Article

The Role "Chief Digital Officer (CDO)" in Public Municipalities—The Conceptual Effect of a Functional Profile for Successful Transformation

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Abstract: The objectives of this study are to demonstrate the effect of a function called 'Chief Digital Office' as a responsible positioning of digitization at the C-level. This is intended to show both the importance of digitization measures and the effect of change projects with a methodical approach in cross-sectional tasks for strategic work. The previous work shows different functional layouts and individual responsibilities without conceptual foundations in the implementation of digital strategies. To provide the first contribution to a common framework for the work of CDOs, a basic concept for public administration based on the municipalities is to be launched. The results lead to statements about the optimization potentials of the status of the study survey of the digitization of German municipalities: "Digital Vorangehen [Leading the way digitally] (2020)". In particular, this includes the development of a holistic digital agenda, the use of future technologies and the mindset for the development of innovative implementation solutions in both internal service provision and outward-looking services. The value lies in contributing to the establishment of the framework of 'Public Digital Transformation Governance' to transfer the fundamental standardization of the action strands into a functional profile.

Keywords: CDO; governance; transformation; digital trends; framework; function

1. Introduction

Various target effects are associated with digitization. Depending on the perspective, these range between efficiency and performance increases and better service provision and more transparency, participation, and cooperation (see [1]). Accordingly, the question of expectations and the context of responsibilities for the position of Chief Digital Officer (CDO) in public institutions is important. There is no unified role, in contrast to the activities of the head of the ICT department, the data protection officers, the head of the main office or the organizational department. Organizational locations also range between the character of a staff unit and the head of the office or the head of a department or division. In this respect, the subordination conditions typically also vary across municipalities.

Many academic papers focus their perspective on an industry-independent view of the CDO role. A promising aspect in the field of social role development comes from Reck and Fliaster [2] around the different types of interpretations of CDO characters: networker and catalyzer, insider expert, innovation evangelist and lone icebreaker.

Additionally, the role is significantly less researched than the topic "digital transformation" or "Digital disruption". Typical contributions in the action-oriented context at the organizational level deal, on one hand, with the methodological tools of management (see for example the elaboration of Nell et al. (2021) [3]) and, on the other hand, emphasis is placed on the support of digital systems (see, e.g., Westerman et al. (2014) [4]).

The research publications deal with e-government, open government and digital administration most strongly in German publications. More than 850 publications deal with these topics. It is therefore necessary to consider the distinction from the private sector. Typical topics of business informatics, such as product innovations, digital branding,

Enterprise 4.0 or market analyses, to identify the challenges posed by (new) competitors are thus not relevant or are only highly adaptive or even alienating in regard to the public contract as a sovereign authority. Therefore, the study is intended to confirm the hypothesis that CDOs should be sufficient to target public values. Most of the e-government research focuses on the citizen-centered public value approach, which is why it focuses primarily on the impact of e-government on citizens, and thus on external effects. Following Porter in 1985 [5], Figure 1 is intended to visually represent the elements of the interaction with the public value chain in relation to the digital public transformation, without explaining them in more detail in the individual components, since the holistic nature of the dependencies would be too complex for this elaboration.
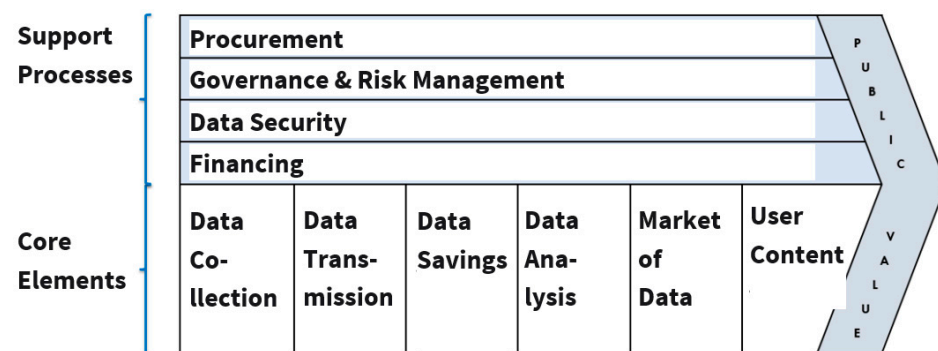

Figure 1. Public Value Chain.

