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Co-production in digital transformation of public administration and public value creation: The case of Denmark

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ABSTRACT

Public administrations are investing in the digital transformation of their citizen-oriented services and internal administrative processes. They are using co-production approaches and include different types of stakeholders into these transformative processes to increase service quality and generate public value. In this study, we investigate how these co-production approaches are implemented in both digital strategy formulation and implementation in Denmark. We identify four different types of public value: citizen, economic, administrative and societal public value.

1. Introduction

Public administrations are moving from digitizing single administrative forms to redesigning full processes and services with the goal to digitally transform their operations (see, for example, [Mergel, Edelmann, & Haug, 2019](#)). Along this continuum, some public administrations are proceeding faster, while others lack behind in their implementation efforts. This can be due to a lack of a national digital strategy, disjointed efforts across levels of government, lack of funding, or misdirected public management reform efforts (see, for example, [Dunleavy, Margetts, Bastow, & Tinkler, 2006](#)).

In the cases where digital transformation efforts have sped up and countries were successful in implementing digital services for their users, they are ranked high on e-government indexes (e.g., [European Commission, 2019](#); [United Nations Department of Economic and Social Affairs, 2020](#)). However, little is known about how they managed to apply a holistic approach to their digital transformation efforts and what the outcomes are ([Klievink & Janssen, 2009](#); [Panagiotopoulos, Klievink, & Cordella, 2019](#); [Tangi, Janssen, Benedetti, & Noci, 2020](#)). As a new standard, co-production and public service design has emerged and governments are including different types of stakeholders in the different phases of digital public service design. We therefore set out to understand how they approached the digital transformation, how they involved stakeholders during the co-production phases and what the outcomes in form of public value are (see, for example, [Allen,](#)

[Tamindael, Bickerton, & Cho, 2020](#); [Casula, Leonardi, & Zancanaro, 2020](#)).

Generally, public value in public sector digital transformation efforts can be labeled as the implementation of “citizens’ expectations” ([Twizeyimana & Andersson, 2019:167](#)). The types of value include citizen value by creating improved interactions with citizens, economic value through monetary and time gains as a result of improved administrative efficiency, or societal value, such as improved transparency (see, for example, [Moore, 1995](#); [Panagiotopoulos et al., 2019](#); [Twizeyimana & Andersson, 2019](#)). In addition, recent literature (e.g., [Cordella, Paletti, & Maha, 2018](#)) stresses the important role of co-production in public sector digital transformation efforts and discusses how co-production can help public sector organizations to produce and deliver services “that are better valued by contemporary society and therefore help public administration to more effectively produce public value” ([Cordella et al., 2018, p.3](#)). So far, there are very few empirical studies that disentangle how public value is created in digital transformation efforts and this study aims to contribute to the emerging literature on public value and co-production in digital government (e.g., [Juell-Skielse, Lönn, & Päiväranta, 2017](#); [Karkin & Janssen, 2013](#); [Panagiotopoulos et al., 2019](#); [Yu, Wen, Jin, & Zhang, 2019](#)).

In order to understand how a national government was able to successfully create public value using co-production in its digital transformation efforts, we selected Denmark. According to the most recent indices, the country has successfully transformed its public services from

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an analogue to a fully digital service delivery model (e.g., European Commission, 2019). Online interactions between public authorities and citizens is high (90%) and well above the EU average (64%) (European Commission, 2018a, 2018b). As a result, according to the latest United Nations E-government Survey (2020), Denmark ranks first among the 193-member states of the United Nations concerning provision of online services and citizens' participation in government decisions and policy making.

Our guiding research question is therefore: How can public administrations digitally transform public service delivery by using co-production approaches and create public value in the process? In order to answer our research question, we first develop a theoretical framework. We then use it to guide the data collection and analysis, consisting primarily of semi-structured interviews complemented by secondary material (Saldaña, 2021).

The findings show that co-production was a key element both in the formulation of national digital policies and strategies and in the implementation of digital transformation of public administration. The findings also highlight actors, activities and tools characterizing such co-production as well as provide empirical insights about the public value generated by such digital transformation efforts.

Next, we will present the key concepts from the literature on digital transformation, co-production and public value and explain our research design. Then we present the findings of the empirical investigation. Lastly, we discuss our findings in light of the existing literature and provide practical implications of our research.

2. Theoretical background

Digital transformation of the public sector has been studied for a few decades, but has increasingly gained importance with the changing needs of citizens and businesses to interact digitally with public administrations (e.g., Janowski, 2015; Mergel et al., 2019; Paskaleva & Cooper, 2018; Tangi et al., 2020). In a recent study, Mergel et al. (2019) extracted a definition of digital transformation from expert interviews that also guides our initial understanding of the term in the public sector, according to which digital transformation is a holistic effort to revise core government processes and “*evolves along a continuum of transition from analog to digital to a full stack review of policies, current processes, and user needs and results in a complete revision of the existing and the creation of new digital services. The outcome of digital transformation efforts focuses among others on the satisfaction of user needs, new forms of service delivery, and the expansion of the user base.*” (p.12) Along similar lines, Tangi et al. (2020) argue that digital transformation includes the whole organization and not just individual administrative services or processes.

The most recent wave of using ICT in government focuses heavily on the involvement of users and aims to take into account how their needs on the demand side are changing (e.g., de Jong, Neulen, & Jansma, 2019; Meijer, 2014). Other studies include different stakeholders in the co-production of public services and conceptualize co-production as the involvement of citizens and other actors external to the public administration in the design, production, and provision of public services (e.g., Cordella et al., 2018; de Jong et al., 2019; Paskaleva & Cooper, 2018; Yu et al., 2019). In this paper, we draw on the conceptualization of co-production developed by Nabatchi, Sancino, and Sicilia (2017): “*coproduction describes activities involving traditional and untraditional service areas, as well as activities that have nothing to do with service delivery but relate to other elements of public services and public policies. Such definition emphasizes a pluralistic model of public service based on inter-organizational relationships, networks, collaborative partnerships, and other forms of multi-actor policymaking and public action.*” (p.7)”. This last focus on policy making and public action is supported by Moore (1995) suggesting that public management strategies aiming at public value creation do not “only need specific organizational capabilities and resources to deliver services that fulfil social expectations but also need to

be politically legitimate and sustainable (Moore, 1995 in Panagiotopoulos et al., 2019, p. 2). By drawing on the above literature, co-production of digital transformation is therefore not simply a participation process, but may involve the re-organization of the relationships, the interaction and co-operation between different actors (Emerson & Nabatchi, 2015; Gawlowski, 2018; Mergel et al., 2019) not only at service delivery and organizational level, but also at policy and national strategy level (e.g. Cordella & Iannacci, 2010; de Jong et al., 2019; Lember, Brandsen, & Tönurist, 2019; Osborne, 2018, 2020). We therefore derive our first research question:

Research question 1: How was co-production implemented across the different governmental levels and relevant stakeholders in the formulation and implementation of the Danish national strategies for digital transformation of public administration?

