financing and operations	May 2019 – April 2020	Written documents
Government's reports and strategies on digital transformation	6	Government agencies' reports on digital transformation initiatives Evaluations of projects and implemented initiatives Government's national digital strategies	May 2019 – April 2020	Online and written documents

5.2 Data analysis

During our research, we use a grounded theory approach [54], which is a systematic method that can assist in the development of explanatory models grounded in relevant empirical data [54]. Interviews are considered a common form of collecting data in research in which the method is applied [55],[56]. We used a thematic analysis approach [57],[54] to analyze the data. The method enabled us to identify patterns in large data set. Further, it offered a means of identifying relations and links within analytic themes both effectively and accurately. Thereafter, a four-step process was applied [57],[58]:

1. an in-depth analysis of the raw data, including coding and identifying first-order categories of codes;
2. further examination of the first-order categories by identifying links, patterns and relationships among them;
3. formation of aggregated dimensions of project management challenges and project complexities, including insights from published literature;
4. comparison and analysis of the aggregated dimensions, which allowed for identification of relationships and linkages between themes.

NVivo software was used to organize and analyze the data from the interviews. The software was especially suitable for ours research because it enabled us to conduct content analysis of rich qualitative data. The process involves "contextualizing and making connections between themes to build a coherent argument supported by data" [59].

The first step involved reading the interviews (located in NVivo) several times and coding common words, phrases, terms, and labels mentioned by interviewees, and then the first-order categories of codes were identified, reflecting the

views of the interviewees in their own words. In the second step, related texts were located together, based on repeated common phrases or ideas. The repeated ideas were grouped into themes to form coherent categories. As the themes started to emerge, the more hierarchal orders of nodes were built, thus creating broader themes related to project challenges. In NVivo the term "node" refers to any named concept that represents what is defined in the data as meaningful in relation to the research project's objectives. To organize themes, NVivo allows them to have more than one dimension (tree branch). In our case, this enabled us to group the themes to build a more general concept. In NVivo this process is labeled as building tree branches. Sorting concepts into branches assisted us in identifying common properties and making early comparisons. To ensure that concerns about validity were addressed [60], insights from secondary resources such as reports and evaluations were taken into consideration. Fig. 3. shows how the first step of the data analysis was performed in one case.