Empirical evidence is currently completely lacking in relation to German administrations, which is due to the novelty of the role. Due to the political-administrative system, the focus should therefore be deliberately placed on the example of Germany. It is therefore necessary to switch to questions of digital administrative modernization, which have a broad basis in academic work. In addition, elaborations on the change in organizations in the context of digital transformation help to obtain reference points for the methodological competencies of CDOs in municipalities. As this article refers to German administrations in the context, an exemplary framework of the areas of responsibility, as a non-exhaustive list, can be illustrated as a starting point, from the author's own role as CDO of a municipality:

- E-Government
- Ict-Strategy and Operations
- Digital Urban Development (GIS, Digital Twin)
- Open Government
- Digital Business Model Development (Investments)
- Smart City/Smart Region
- Digital Incubators
- Co-Creation and Innovation Labs
- Research and Development Projects
- Funding Management
- District Development
- Citizen Surveys and Service Level Surveys

In this context, the study also aims to develop the first framework for action for CDOs in public local authorities based on the publications of the future challenges of digitization to further define the role of the CDO based on its activities and design fields.

In this respect, it is worthwhile to conceptually approach the task area of administrative digitization, which has so far been declared as e-government since the administrative reform that took place in the early 2000s. Empirical e-government research addresses various key aspects of descriptive research (e.g., [6]), IT tools (e.g., [7]), or methodological success criteria (e.g., [8]).

The systematic classification of results and impacts via KPIs or OKRs is usually omitted to develop the basis of a benchmark ecosystem. This means that most models remain predominantly normatively constructed if a holistic understanding of e-government is to be explained. From this bias, it can be implicitly concluded that the fully transactional systems with increased interaction with citizens represent a better service (e.g., [9]).

Increasingly, models of e-government follow the logic of digital transformation, which justify phase elements of the information, interaction and transaction of successful establishment projects of digitization. However, a uniform definition cannot currently be derived, and the value references in the literature are correspondingly diverse. Lindner and Leyh define digital transformation "as the exponential and permanent change of society and companies based on technology" [10].

The change is based on transparent information and targets group-specific communication, whereby a continuous process of the digital modification of the existing instruments takes place. An essential task for the position of the CDO is also to transform this into new organizational models. Practice usually defines, without a defined regulatory framework, the period beginning when the goal achievement of the desirable values within the process of self-determined transformation is fulfilled, which is problematic and not very meaningful. Bannister and Connolly (2014, p. 128) provide the continuous element from transformation to radical change, which calls for the so-called "Great Transformation" in several areas of life (see [11]).

In addition, a CDO must operationally interpret digitization in application scenarios of IT tools in analog processing processes, which is also a feature of an institutional change towards innovation (see [12]). As a further task, in addition to organizational and procedural changes, it can also be declared to establish a profound cultural change in the authorities, in the focus areas of personnel and qualification development, as well as the service provision of public services. In this respect, from a conceptual point of view, digital transformation may predominantly comprise a socio-technical component of change, and only subordinate technical questions. Empirical research to date is therefore faced with the challenge of defining a clear demarcation between digitization strategies and digital transformation in terms of the degree of organizational change.

However, practice also needs questions to shape the technological trends into data governance. In particular, the movement around the realization of the concept "Internet of Everything (IoE)" [13] represents a particular challenge. In contrast to the "Internet of Things (IoT)", which is essentially based on a "Machine to Machine (M2M)" operation, additional people, processes, and data are integrated into the interaction. Accordingly, the four elements within the logic can be distinguished, which, in interaction with the indicators, result in the maximum added value:

1. Humans: connection between teams for creating value.
2. Processes: lifecycle-orientated evaluation of all phases of creating services.
3. Data: usage for decision-making with, e.g., bots or smart contracting.
4. Things: physical-digital utilities for IoT services with sensors or robotic applications.

A mix of devices, such as wearables, and technologies, such as machine learning, and further complex scenarios of everyday life are automated from various sources. To explore the psychological effects resulting from IoT use, see the study by Vahdat-Nejad et al. (2022) [14]. However, the basic prerequisites for infrastructure renewal offer opportunities, but also new challenges, for the design of applications and their user experiences, as Alam (2021) [15] shows. In addition, a functioning management system for the implementation of IoT networks with the design of use cases for new possibilities of using smart devices is necessary. Nemesanu and Paznzaru (2017) [16] formulate the first steps in this direction.