Especially in cases where public administrations are aiming to fulfil the needs of citizens and businesses, these two stakeholder groups are included in the co-production phases of digital transformation. The existing co-production literature shows that there might be different phases that go beyond the consumption phase as the single point of interaction (Nabatchi et al., 2017). By focusing on the “Who, When and What” of co-production, Nabatchi et al. (2017) analyze different definitions and applications of co-production, and argue that the “co” side of the term captures who is involved, while the “production” side captures what occurs and when (see, also, Alford, 2014; Fugini, Bracci, & Sicilia, 2016; Sorrentino, Sicilia, & Howlett, 2018). In addition, Nabatchi et al. (2017) note that in some studies co-production is limited to situations where a state actor and a lay actor work together on a specific service at the point of delivery (see, also, Alford, 2009), while in other studies co-production is applied across the phases of the public service cycle (e.g., Bovaird, 2007; Bovaird & Löffler, 2013, 2016; Sicilia et al., 2016). In the latter studies, state actors and lay actors can work together at any stage to ‘produce’ something of value. In varying degrees of granularity, several authors show that there are in fact different co-production phases, including co-design, co-development, or co-delivery (Brandsen & Honingh, 2016; Loeffler & Bovaird, 2016; Nabatchi et al., 2017). In the digital era, co-production then goes beyond citizen participation (e.g., de Jong et al., 2019) or crowdsourcing activities (e.g., Koch, Fuller, & Brunswicker, 2011). For example, Blomkamp (2018) shows the potential benefits of co-design, that occur throughout the whole production process of a digital product. Van Eijk and Steen (2014) show the potential of co-planning. Brandsen and Pestoff (2006) focus on how co-management can potentially be distinguished from other types of co-production, while others discuss the phase of co-assessment and the extraction or explication of the resulting value (Bovaird & Löffler, 2013). We consider the above co-production activities as phases of co-production and assume that several or all of these phases might be existing in the co-production of digital transformation of public administrations. Our second research question is therefore:

Research question 2: Who are the actors and related activities and tools characterizing the different co-production phases of digital transformation of public administrations?

Finally, what is not understood well so far is how digital transformation and co-production activities are creating public value (Bannister & Connolly, 2014; Panagiotopoulos et al., 2019; Twizeyimana & Andersson, 2019). While there are many different ways to conceptualize public value (for different definitions, see, for example, Alford & O'Flynn, 2009; Bannister & Connolly, 2014; Jørgensen & Bozeman, 2007), there are rarely any empirical studies available that operationalize the concept and provide guidance on how public value is empirically created (Andersen et al., 2010; Panagiotopoulos et al., 2019). The existing inventories show how diverse the conceptualizations are (e.g., Bannister & Connolly, 2014; Jørgensen & Bozeman, 2007) and what additional work is needed to derive actionable insights

(Panagiotopoulos et al., 2019). Thus, when it comes to the digital government literature, public value is assumed to be an outcome that is created as a by-product of the investments into digital transformation (see, for example, Twizeyimana & Andersson, 2019), but it is rarely measured, as Panagiotopoulos et al. (2019) confirm in their most recent editorial or operationalized. Therefore, empirically, public value in digital transformation of public administration is still a relative under-explored concept (Panagiotopoulos et al., 2019; Sorrentino et al., 2018).

By drawing on Moore (1995) and Twizeyimana and Andersson (2019), we define public value in public administration as “the citizens’ collective expectations in respect to government and public services” (as also stated in the introduction) and broadly refer to public value as “what is worth” (Bannister & Connolly, 2014). Citizens are defined as people in their different stakeholder roles, which include policymakers, public servants, users or customers of public services, tax-payers or entrepreneurs, and citizens as such (Twizeyimana & Andersson, 2019). Other authors have built on this seminal work and provide inventories of different types of public value (e.g., Jørgensen & Bozeman, 2007). By building on Jørgensen and Bozeman (2007)’s work, Bannister and Connolly (2014) frame the complex notion of public value by proposing a taxonomy of public sector values and argue about the impact of each value on digital government initiatives such as transparency, efficiency and inclusiveness. Twizeyimana and Andersson (2019) state that achieving public value in e-government should be understood as the ability of e-government systems to provide improved efficiency in government, improved services to citizens, and social values such as inclusion, democracy, transparency, and participation. By drawing on the previous literature, (Bannister & Connolly, 2014; Jørgensen & Bozeman, 2007; Twizeyimana & Andersson, 2019) and for the purpose of this article, we synthesize the different types of public value into four categories: (1) economic value, expressed in form of cost savings through digital transformation (see, for example, O’Flynn, 2007, 2) administrative value, expressed as improvement of public service delivery (Alford & O’Flynn, 2009, 3) societal value, broadly understood as the public sector contribution to society and expressed in terms of the rule of law (see, for example, Jørgensen & Bozeman, 2007; Stoker, 2006), and (4) citizen value, expressed for example in form of transparency or privacy (see, for example, Bryson, Crosby, & Bloomberg, 2014). Our third research question is therefore:

Research question 3: What kind of public value is generated by digital transformation of public administration operationalized by the employees at a public administration unit?