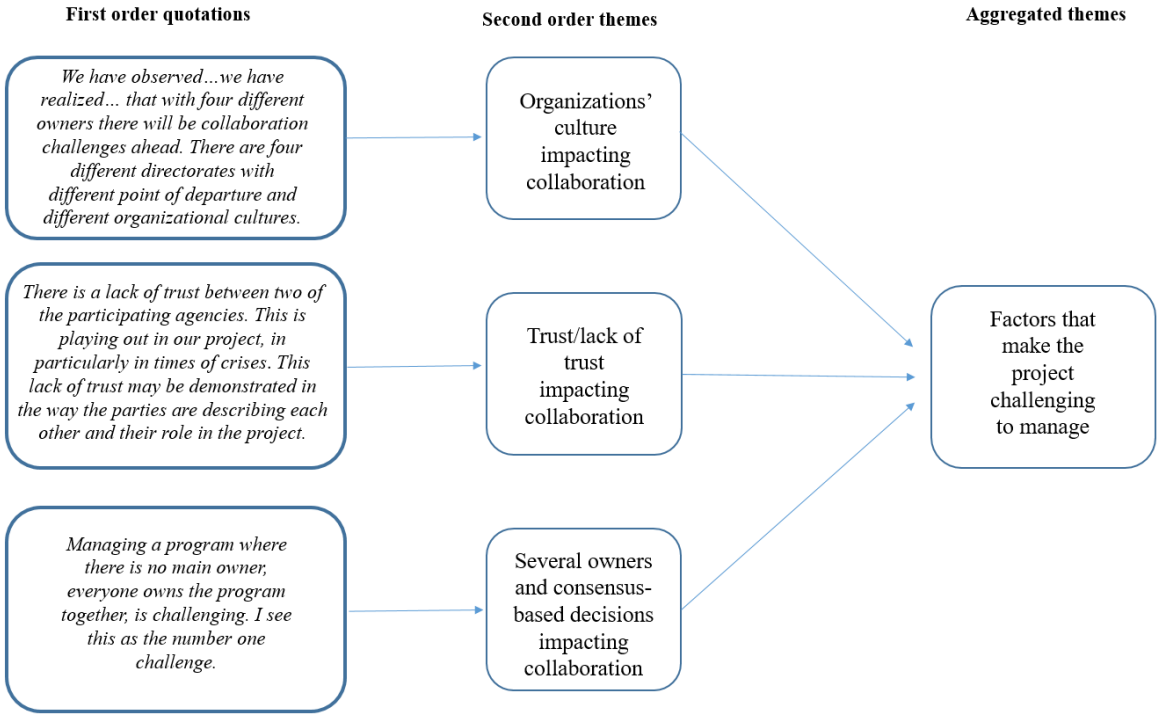

Fig. 3. Examples of first and second steps of coding interview data, the building hierarchy of nodes, and aggregated themes.

The third step in the coding of the interview data generated aggregated dimensions, which represented a higher level of abstraction. In that phase, the second order themes were combined with insights from the literature on project management concerning challenges related to the management of digital transformation projects. An example of the data structure generated from the data analysis in third step is presented in Fig. 4.

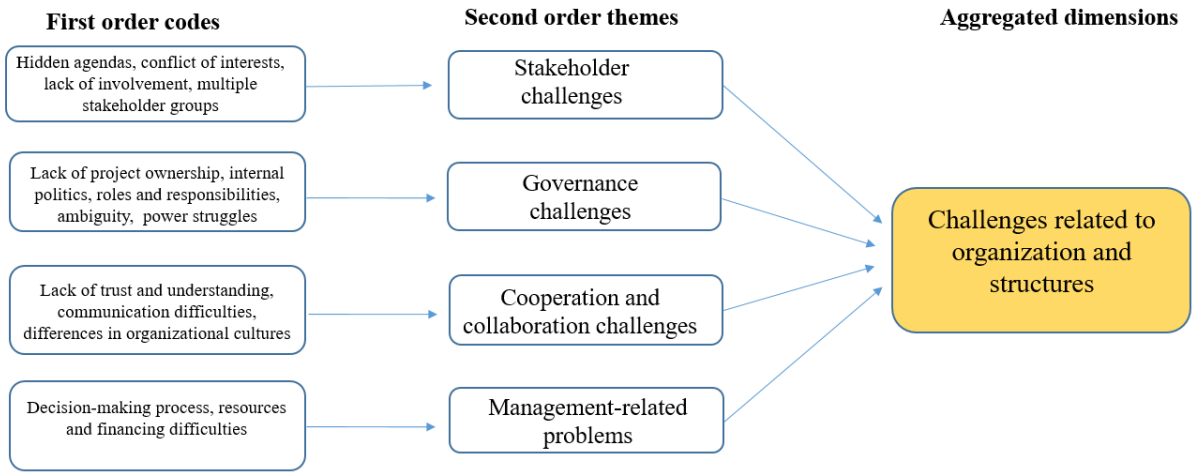

Fig. 4. Examples from the third step in the data analysis process, the creation of data structure related to the organizational dimension.

The fourth and final step included the comparison and analysis of the aggregated dimensions, which allowed for relationships and linkages across them to be identified. The matrix coding query function in NVivo is suitable as a search tool for investigating relationships between themes and concepts [61]. The query examines any possible appearance of themes that are closely associated with each other. The results are presented in tables in which each cell in the matrix displays a chosen piece of information concerning the corresponding pair of items. In our research, the cells contained numbers that represented corresponding coding references (Fig. 5). Consequently, from the results, we were able to examine a number of themes that appeared closely interconnected. Further investigation of these interrelationships might reveal insights into about the emergence of dynamic and extensive relationships between elements that may cause complexity and impact the performance of the case project.

THEMES	Technology/choice of digital enabler	Dependencies in deliveries	Lack of technical competencies	Newness of technology	Progess challenges	Technical deliverables
Collaboration/cooperation challenges	2	10	21	5	3	16
Financing challenges	0	3	3	3	1	4
Governance challenges	3	7	9	4	5	13
Management challenges	5	9	13	6	7	10
Politics: constraints and influence	1	2	2	1	1	1
Stakeholder group challenges	2	5	5	13	2	11
Organizational structural challenges	0	0	2	1	1	0

Fig. 5. Example of a table created by running a matrix query.