2. Materials and Methods

Due to the explorative character of the determination of the fields of application and the location of the action added values of CDOs, a systematic literature search on the effects of digitization in public administration in the Web of Science is used. Due to the local

specialized aspects in German municipalities, studies in German were in focus and some general methodical articles in English were used also.

The research was set with a time parameter between 2019 to October 2022 because the COVID-19 pandemic is assumed to be an engine for administrative digitization and, accordingly, for the importance of the role of the CDO. The search itself was conducted in October 2022. A review protocol was used for reducing bias in the data management, as you can see in the PRISMA Flow Diagram (Figure 2) [17].
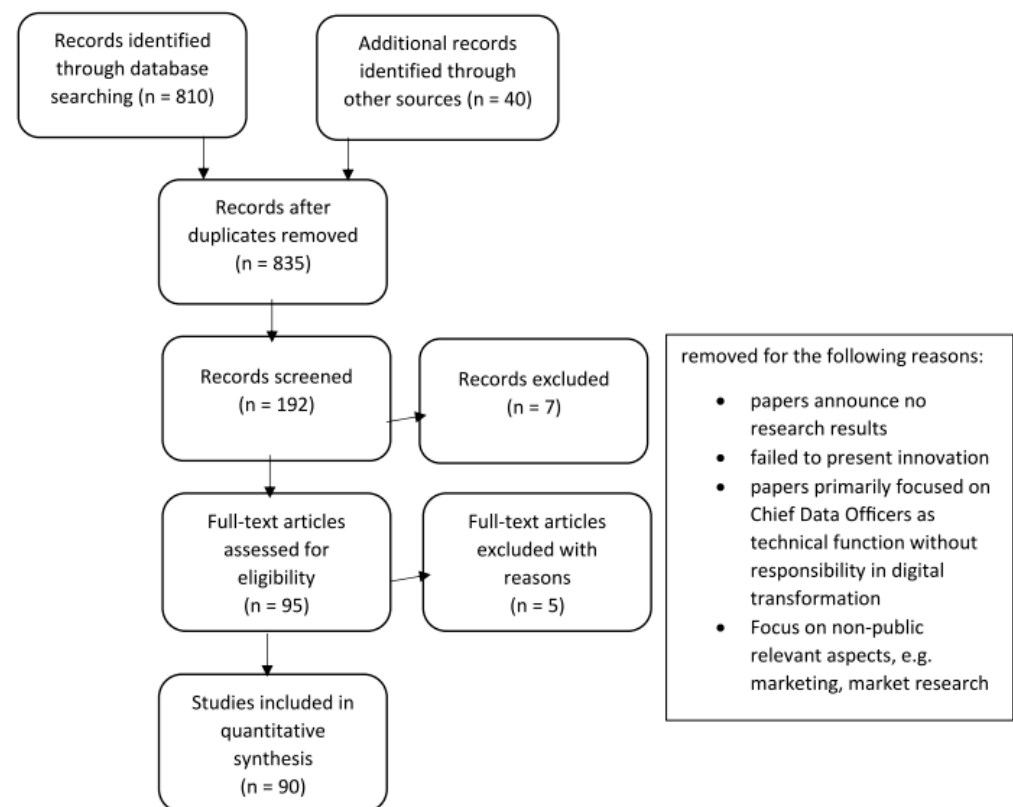

Figure 2. PRISMA Flow Diagram.

The purpose of the study is to make clear the importance of the review process on the role of public CDOs in contrast to private companies and the different working context near political governance. The current gap in the literature is about the competencies and instruments the role should have to.

The objectives are concerned with the outcomes of the publications that the review focuses. Structural elements of the search should be relevant indices for the interdisciplinary field of digital government research from the social science- or management-based perspective of information systems. For this purpose, the following inductive indices were selected: SSCI, SCI-Expanded, CPCI-S and CPCI-SSH.

The combined search criteria represent: (a) the impact and effect dimension; (b) the digital government dimension; and (c) empiricism regarding data governance. The latter was chosen to focus on empirical results rather than theoretical implications. The search results were divided into categories of research disciplines located in the field of public administration, political science, computer science and management. The 850 hits obtained from this search were further filtered in relation to publications dealing with the effects or effects of digital administration measures. The final keywords of the study were determined in a further step, due to the intention of using only peer-reviewed scientific papers.