In summary, our resulting conceptual framework for the subsequent data collection and analysis includes the following theoretical concepts derived from the literature:

3. Research design

We apply a qualitative research methodology in the interpretive tradition (Miles & Huberman, 1994) and take the starting point in our theoretical framework acting as a guide and a source for inspiration in the understanding of the phenomenon investigated (Walsham, 1995). This interpretive approach to the phenomenon focuses on the qualities of the entities under investigation, the processes, and the meanings occurring naturally in the environment. With this approach, we aim to understand the actors, actions, and mechanisms and how the involved social actors interacted with each other to create the observable digital transformation and the value created.

Given our research purpose and research questions, we have chosen a case study research design and Denmark as a case (Yin, 2003). The case of Denmark can be defined as an intrinsic case (Mills, Durepos, & Wiebe, E. (Eds.), 2009). A case may be intrinsically interesting because it is special and unusual among others and therefore we may be interested in investigating it due to its special nature. According to Taber (2014),

intrinsic cases may be selected because they have been identified as special according to predefined empirical or theoretical criteria. Denmark was selected as an intrinsic case because of the Danish national government success in creating public value through the digital transformation of public administration as reflected by the high ranking in most of the e-government indices such as the DESI index (European Commission, 2018a; European Commission, 2018b; European Commission, 2019) or UN surveys (United Nations Department of Economic and Social Affairs, 2020). In addition, as Andersen, Medaglia, Vatrapu, Henriksen, and Gauld (2011) argue, Denmark is an interesting case due to its “strategic commitment to face challenges and formulate explicit milestones for the success of e-government strategies” (Andersen et al., 2011, p. 441).

To investigate the phenomenon under consideration, we investigate the co-production of digital transformation strategies across different governmental levels. In addition, we aim to understand the co-production of digital transformation at the organization level. This is important and necessary as the main objective of the study is to create a link between governmental strategies for digital transformation of public services and the value generated by their implementation at public administration level. The public administration unit selected for our study is the Danish Business Authority (DBA). DBA is an outstanding example of digital transformation of public administration both in Denmark and in the European Union. As a result, for a long period, DBA has given “GO & SEE” seminars to showcase and share experiences about their digital transformation for both Danish and EU representatives from the private and public sector (Danish Business Authority, 2016).

3.1.1. Data collection

The data sources include both primary and secondary data. The primary data consisted of fifteen interviews based on a semi-structured interview protocol with open-ended questions (Maxwell, 2013). The interview protocol was structured around three main themes. Each theme covered a phase of the conceptual framework and related research question (Fig. 1). The order of the main themes was progressive and logical and started with theme one covering RQ1, followed by theme two covering RQ2 and finally theme three covering RQ3. We first conducted eight interviews with national experts mostly responsible for digital policy and strategy development, but also involved in digital transformation projects of public administration (RQ1). These interviews mostly contributed to understand theme one, but also to understand themes two and three. Subsequently, seven interviews were conducted with experts mostly responsible for the implementation of digital transformation of a public administration unit, but also involved in digital policy and strategy formulation exchanges (RQ2 and RQ3).

Our interview partners can be labeled digital transformation experts. According to Bogner, Littig, and Menz (2009) experts are subjects with technical, process and interpretative knowledge in relation to their areas of expertise. Such knowledge is a result of their actions, responsibilities, or obligations within an organization. The experts interviewed in our study are key actors involved directly in digital strategy and policy formulation and implementation, as well as digital transformation of public administration and public services and thus related in their real-life settings to the phenomenon under investigation (see, Table 1 for a full overview of interviewees, which due to confidentiality and purpose of the study only includes information related to job position and seniority).

To identify the interviewees, we used a snowball sampling method (Biernacki & Waldorf, 1981). Snowball sampling is a very good technique for conducting research with a specific and relatively small population that is hard to identify or locate (Lewis-Beck, Bryman, & Futing Liao, 2004). The technique allowed us to recruit research subjects by identifying an initial subject who then referred us to additional potential

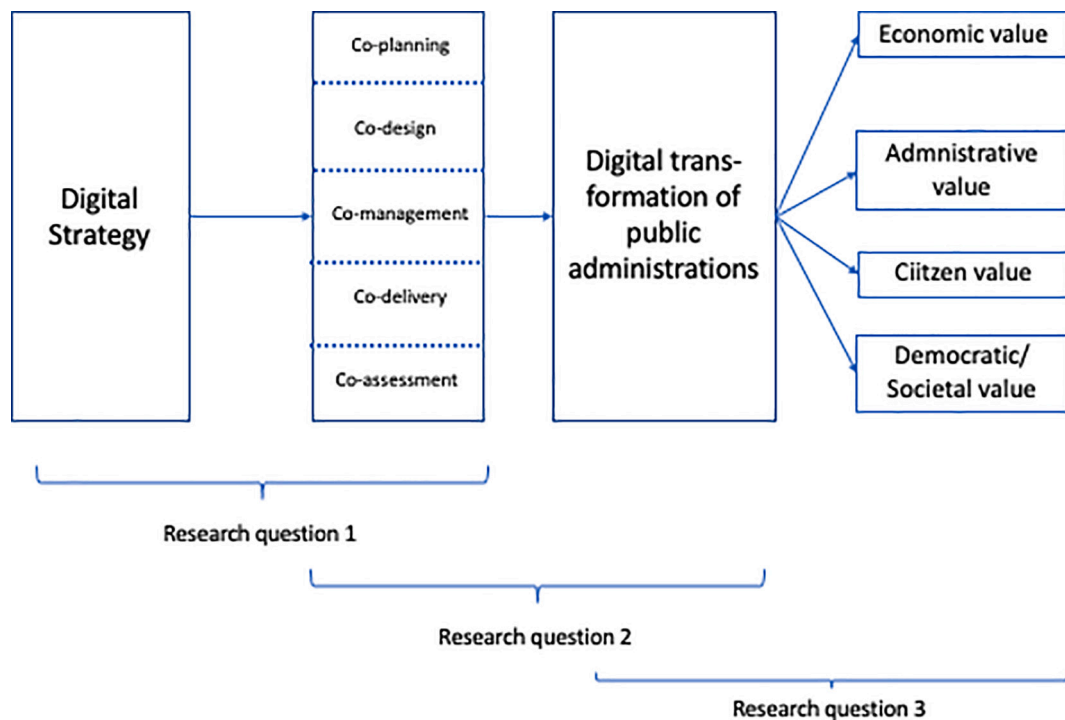


Fig. 1. Conceptual framework

Table 1

List of interviews.