6. Results and discussion

In this section we present and discuss the elements of complexities we discerned in the case project. Based on the method described in the preceding section, we were able to distinguish elements of complexities within the dimensions of organization, technology, and innovation. Although the complexities are treated separately to greater or lesser extent in the project complexity literature, the results from our data analysis, which included running matrix queries, indicate that complexity in the studied government digital transformation project incorporated multiple factors and was a result of a dynamic and extensive interplay between complexity elements from all three dimensions.

This section is divided in two main parts. The first part includes Tables 3, 4, and 5, which present the complexity elements prevalent in each of the dimensions. Each complexity element is further described based on an analysis of the interviewees' words, which were aggregated into more overarching themes using the software NVivo (see Section 5.2.). In the second part we explore potential relationships between the identified elements of complexity based on the matrix queries run in NVivo, and the assumption that additional complexities emerged in the interplay between those dimensions. The interplay between the dimensions added up to the known challenges found in each singular dimension.

6.1 Complexities related to the organizational dimension

The group of challenges identified in the organization dimension include governance challenges: lack of project ownership within the participating organizations; cooperation and collaboration challenges, including communication difficulties and lack of trust and understanding between the parties involved; management-related problems; and ineffective decision-making structures. Additionally, resources and financing, stakeholder management, and issues related to politics were identified as elements of complexity within this dimension. An overview of the groups of challenges contributing to complexities in the organization dimension is presented in Table 3.

Table 3. Groups of challenges contributing to complexities in the organizational dimension.

Elements contributing the most to complexities in the organization dimension	**Description**
Collaboration and cooperation challenges	Inter-organizational collaboration, lack of trust, hidden agendas, lack of transparency, differences in the organizations' culture, communication challenges
Stakeholder management	Number and variety of stakeholder groups, multiple owners, lack of involvement of key interest groups (i.e., suppliers), dependencies between stakeholder groups
Governance challenges 3	Lack of steering and anchoring within the participating organizations
Management challenges	Project organization, including frequency of meetings, documentation, ineffective meetings, ineffective decision-making processes, lack of resources and lack of diversity in resources, lack of project maturity among the project members
Financing	Uncertainties about funding, several funding sources and differences in financing mechanisms between the owners; insecure future funding: "who pays for what"
Politics: constraints and impact	Bureaucratic structures, silos, focus on taking care of interests of own sector/organization, political issues, and public administration policies
Structural challenges within the sectors and the organizations	Differences in organizational structures, differences in the sectors' structure, reorganizations within the owners' organization

6.2 Complexities related to the technology dimension

One of the challenges related to the technology dimension was the choice of technology, which was not known in advance of the project's establishment, thus creating a high degree of uncertainty. The project also faced challenges due to lack of technical competencies in the project group, newness of technology, dependencies in deliveries, and changes in requirements. An overview of the groups of challenges contributing to complexities in the technology dimension is presented in Table 4.

Table 4. Groups of challenges contributing to complexities in the technology dimension.

Elements contributing the most to complexities in the technology dimensions	Description
Lack of skills and competencies	Lack of technical and digital competencies, and experiences with technology
Choice of technology/digital enabler	Difficult discussions in the project Technology not known in advance
Technical deliverables	The "hard" deliverables Interoperability challenges
Newness of technology	Challenges of introducing new technology, the platform, to the health care market
Dependencies in deliverables	Multiple dependencies in technical deliveries
Requirements—specifications	Changes in the requirements
Progress challenges	The late choice of technology The change in requirements Dependencies in delivery, impact progress

6.3 Complexities related to the innovation dimension

In the innovation dimension, the main challenges relate to change, uncertainties, and expansion of scope. The chosen technology is a "game changer" in the way that it processes and transmits health data, and thus there is a huge innovation potential associated with it. As the technology is new to the Norwegian health care market, there are uncertainties connected to the acceptance of the digital solutions among key stakeholders, namely the suppliers of electronic health records, and the user groups such as the GPs. Furthermore, there are challenges related to value creation and benefits realization, as the involved agencies are uncertain about where and when the benefits will be realized and the added value created. An overview of the groups of challenges contributing to complexities in the innovation dimension is presented in Table 5.