The most important findings for answers to the above-mentioned research questions were articles that included descriptive methodologies. Taking into account the most

important literature sources, the following list (see Table 1) was created, from which added value can also be derived.

Table 1. List of papers with special relation to the research questions.

No.	Year	Authors	Publications	Content
1 [18]	2022	Raković, L.; Marić, S.; Đorđević Milutinović, L.; Sakal, M.; Antić, S.	Journal Paper	• Role • Literature Sources • General Status • Sustainability Procedures
2 [19]	2018	Tumbas, S.; Berente, N.; vom Brocke, J.	Journal Paper	• Digital Tools • Innovation Management • Entrepreneurship • Perspectives on creating outcome
3 [20]	2020	Buchwald, A.; Lorenz, F.	Journal Paper	• Responsibility • Digital Mindset • Organizational status • Success factors
4 [21]	2020	Kunisch, S.; Menz, M.; Langan, R.	Journal Paper	• Governance • Characteristics • Goals • Input Factors
5 [22]	2020	Berman, S.; Baird, C.H.; Eagan, K.; Marshall, A.	Journal Paper	• Succes factors • Requirements • Success Stories • Examples of Outcome
6 [23]	2020	Singh, A.; Klarner, P.; Hess, T.	Journal Paper	• Internal Positioning • Activities • Ratings • Transformation and Frameworks
7 [24]	2021	Firk, S.; Hanelt, A.; Oehmichen, J.; Wolff, A.	Journal Paper	• Level of Presence • Marketing and internal Status • Centralization of Digital Service • Roles in Transformation

To substantiate the type of outcome and to determine the possible outcomes, a quantitative survey was included in the academic research as a plurality of methods. One of the most quantitative records that was considered was a study on the state of the digitization of German municipalities in general. The study, "Digital Ahead" by Lemmer and Niehaves, from 2020, also contains evidence about the challenges, derivable paths and best practice examples, published by the "Competence Center Public IT (ÖFIT)" and the "Kommunale Gemeinschaftsstelle für Verwaltungsmanagement (KGSt)" [25].

As part of Lemmer and Niehaves' quantitatively fully standardized study, 1828 municipalities in Germany were surveyed as a full survey through an online questionnaire regarding their strategic positioning in the digitization of their local government. The target of the study was the positioning of digitization by fulfilling the mission of services of general interest (e.g., health, education and local supply) through digitally supported tools.

The inspection period was between December 2018 and February 2019, with a response rate of 23%, i.e., 412 municipalities in Germany via online survey. The corresponding population were people with management functions in digitization in the municipalities. The research questions were the status of German municipalities in the field of digitization and the challenges. In addition, the survey asked about the best practice criteria and how the implementation process was designed.

On this basis, the first success factors were to be identified, which, in addition to e-government strategies, were also formed in the field of the formation of digital compe-

tences on an indicator-based basis, as well as the identification of municipalities as service providers for the further development of digital tools, which are accepted by users. The response rate of 23% of the institutions surveyed, or 412 municipalities, in the period between December 2018 and February 2019 was answered by managers in the context of digitization, but also by line managers such as department heads, department heads or office managers. Most of the data sets generated were distributed among the federal states of Saxony (28%), North Rhine-Westphalia (27%) and Schleswig-Holstein (26%).

The conclusion of the mix of methods from the exploitation of primary and secondary data processing is a model of Public Digital Transformation Governance, which was derived by means of qualitative content analysis. The clustering is based on an intensity evaluation of the challenges already addressed in the public sector, as well as the relevant challenges of the future in an unsolved state, derived from the study results. This representativeness reduces the potential risks or toxicities of one-sided interpretation and shows the benefits of the special role of CDOs' fields of action in German municipalities.

In a proportionality classification, the fields of action regarding the profiling of a CDO in the size class of the European NUTS level 3 (local authorities with up to 180,000 inhabitants) relevant for municipalities were predetermined.

3. Results

The primary survey of the systematic literature search results in the following findings. While the distribution of quantitative and qualitative articles in the sample is relatively mixed (47 quantitative, 39 qualitative, 4 mixed methods), 40% of the quantitative papers ($n = 19$), but only 18% of the qualitative works ($n = 7$) and none of the works with mixed methods, are cited to a relevant extent.