Interviewees	Position	Type of Organization/Level of Government
Interviewee 1	Director	Public Sector Organization/State Government
Interviewee 2	Director	Public Sector Organization /State Government
Interviewee 2 (a)	Director	Public Sector Organization / State Government
Interviewee 3	Director	Public Sector Organization
Interviewee 4	Chief Technology Officer	Government and private consultancy
Interviewee 5	Head of Section	Government Agency / State Government
Interviewee 5 (a)	Head of Section	Government Agency / State Government
Interviewee 6	Deputy Director General	Public Sector Organization
Interviewee 7	Director	State Government / Danish Business Authority
Interviewee 8	Vice Director	State Government / Danish Business Authority
Interviewee 9	Chief Advisor	State Government / Danish Business Authority
Interviewee 10	Special Advisor Special Advisor	State Government / Danish Business Authority
Interviewee 11	Head of Department	State Government / Danish Business Authority
Interviewee 12	Office manager	State Government / Danish Business Authority
Interviewee 13	IT development manager	State Government / Danish Business Authority

interviewees. We started by contacting and interviewing two of the most publicly known actors of digital transformation of the Danish government scene. They referred us to other interviewees that satisfied our selection criteria. Even though the number of interviews in our study is relatively limited, given the respondents' unique and central role in digital policy formulation and digital transformation of public administrations, they provided us with unique and exhaustive data to understand the phenomenon under investigation. The interviews were

conducted between March 2018 and May 2019 and lasted on average one hour each, were tape-recorded and fully transcribed. Most of them were conducted face-to-face at the workplace of the respondents, a few were conducted over teleconferencing systems, Skype or telephone.

Secondary data complemented the data gathered through interviews. These data included official Danish policy and strategy reports, press releases published on key governmental web sites such as the Danish Digitalization Agency, as well as internal reports and PowerPoint presentations provided by the DBA employees (Danish Business Authority, 2016; Danish Business Authority, 2020a, 2020b, 2020c). The combination and triangulation of these types of data has contributed both to increase the level of knowledge and to gain a better understanding of the phenomenon under investigation (Lewis-Beck et al., 2004).

3.2. Data analysis

The data analysis broadly followed a deductive thematic analysis approach (Crabtree, 1999). Deductive approaches in thematic analysis involve the identification in the dataset of themes identified in previous research or the use of existing theory as a lens through which to organize, code, and interpret the data (Crabtree, 1999). Thus, this form of data analysis is interpretative, shaped and informed by pre-existing theory and concepts. The thematic analysis of our data was guided by our theoretical framework (Fig. 1) and our research questions. We aimed to identify actors, ongoing action and interaction taken in response to situations, or problems with the purpose of reaching a goal or handling a problem, thus identifying how the digital transformation experts in the Danish government defined the value propositions of their work.

3.2.1. Case description

Denmark belongs to the high-performing cluster of countries and is a leader in digitization in the world (European Commission, 2019, 2018a, 2018b; Andersen et al., 2011). It is a relatively small country with a population of 5,8 million inhabitants, has a low unemployment level and a highly educated population (Statistics Denmark, 2018). It is a constitutional parliamentary monarchy with legislative power held by a

single-chamber parliament. Parliamentary elections are usually held every four years (Statistics Denmark, 2018).

Denmark has three levels of governance: central, regional and municipal. Prior to 2007, the Danish territorial organization consisted of the state, the counties and the municipalities. A major reform in 2007 resulted in the dissolution of counties, the creation of five regions and the reduction of the municipalities from 271 to 98. It also modified the division of powers among the different levels of government. Only municipalities are considered local authorities. Municipalities and regions are represented before the central authorities by the associations Local Government Denmark (*Kommunernes Landsforening* – KL) and Danish Regions (*Danske Regioner*) respectively. The three levels of government collaborate closely on tasks and obligations laid down in the legislation adopted by the Danish Parliament (OECD, 2010).

Within the central government, the Danish Business Authority (DBA) is an authority organizationally embedded under the Ministry of Industry, Business and Financial Affairs and funded through the Finance Act with a yearly budget of about DKK 600 million. It is responsible for business registrations, including registration of VAT and the Register of Foreign Service Providers. DBA is providing a range of digital services including Virk.dk, the main digital portal for licenses and company registrations in Denmark and CVR, the Central Business Register containing data on all companies in Denmark (Danish Business Authority, 2020a, 2020b, 2020c). DBA has a large number of stakeholders that include the ministries, the 40 Danish authorities, and the Confederation of Danish Industry.

DBA's digital transformation started in 2009 due to old legacy IT systems that created several problems. For example, DBA had difficulties to implement changes in the IT systems to comply with the law changes, had problems to meet customer demands concerning digitalization and had inefficient operations. It is a business-driven digital transformation that has taken the starting point in both DBA's customer needs and employees' knowledge. The result is that DBA has changed from being an "organization focused on cases and inwards; with limited ability to change and legacy IT and traditional IT development organization" to an organization which is "customer centric and with digital solutions based on a stable and constantly evolving platform; agile culture with a focus on continuous improvements; data driven insights" and "digital laws, regulation and process" (Danish Business Authority, 2016).

4. Findings: co-production and public value creation in the digital transformation of Danish public administration

In this section, we first present the background findings in relation to the changes in administrative, political and legislative context as our analysis shows that these context factors were essential for the success of the digital transformation of Danish public administration. Then we present the findings answering the three research questions posed in the theoretical background section.