Table 5. Groups of challenges contributing to complexities in the innovation dimension.

Elements contributing the most to complexities in the innovation dimensions	Description
Uncertainties	Uncertainty related to technology, market adoption, competencies
Change	Introducing change (i.e., in work processes), and new opportunities as a result of the innovative digital services
Expansion of scope	Additional resources and time needed for market research, involvement of political administration, market activities and reach-out efforts
Value creation	Value creation and benefit realization challenges in terms of whom will gain, and where the benefit realization will occur

6.4 Summary of the elements of complexity related to organization, technology, and innovation

In sum, results of our analysis indicate that the case project has experienced complexity related to organization, technology, and innovation. The identified groups of complexity elements resonate with the results and the conclusions of several other studies that identify and categorize complexity factors into organizational, technological, and innovation related groups [33],[39],[62]. The identified groups of complexity elements separately constitute management challenges for the project. Researchers have responded to these types of challenges by presenting a multitude of strategies and management tools for how to embrace, tackle, and manage complexities related to organization, technology, and innovation [5],[33],[63].

The trend in the project complexity literature is for a stronger focus on projects that are unique and should be treated as such, explicitly taking into account the contextual and environmental influences [64],[65]. Accordingly, we assume that the project case we studied has some contextual aspects that makes it unique, for instance the public context in which it operates. Researchers also report that projects that are set up to deliver digital and IS solutions can no longer be regarded as purely technologically focused endeavors, as the complexity embedded in such projects has multiple implications [5]. In line with this thinking, we assume that complexity in the studied government digital transformation project incorporates multiple factors and is a result of dynamic and extensive interplay between complexity elements from all three dimensions.

6.5 Investigating the interplay between the organization, the technology, and the innovation dimensions

Given that with organizational complexity, digital technology, and innovation, the level of uncertainty and complexity in digital transformation projects increases [31],[66], we investigated the intersections in which the dimensions of organization, technology and innovation meet. The results emerging from the following intersections are elaborated as follows:

- Complex situations that arise at the intersection between managing organizational issues and the efforts made for the selection and implementation of new technology;
- Complex situations that arise at the intersection between managing organizational structure and attempts to acquire and introduce innovative digital solutions that create value for users and end users;
- Complex situations that arise at the intersection between efforts to introduce innovate digital solutions, and efforts to select and implement purposeful digital enablers. This intersection defines the space of possibilities.

With regard to the first of the three points listed above, high correlations generated from running a matrix query indicate that the challenges of cooperation and collaboration (organizational complexity) in the project are closely related to a lack of technical competencies within the project group (technical complexity). The members in the project group held different professions, such as GPs, engineers, lawyers, and IT experts. The variety of professions in the project group made the communication among the members demanding, particularly during the process of selecting the digital enabler. The lawyers and GPs, who represented the bureaucratic side of the project group (the National Police Directorate and the Directorate of Health) did not have the same technical competencies or digital skills as the IT experts from the Directorate for eHealth and the NPRA. This made communication and discussions about the technology complicated, as stated by one project member (a lawyer):

> When the “digital side” of the project, i.e., those with the technical expertise, tried to explain the challenges of the digital solution to those of us lacking digital competencies, we talked past each other. The bureaucrats that lack the technical competencies could not make themselves understood, nor could they understand what the IT experts explained, as they were not speaking the “technical language.” The consequences being that those with little technical competencies needed “three rounds of explanations” from the IT experts prior to understanding the technology and the challenges associated with the technical solution.

Gaps between the parties in their digital competencies and experiences with technology impacted the project performance in terms of time overrun, as described by the project manager: “We have had long and difficult discussions about technology, as several members of the project group do not understand the technology, they lack competencies, and how a digital development project is undertaken. This has been demanding, impacted the progress, and somehow exhausted the project and its members.” The results of our analysis indicate that the interplay between the organization dimension and technology dimension is a meeting between bureaucrats and technocrats. The two parties represent different cultures and communicate using different jargon, the technocrats use the ICT jargon of the digital world and the bureaucrats speak the civil service jargon of the bureaucratic universe. They also have different starting points with regards to technical competencies and familiarity with advance technology.