The data suggest that further research is needed on the role of a CDO, which was the motivation for writing this paper. Through a systematic literature review, this paper aims to explore the views regarding the role and tasks of a CDO, as well as the competencies necessary to accomplish these tasks. It was also striking that the research focus has an influence on the citation rates about the type of digitization: articles on service provision are cited most frequently (51), followed by open government (36) and internal processes (24). In this procedure, a publication bias can be determined about zero findings in the field of research, which is why, methodologically, the distribution found between the effects and non-effects, and intended and unintended effects, cannot claim representativeness. If value-based motives are sorted according to the type of digitization (service delivery, 89%; Open Government, 55%; internal, 29%), a pattern can be identified: utilitarian-instrumental values dominate the effects and effects of service-oriented and internal digitization projects, while open government projects are mainly characterized by political-social values. Hedonistic-aesthetic values are primarily associated with service delivery, while moral-ethical values can be found both in service delivery and in open government projects. However, these are significantly less represented in internal digitization projects.

Analysis of the literature on the impact of digitalization in public administration over the past decade has shown that the playing field is exponentially small. Only a few studies deal with the effects of digitization in public administration. The publications focus less on employees as agents of transformation and creators of CDOs. The performance of the public administration, and thus the public value, could be significantly increased if the internally used information systems were aimed at usability, interoperability, and adaptability by specialist users. In particular, the use of algorithm-based assistance systems to optimize the entire value chain of public service provision should be examined holistically. This research gap needs to be closed in future research.

As conclusions from the study results on the literature sources and including the detailed evaluation of the full survey on the status of digitization efforts of German municipalities, the following model of Public Digital Transformation Governance (Figure 3) can be derived as a framework for action for CDOs in municipalities:
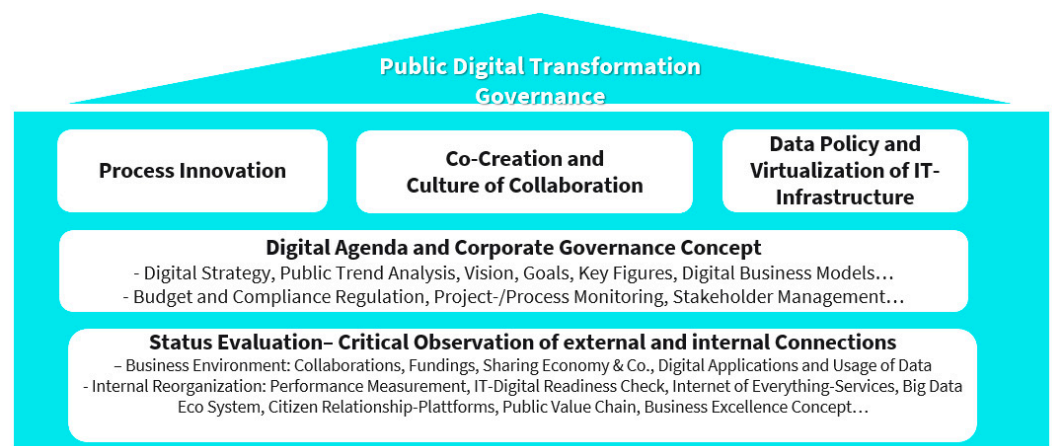
Figure 3. Public Digital Transformation Governance Chain.

The value level that exists in a transformation strategy under public law is characterized by three focus areas:

(1) The process innovation must take place within the framework of the legal enabling principles, but includes the legislative process, the application of the law and the organizational sovereignty of public institutions.

(2) Co-creation as a basic understanding of an "out of the box culture" for testing established routines for further optimization potentials with systematic self-evaluation concerns the attitude of different levels of decision-makers. Collaboration with other actors as the first review of new projects as a spirit of strength in unity is also a fundamental value.

(3) The development of a data understanding, a value and an ethics strategy, as well as a data-based business model, are new topics for municipal corporations. The infrastructure component provides the starting point for the combination of the relevant data sets for the added value of overview, automation, or error reduction.

The strategic level is characterized by a networked digital agenda and the control regulators for impact-oriented projects:

(1) Future orientation: Agenda setting with trend analysis, work packages, target achievement measurement and business model development.