4.1. Context: The administrative, political and legislative structure

The administrative, political and legislative structure of Denmark has been changed over the years to adapt to developments of digital transformation of public administration and to make its implementation possible (Henriksen & Andersen, 2004; Scupola, 2018). This need emerged at the end of the 1990's. Due to the small size of the Danish country, each single public administration unit was too small to solve the complex problems arising from digitalization by itself, therefore a need for change emerged. An important example is the structural reform of the local government in 2007, which by reducing the number of regions and municipalities has simplified the political structure by simultaneously increasing the size of each single administrative unit, thus also increasing the budgets that each municipality or region has available for the implementation of digital transformation. In addition, in order to implement the national digital strategies, the existing

legislation had to be simplified, made more flexible, and agile to accommodate digital transformation demands and challenges. Policies and regulations did not necessarily fit with what is required to digitally transform Danish public administration, therefore the need to formulate them in such a way that they can facilitate the process arose, as one of the interviewees states:

"For digital transformation to be successful you have to also think about agile and digital legislation and digital policies." (Interviewee #3, Director, Public Sector Organization).

There was a need for new legislation at state level. An important step to accommodate this need is the Danish Government's "Agreement on digital-ready legislation" that established that new legislation must be digital-by-default from 1 July 2018. In order to fulfil this goal, the agreement stipulates seven principles, which must be followed in any new legislation. One principle, for example, deals with prevention of fraud and errors establishing that the legislation must be worded in such a way to allow effective IT application for control purposes (Agency for Digitalization, 2018).

4.2. Finding 1: Co-production of Danish digital strategies: actors and activities

The three Danish government levels, central government, local government and the five Danish regions have co-produced over the years the digital policies and strategies (OECD, 2010). The main idea of such co-production is to decrease costs, increase efficiency and improve communication among public administrations as well as between the public administrations, the public authorities and other stakeholders including the citizens and businesses.

This co-production has been accomplished, supported, and coordinated through governmental agencies under the umbrella of different ministries. Task forces lasting several years and spanning several strategic agendas as well as a number of more temporary commissions have also been established. Such commissions and task forces have changed according to the plans and needs of the moment. A recent example is the digital growth panel (OECD, 2019).

In addition, a combination of centralized and decentralized co-production of digital policy and strategy has been key to digital transformation of public administration in Denmark. At first, a centralization of co-production activities took place with the involvement of a few key authorities, agencies and ministries. Lately, many ministries (up to 13) and other types of organizations such as the Confederation of Danish Industry and NGOs got involved in the co-production of digital strategies and policies:

"What is called a digital government, the way you do that is through, iterative collaborative involvement and engagement of end user citizens, but also of partners and suppliers and internal staff, and other parts of government" (Interviewee 3, Director, Public Sector Organization).

While some actors such as the Ministry of Finance and the Ministry of Industry, Business, and Financial Affairs have continuously been involved in the co-production of digital policies and strategy since the beginning of the digitalization program at the end of the 1990's, a few actors have changed name over time but kept the same responsibilities or have merged with other actors. Thus, co-production evolved as a result of these multi-actor engagements. The Ministry of Finance has a central position in the co-production of digital strategies, since it is responsible for public sector digitalization in Denmark and has been historically in charge of the annual budget, the modernization program (including digitalization) of the public sector, and the yearly negotiations with the municipalities and regions.

Co-production is implemented through cross governmental committees, task forces and agencies that have the purpose of breaking down silos between the different government levels and public versus private

sectors. For example, when the digital agenda started to roll out in 2001, a digital taskforce comprised of a team of 25 young people from different ministries, local, and regional government, as well as the private sector organizations was put in place by the Minister of Finance to co-produce Danish digital policies and strategies. Additional members of the task force were high-level representatives, such as director generals from central ministries and representatives from Danish Region and Local Government Denmark (LGDK), representing the interests of their respective members. These committee members have great administrative, budgetary, and decision-making authority within their organizations and the ability to execute policies and advise politicians. The task force co-produced a cross-governmental, jointly agreed-upon strategy, with a shared decision-making forum. Such digital strategy envisioned co-sharing of experiences, financing and risk among different actors and governmental levels in the digital transformation of public administration and public services:

“Of course, there’s a lot of things that the municipality has to do on their own. But we co-share a lot of experiences and help each other as far as we can.” [... Let’s see if it’s good enough, you co-finance so you’re a part of the risk.] (Interviewee 2, Director, State Government).

In addition, substantial co-production has been taking place with the private sector actors including companies and banks:

“That has taught us that we have to ... cooperate with the private sectors, in another way than just having the solutions built by the private sector.” (Interviewee 2, Director, State Government).

This co-production across all levels of government (central, regional, and local) and with other types of actors (for example NGO's) has had a focus on benefit realization and has been important to ensure data exchange and a high degree of interoperability across different levels of government and authorities thus ensuring the overall digital transformation success. The funding scheme being complex as all authorities and government levels co-finance their own digitalization at a minimum as part of continuous business maintenance and development. The main idea is that the state government provides seed money that has to be supplemented by economic resources invested by all actors involved. The joint public efforts (e.g., joint solutions) get allocated separate funding.

Similarly, co-production of broadband goals and policies has been strictly linked to digital transformation of public administrations and supported and co-financed by a number of political initiatives at central, regional, and municipality government levels aiming at nation-wide broadband coverage.

The co-production of digital policies and strategies, thus, has been characterized by a high degree of centralization aimed at “evolving people” towards a digital mind set. The idea is that citizens might not by themselves be prone to think of or are interested in big changes in the way they interact with the public administration, but they may be interested in the co-production of public administration services:

“So, the question you have to put forward for the citizen is not necessarily, do you want to change, but, how can we make this a successful experience for you, how can we do the services that we direct towards you, make it more easy for you to be citizens.” (Interviewee #2a, Director, State Government).

While the co-production of the digital strategies and policies has involved mainly governmental and other types of stakeholders such as businesses and NGOs, the co-production of digital transformation of public administration has mostly focused on human-centered design perspectives taking citizens' and businesses' needs into consideration:

“The way that you study their needs, that you understand the daily life of the citizens, how can we then use technologies to provide services to them, so their lives get easier, digitalization of the public sector is that, it makes it

easier to be business or citizens in the country.” (Interviewee #2a, Director, State Government).

“The digital products need to be designed so that they are meaningful to them as well, that is meaningful to citizens.” (Interviewee #3, Director, Public Sector Organization).