An inter-organizational project that is set up to deliver seamless digital services for citizens typically involves parties that represent the different government agencies that have a stake in the development and implementation of the digital service [51]. Several authors have identified and reported organizational challenges in inter-organizational collaboration projects, such as lack of resources, development of adequate organizational capabilities, and cultural challenges [67],[68],[69]. In a digital transformation project, these types of organizational challenges may interplay with the challenges of selecting and implementing new digital technologies. As observed in our case study, the project had to deal with collaboration challenges such communication difficulties and differences in organizational cultures among the project members, coupled with challenges related to technology, such as the lack of technical competencies. These interrelated elements of complexities may lead to misunderstandings, lack of progress, and time overrun.

A recent study of complexity factors in the ICT industry [65] revealed that "interfaces between different disciplines" is an element of complexity in ICT projects. The authors explain that the challenges faced in the collaboration between parties that represent several sectors can be well understood, as inter-organizational projects can involve close collaboration between sectors that do not have a history of cooperation. In addition, these types of projects have to rely on interfaces in order to achieve a broader public goal. Furthermore, studies of project complexity in IS projects show that technical aspects, such as lack of knowledge and familiarity with advanced and new technologies, and lack of skills and competencies in handling technical risks and quality requirements, will impact the organizational processes and management of projects [34],[70]. Furthermore, studies of complexity in IS projects reiterate that selecting the right competencies is highly critical for coping with technological complexity, and should be considered an important task of the project manager [5]. In government digital transformation projects, the ability to select and devote the right resources to the project might be a more critical problem and one that that occurs in current project practice in the public sector, namely the problem of dealing with constrained resources [68], which also impacts the selection of people and competencies for a project.

The results of our investigation into the relationships between the challenges that arise at *the intersection between managing organizational structure and attempts to acquire and introduce innovative, digital solutions* suggest that the management of the stakeholder relations (a complexity element identified in the organization dimension) is closely connected to the uncertainties of introducing digital innovation to the market (complexity related to innovation). There are uncertainties related to the stakeholders' acceptance of the digital innovation, such as whether GPs will make use of the digital services delivered by the project and accept the changes in the work procedures. According to the project manager, the acceptance of the digital solution introduced by the project is a "make or break" situation for the project: "The technology choice and the importance or challenge of getting the suppliers of the EHR [electronic health record] and the general practitioners onboard, convincing them that this solution will benefit them, on a larger scale, is the major challenge of the project. If the GPs do not use the system then the project will fail." As our findings indicate, the project is highly dependent on the external stakeholders for creating added value for the end users and therefore meeting the stakeholder groups' expectations are key for succeeding. However, as the project has to balance the stakeholders' needs and expectations with the challenges of introducing innovative digital solutions to the market, additional challenges emerge.

The uncertainties associated with the implementation of the new innovative technology are concerns that were highlighted by the project members: "The project has to take on the responsibility of pushing this digital solution into the market, which has expanded the scope of the project. The project had to investigate possible new opportunities by investing in research, [and] documenting the impact and positive effects of the chosen technology." These efforts in supporting the introduction of the new technology may have had negative consequences for the involvement of key stakeholder groups, such as the suppliers, as reported by one interviewee: "The project has lost its window of opportunity, as too much time has been spent on discussions and researching the effects of implementing the new technology. So, if we will launch the new, innovative framework next year, we have lost momentum. Only a handful suppliers have so far confirmed their commitment to implement the applications provided by the framework."

Our results indicate that the challenges of meeting the expectations of key stakeholder groups are closely related to the challenges of bringing innovative digital solutions to the market. The project managers have to balance the expectations and involvement of the stakeholders, and they have to manage the uncertainties related to introducing innovative

services to users. As demonstrated in by the case project, too much focus on one part (i.e., the introduction of new innovative digital solutions) may have negative consequences for the project, such as lack of commitment from the key stakeholders. According to Gil-Garcia et al. [71], balancing the different expectations of the various stakeholder groups is challenging. However, if successful, it increases the likelihood of stakeholder acceptance and the adoption of new services. By contrast, if stakeholders' expectations are not met, the collaboration between the partnering public and private organizations will be less likely to grow, resulting in lack of commitment to the services being delivered by the project. Due to the challenges of bringing innovations to the market, which is demanding and requires strong alignment and commitment between project participants, the need for extensive market research, and a clear execution plan [72], the complexity level will increase. As observed in the case project, the introduction of new innovative technology to the market resulted in expansion of project scope, since unplanned market activities were required, which in turn influenced the project's efforts to meet the expectations of key stakeholders.