For example, for digital public services to become mandatory and be launched at full scale they have to comply and pass a user test. Such tests include fulfilling 26 user requirements including user friendliness, accessibility and active involvement of the users in testing the services:

“We have for our mandatory services in our strategy pyramid, they have to comply (to) and pass a user test.” (Interviewee #5, Head of Section, Government Agency).

However, citizens can also be involved early in the co-production of the public services:

“We have invited a small group of users to a workshop, where they can give their feedback on the ideas that we are working with, or that is the common way of using users.” (Interviewee #6, Deputy Director General, Public Sector Organization).

4.3. Finding 2: Co-production of digital transformation of public administration: actors, activities and tools

The co-production of DBA's digital transformation has involved multiple actors from the public and private sector, including the Ministry of Finance, the other circa forty Danish authorities, the employees, businesses and business organizations as well as the end users of the digital services and the IT vendors in different co-production set-ups and activities. In addition, DBA is participating in the co-production of digital strategies and policies concerning public service delivery (strategizing). They do this by contributing to, among other activities, cross-governmental work groups responsible for the co-production of a joint vision of demands for public service delivery, thus establishing a link between digital strategy formulation and its implementation at public administration level.

In fact, these digital strategies have been the starting point for DBA's digital transformation which started with co-planning between DBA and the Ministry of Finance. Such co-planning also included co-financing according to the overall Danish co-production approach to digital transformation of public administration involving co-financing and risk sharing among different actors and levels of government (see, finding 1). For example, the idea of the CVR, the Danish state's master register of business information was first conceived by DBA, and then co-planned and co-financed by the Ministry of Finance. The CVR gives now the possibility to start a new company, change all the registered info about a company and close the company completely online.

Another example is provided by the co-production of the single point of contact “Virk.dk”. The idea of Virk.dk was conceived by DBA on the basis of the customer wishes to find all the information needed in one place. The idea was then presented to the finance minister, who decided to co-finance it and support its implementation by co-planning it. Virk.dk was initially a joint public-private partnership between DBA and a Danish digital front-runner “Krak.dk”. Krak.dk provided gratis online access to telephone numbers and driving directions. Initially, co-production of Virk.dk entailed its co-planning, co-design, co-management, co-delivery and co-assessment between DBA and Krak.dk. Later DBA decided to get out from such partnership and be the only provider of Virk.dk because the users showed more trust in a fully public digital service without private commercials, which instead was the case during the partnership with Krak.dk.

In the present version of Virk.dk, several actors participate in Virk.dk's co-design activities including IT vendors, DBA employees, and end

users. These actors get engaged with co-design tools such as user stories, user tests, personas, or customer journeys. Examples of activities in the co-delivery phase include the use of CVR system and Virk.dk by businesses or co-provision of services by other authorities on Virk.dk.

Finally, co-assessment takes place for example through activities such as the improvement forum, an internal online platform where DBA's customer service employees register customers' wishes and complaints and the coordination forum, where DBA discusses digitalization issues including the status quo of the portal "Virk.dk" and future possible changes with other actors, including the other authorities:

"Then we have a cooperation forum, where we sometimes.. right now it's... 4 times a year, we...discuss all kinds of matters that relate to public digitization." (Interviewee #10, Special Advisor, DBA).

Another example of co-assessment activity is the Business Forum for Better Regulation, a forum where businesses meet and discuss needs and provide important inputs for change to DBA. Based on this input, DBA is currently working on providing personalized services on "Virk.dk", where the users are presented only with the content that is relevant to them.

The analysis shows, therefore, that a variety of tools, activities and organizational set ups are used in the different phases of co-production of digital transformation of DBA. These vary from design tools such as user stories, personas, customer journeys and workshops in the co-design phase, to the use of tools for the transformation of paper forms into digital forms such the blanket engine in the co-delivery phase. Other tools include public-private partnerships and contracts with IT vendors and consultants in co-management phase or different types of forums (e. g., Cooperation forum, Business Forum for better regulation) and web surveys in the co-assessment phase. Human-centered design was essential in DBA's co-production of its digital transformation:

"So, it was very valuable for us to have them (citizens-businesses) involved during the way because, we could change things, and we could make it better for them. And we don't always know what they want. We think we do. And we do in some cases, but we don't know it all. So, it was very valuable for us to get their input along the way." (Interviewee #12, Office Manager, DBA).

The following Table 2 synthesizes the approaches, tools and activities across all co-production phases.

Our analysis shows that co-production of DBA's digital transformation was not problem free and a number of challenges emerged during the process. Examples include distribution of budgets among the different stakeholders in the co-planning phase, establishing collaboration in co-management and sometimes co-delivery phase, citizens' reluctance to invest time in co-design phase, quality of feedback in co-assessment and an overall resistance to change at organizational level (Table 2).

Table 2
Co-production phases in DBA's digital transformation and relative tools/activities.

Co-planning	Co-design	Co-management	Co-delivery	Co-assessment	Co-production Challenges
Strategizing and participation to work groups for national digital strategies (e.g., joint vision of demands for public service delivery); Co-financing; Business Forum for better regulation; Cooperation Forum	User stories; personas; workshops; customer journey; user tests; prototype tests	Public-Private Partnership (e.g., Krak. dk), Contracts (e.g., with 10 consultancies and 10 IT vendors)	Blanket Engine Use of Digital Services (e.g. CVR; Virk.dk)) Data input by users Co-Provision of services and data from authorities	Cooperation Forum; Business Forum for better regulation; The Danish Executive Board for Business Development and Growth; Improvement forum (indirect); Web site surveys	Co-financing, collaboration with and among different authorities, users' reluctance to invest time, feedback quality, internal organizational resistance.

4.4. Finding 3: Public value generation through co-production of digital transformation of public administration

The co-production of DBA's digital transformation has generated different types of public value (Table 3). First, it has generated economic value by decreasing government expenditures due to the cost reductions in human resources needed to accomplish the same tasks, increased efficiency, a cost-effective digitalization program, improved business contact with public administrations, enhanced use of digitalization and new business models in Denmark, as well as decreased expenses to both update the ICT systems and the information stored in them such as for example company's laws:

"For the government, the value will of course be that we don't use as much money ... we don't have many employees to do that as we used to." (Interviewee #12, Office Manager, DBA).

"Then the third (value) is to enhance and... make possible new business models and the use of technology in businesses...in Denmark" (Interviewee 7, Director, DBA).

DBA operationalizes and measures the economic value, for example, by the number of customer calls to the support center that has substantially decreased after the digital transformation, the reduced internal employee training time from an average of 5 to 0,5 months per employee, and 20% less human resources to do the same type of work. In

Table 3
Public Value of DBA's digital transformation.

Economic Value (Output of Public Administration)	Administrative Value (Procedural Perspective)	Societal/ Democratic Value (Societal Perspective)	Citizen Value (Individual Perspective)
Less government expenditure; less human resources; increased efficiency; cost effective digitalization; better contact with public administration; enhance the use of digitalization and new business models in Denmark; time saving for the authorities and businesses.	Possibility for digital transformation phase 2 based on Machine Learning; easier business compliance with rules and regulation; business self-sufficiency; common platform; personalized public service; single line of communication; better data coherence among different authorities; data sharing among different authorities.	Increase trust in the public sector; make life easier for businesses; happier customer; stronger companies control; using tax money in a better societal way.	One stop shop; better services due to quality standards; personalized service delivery; increase in number of services delivered; reduction of administrative burden; transparency.

addition, the economic value is also measured as time saving for the authorities and businesses, which in turn can be translated into money savings. One example is the time saving generated by the use of the form builder, a software for automatic digitalization of paper forms:

“Form builder. ...allowing them to save money on building digital forms. Different projects try to measure the value of this and that, for example, a report on the value created by using this form builder. Where they concluded that this saved the companies for 15 million Danish Crowns a year. At that point in time.” (Interviewee #10, Special Advisor, DBA).

The administrative value mainly reflected in the automation of the back end, is operationalized by DBA in terms of a more effective public administration that can translate into business self-sufficiency, one common platform or one-stop shop (Virksomheden.dk), data sharing among different authorities, personalized public service delivery, single line of communication with the different authorities and governmental bodies, better coherence between different authorities:

“The other (value) of course is that we also digitalize the back end. So, it's also a matter of making administration more effective. Automating our case handling and we've had quite some success with that as well.” (Interviewee 7, Director, DBA).

In addition, for DBA, an important administrative value generated by the digital transformation is the potential for next phase of digital transformation based on Machine Learning (ML).

The societal value, broadly understood as the public sector contribution to society, is operationalized as an increase in trust in the public sector and its productivity, making life easier for businesses, making the users happier, decreasing company fraud through increased control, and potential to increase societal wealth by using less citizen taxes on public administration tasks, thus potentially increasing the overall wealth of the society as the statement below shows:

“Easier, quicker, faster... Easier, quicker, faster. Easy to do business, then business can make more money, so we can tax more money, so we all become richer, but it is a political decision to redistribute the value or not.” (Interviewee #11, Head of Department, DBA).

Finally, the citizen value, which in this case relates to businesses, is operationalized in terms of reduction of administrative burden through one stop shop, better public service provision, increase in number of services provided, personalized overview as well as transparency:

“A single line of communication to the customers, that all the different government agencies and authorities can use. So, that's the main value I think.” (Interviewee 10, Special Advisor, DBA).

In fact, company registration time has decreased from 6 to 8 weeks prior to the DBA's digital transformation to about 3 min after the digital transformation if the company applying for registration does not have problems with tax authorities:

“For the companies, the value of course is that they get their CVR number very fast. They can make a registration very fast. They don't have to wait 6 to 8 weeks for us to do it for them, and they can just carry on doing what their business is supposed to do, and not wait for us.” (Interviewee 7, Office Manager, DBA).

5. Discussion and conclusions

We set out to understand how public administrations use co-production to digitally transform public service delivery and create public value in the process. To investigate this empirical puzzle, we reviewed the existing literature of co-production of digital public services and its potential outcomes in form of public value. We applied it in

the investigation of Denmark as an intrinsic case of a national government that was able to successfully create public value through its digital transformation efforts. This study, thus, aims to contribute to filling the gap highlighted by several authors on the need to disentangle how public value is created in the digital transformation of public administrations (e.g., Panagiotopoulos et al., 2019). In doing this, the study makes several theoretical and empirical contributions.

First, the study theoretically connects the fields of digital transformation, co-production and public value into one theoretical framework. To the best of our knowledge, this is one of the first studies in this area, as previous studies either focus at digital government level (e.g., Janowski, 2015; Juell-Skielse et al., 2017), at public administration level (e.g., Klievink & Janssen, 2009; Tangi et al., 2020), or on the use of digital technologies for co-production, especially crowdsourcing (e.g., Lember et al., 2019).

Our results show that co-production was key in the success of such digital transformation. In addition, our study shows that for Denmark to successfully develop and implement digital transformation of public administration, co-production was a key element in all the phases and levels of the digital transformation starting from strategy and policy formulation at governmental level to implementation at the decentralized public administration level. Our results show that through the co-production efforts, central, local, and regional governments as well as private sector actors and NGOs were involved in the formulation and implementation of digital strategies and policies in different multi-actor co-production activities and set ups. They vary from permanent to ad hoc task forces, committees and agencies.

Our study also shows that, in the case of Denmark, an important co-production instrument in the implementation of the digital transformation of public administration was co-financing. The funding scheme of the digital transformation of the Danish public administration, in fact, has been set up in such a way that the state government makes available seed money that need to be supplemented by economic resources contributed by all the parties involved. Thus, all public administration units at all levels of government are responsible for their own digitalization at least as part of continuous business maintenance and development. This study illustrates this point by showing that DBA's digital transformation was co-financed by both the ministry of finance and DBA at the initial planning and implementation stage through specific budget allocation, as well as in the continuous business maintenance and development stage through a permanent decrease of 20% of DBA work force. Another example is the co-production of broadband goals and policies aiming at nation-wide broadband coverage, the implementation of which has been co-financed by the central, regional, and municipality governments.