Our investigation into *relationships that arise at the intersection between efforts to introduce new digital solutions, and efforts to select and implement purposeful digital enabler* revealed close connections between, on the one hand, the challenges related to the newness of technology (technical complexity) and the challenges related to changes and expansion of project scope, and, on the other hand, the creation of benefit for the users and end users (complexity related to innovation). The selected technology is associated with novelty and uncertainties, as it is new to the Norwegian health care market and will change the way the market transmits health data. The project members expressed concerns regarding the choice of technology, possible expansion of scope, and the achievement of the target benefits for users and end users: "We need to know more about the technology and the concept, as the development of this will expand the scope of the project. We need to know the true potential, where and how the technology can be applied." A recent study of innovation and complexity revealed that innovation is connected to technical complexity [62]. However, the extent to which innovations are invented within a project or adopted from other sources will influence the overall complexity of that project. Cantarelli argues that introducing innovations developed by other sources (projects) requires particular resources, technical skills and experience with technologies [62]. In the studied case, the project has not been involved in the innovation process of the digital framework, SMART on FHIR framework (it has been developed by a company in the USA). In addition, several members of the project lacked technical competencies and experience with advance technology. This might have influenced the project's experience of uncertainty about the technological platform's potential and capabilities, and whether the targeted benefits for the users and end users will be achieved.

7. Conclusions, research limitations, and further research

In this paper we have aimed to provide a better understanding of the elements that cause complexity in a government digital transformation project. The results from our case study support our primary postulate that government digital transformation projects become increasingly difficult to manage when organizational structuring, the introduction of new technology, and efforts to innovate and create added value for citizens and businesses all operate in tandem.

Our analysis of a single exploratory case study, combined with document research and insights gained from literature has revealed the challenges and elements of complexities within the dimensions of organization, technology, and innovation. By running matrix queries in NVivo, we were able to explore the relationships between the identified elements of complexity, assuming that additional complexities emerged in the interplay between where those dimensions. The results suggest that there are extensive and dynamic relationships at play between multiple dimensions of organization, technologies, and innovation.

The results from the data analysis of the case project indicate that the interplay between the organization dimension and technology dimension is a meeting between technocrats and bureaucrats. The two parties represent different cultures and have different starting points concerning technical competencies and familiarity with advanced technology, which complicated the process of selecting the digital enabler. Due to gaps in competencies and lack of a common, "technical" language, the communication between the parties became difficult, which had a negative impact on the progress of the project. With regard to the intersection between innovation and organization, the results suggest that the challenges of

selecting and introducing the digital innovation interacted with the challenges of meeting the expectations of important stakeholder groups. As demonstrated, too much focus on one part (i.e., the introduction of new, innovative digital solutions) had negative consequences for the project in terms of lack of commitment from key stakeholders. The results also suggest that at the intersection between innovation and technology there is a need to balance the targeted benefits with the uncertainties of the technological platform capabilities. Lack of technical competencies and experience with advance technology among the project members might have influenced the project's experience of uncertainty about the technological platform's potential and capabilities, as well as whether the targeted benefits for the users and end users would be achieved.

The results of our attempt to understand complexity in a government digital transformation project suggest that the project cannot deal with just one dimension at the time, but has to address the challenges within the dimensions simultaneously, including in a coordinated manner. We conclude that *complexity in a government digital transformation project may incorporate multiple factors and result from a dynamic extensive interplay between complexity elements from the dimensions of organization, technology, and innovation*.

Our results are primarily based on grounded theory approach, which means that they require extensive theoretical elaboration, testing, and contrasting with other theoretical assumptions. Furthermore, our results do not form a basis for generalizations about the complexities in government digital transformation projects, as the investigated relationships are based on a single case project, in a Norwegian government setting. In addition, it should be taken into consideration that a correlation of themes is not necessarily an indication of an interaction of the corresponding dimensions. However, the results may contribute to pinpointing some factors and their relationships that need to be further investigated in order to understand complexity in a government digital transformation project fully. It follows that more research is needed to investigate and test the identified determinants and other determinants that contribute to complexity in government digital transformation projects.

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