This study theoretically identifies different phases of co-production of digital transformation that go beyond the service delivery phase and empirically extracts a number of activities and tools characterizing these phases, thus theoretically and empirically contributing to understanding co-production in digital transformation of public administration in a holistic way. Most of the previous literature on co-production of digital services focuses, in fact, either on co-production as crowdsourcing activity (e.g., Koch et al., 2011) or citizen participation (e.g., de Jong et al., 2019) and in general looks at co-production as taking place at the end of the digital transformation process, when the citizens finally use the digital services (de Jong et al., 2019; Panagiotopoulos et al., 2019). The empirical insights obtained through the interviews with DBA experts show that each co-production phase is characterized by activities, tools and organizational set-ups where different stakeholders such as the government, citizens and businesses get involved using or applying different tools. The co-production activities vary and include: DBA's employee participation to workgroups for national digital strategies formulation to ensure a link between co-production of digital policies at strategizing level and their implementation at DBA level; organizational set-ups such as public-private partnerships and contracts in the co-management phase; user stories and customer journeys in the co-

design phase; co-provision of data to Virk.dk by other authorities in the co-delivery phase; and establishment of different types of fora in the co-assessment phase.

In addition, the study provides empirical insights about the challenges arising in the co-production of digital transformation of public administration. Such challenges have to be carefully handled in order to succeed. They vary from budget negotiations in the co-financing phase, to overcoming user reluctance when they are asked to invest time in user or prototype tests in the co-design phase, to difficulties in the co-provision of data and services from the different authorities in the co-delivery phase, to managing shared responsibilities in the co-management phase as well as feedback quality in the co-assessment phase.

Finally, one of our main contributions of our study is to theoretically identify four types of public value that digital transformation of public administrations may generate and empirically extract how they are operationalized in the Danish case of DBA. While the existing literature has done an immense service in identifying extensive inventories of different types of public values, we took the opportunity here to here provide empirical evidence of how public value is operationalized by public administrations. This is the case especially in the context of digital transformation as argued, for example, by Panagiotopoulos et al. (2019) and Sorrentino et al. (2018). The existing studies provide overviews of different types of public value (e.g. Jørgensen & Bozeman, 2007), develop taxonomies of public sector values in digital government initiatives (e.g. Bannister & Connolly, 2014) or take a normative stance (e.g., Twizeyimana & Andersson, 2019). The types of public value identified and empirically extracted and operationalized in our study vary depending on the beneficiary of the value. Such public value can range from personalized service delivery and minimization of administrative burden for businesses at the individual perspective to stronger companies control or making life easier for businesses at the societal perspective, provision of a common platform where businesses can access data from all authorities at the administrative perspective, to less government expenditures and time savings for authorities and businesses at the economic perspective.

In conclusion, we add to the existing literature (e.g., de Jong et al., 2019; Osborne, 2018; Panagiotopoulos et al., 2019; Sorrentino et al., 2018, Twizeyimana & Andersson, 2019) insights from a highly prominent and advanced case of digital transformation of public administration and open the black box of how co-production of digital transformation occurred and what the outcomes in terms of public value are. Others might seek to quantitatively verify our case analysis by evaluating through a large-n study the impressions of cross-agency and cross-level co-production we identified in the digital transformation of public administration in Denmark.

5.1. Practical recommendations

A number of practical recommendations can be derived from this study. First, our results show that co-production was a key element in all the phases and levels of the Danish digital transformation starting from strategy and policy formulation at governmental level to implementation at public administration level. An important recommendation derived from this result is that policy makers and public administrators engaged in digital transformation of public administrations need to consider applying a holistic approach to co-production at and across all levels of government and public administrations. In addition, policy makers might want to consider applying co-financing as an instrument to co-production as involving the different actors in co-financing might increase their motivation to share the risk and increase their commitment to the digital transformation.

Second, our study shows that co-production of digital transformation at public administration level goes beyond the service delivery phase or the co-design phase, but comprises also important phases such as co-planning, co-management and co-assessment. An important

recommendation deriving from this result is that public administrators need to apply a holistic approach to the co-production of digital transformation by involving different relevant stakeholders in all phases of the co-production. This study provides inspiration concerning the activities, organizational set-ups and tools that public administrators can use in doing so.

Third, our study provides empirical insights about the different challenges arising in the co-production of digital transformation of public administration. An important recommendation derived from this is that those public administrators starting the digital transformation journey need to be aware that digital transformation is not problem free, but there are several challenges (e.g., financial, organizational or technical) that need to be addressed properly for the digital transformation to succeed.

Finally, this study provides empirical insights about how public value of digital transformation of public administration is operationalized by Danish policy makers and public administrators. These insights may be useful for policy makers and practitioners in other countries in implementing digital transformation as they provide guidance on how public value is empirically created.

5.2. Limitations and future research

Our study has provided unique empirical insights about how a national government was able to successfully create public value through the digital transformation of public administration. Our study is however not without limitations. First, as a single case study, our results are context-bound and therefore subject to limited generalizability (Yin, 2003). Nevertheless, we claim that other national governments and public administrations may gain useful insights from our study about how to go about the digital transformation of public administration and learn from the Danish case example. In addition, it could be interesting to test the transferability of our results to settings and nations with similar socio-economic and political structure as Denmark and as well positioned among the top countries according to different indices such as the DESI index (Yin, 2003).

Second, we conducted a relatively small number of interviews. However, we feel confident that the key role of the interviewees in the Danish digital transformation scene has provided us with a unique and rich data set to understand the phenomenon under consideration. In addition, the use of secondary material such digitalization strategies has supplemented the expert interviews in a meaningful way (Lewis-Beck et al., 2004), thus contributing to gain an understanding of the phenomenon under investigation from different perspectives.

With this work, we laid the basis for future research to extract phases and related activities, organizational set-ups and tools of co-production and public value operationalizations. Other researchers might want to empirically test the prevalence in other types of digital transformation of public administration cases. Finally, future research could extract additional practical, applied set of activities that constitute a handbook for co-production of value in public organizations.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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