(2) Status assessment: Budget planning for innovation, compliance regulation, monitoring and benchmarking in competition between similar institutions.

The operational level can be transformed into a bipolarity of network building activities and the reorganization of internal structures as To-Dos:

(1) Analysis of the collaboration possibilities of comparable institutions and a strengths-weaknesses chart, innovation partnerships with commercial enterprises and data sharing models.

(2) Internal reengineering with performance measurement, digital readiness check or big data value chain concepts.

The challenge analysis showed a ratio of more than 50% of tasks for CDOs in planning a digital agenda and interface management. On a second requirement level, more than one-third of the tasks mentioned are the development of digital business models or data governance/data literacy, hybrid project management for digitization projects and the monitoring of data-driven measures.

Finally, the development of an abstract requirement profile for CDOs of municipalities can be divided into areas of competence. This includes a conceptual proposal according to the following structure:

Soft skills: decisive, with 54% of the requirement cluster including communication skills, followed by competencies in assertiveness and persuasiveness in understanding leadership (both 43%).

Hard skills: CDOs should have a decisive command of methods for the further development of the digital mindset (57%), strategic aspects and interculturality (46% each).

4. Limitations and Future Research

This literature-based study has limitations in just choosing the most comprehensive citation databases. Additionally, because of the topic focus on German municipalities, international best-practice solutions are not part of the observation. However, in focusing German language papers with some international papers. 10% of the total amount were in English. The limited number of empirical and theoretical papers published only on the topic of Chief Digital Officer could also be seen as a limitation. The bridge from a qualitative conclusion supported by a full survey of quantitative analysis is also awakening of representativeness. The content-related connection between publications with a focus on the implementation of a digital transformation process, with assumed correlation to the CDO position, also further leads to testing the analyses. This was deliberately put into relation by the intended derivation of a framework via Public Digital Transformation Governance.

Future research should deal with the organizational location of the tasks and responsibilities of CDOs, as well as academic and professional study programs as Master's or additional academic programs. Furthermore, the recruitment process of the CDO's position, as well as the sharing models and delegation to others in the organization, would deal with digital initiatives. Therefore, research is necessary for generating theoretical insights to centralized and decentralized strategies of digital transformation. Empirical validation by using interviews with executives who are responsible for innovation and digital technologies in organizations would also be a foundational element.

5. Discussion

The research in the literature could not prove a possible contrast of practitioner's interpretations of their role with the established CIO role models. In addition, the grade of digital technologies and institutional entrepreneurship in organizations will show a huge variety.

Regarding the classification and interpretation of the results, it can be said that digital transformation must not be an end. At the same time, the solution of all internal problems must not be built up as an expectation, neither within public organizations nor at the social level. However, the potential for change and the scope of the effects of digitization have not yet been researched in great depth. Overall, the analysis reveals significant research gaps regarding the impact of digitization in public administration. For example, concrete target indicators often cannot be identified, and the effects are difficult to compare, which in turn makes it difficult to predict the effects.

On the other hand, unintended side effects and the possible resulting tensions in change projects must generally be moderated and accompanied. On this basis, an approach to the optimal degree of the digitization of individual public organizations can be made, which is to be expected as a further challenge in the operational responsibilities of CDOs. These optimal influence possibilities on digitization levels and maturity models should lead to further research projects for the public sector. However, it must already be signaled that not every organization and every process has to be digitized, but priorities must be set according to the effectiveness criteria.

6. Conclusions

In the present study, various definitions of the elements in the role "CDO in municipalities" were shown. CDOs must analyze and coordinate the impact of municipal action in relation to the various aspects of coordination, employee qualification, citizen service, organizational culture and specific internal processes and services, such as accounting,

participation and data use. They go beyond the mere analysis of the introduction of tools or the collection of acceptance by various stakeholders. This also seems to be a problem today due to the collection of publications in the research field of public management, as descriptive research is the focus of digitization studies in administration. According to a holistic perspective, the effects of data-based measures should be demanded, especially regarding the affected public values of the transformation idea.

The findings show that is necessary to find conceptual objectives and theoretical framing focused on the centralization perspective about why municipalities choose a CDO. As there is no valid model, a theoretical framework focused on responsibilities and future tasks associated with the CDO role was created out of the selected publications. This paper attempts to identify this gap by pointing out several strands of action for further investigation, the moderating role and CDOs' effectiveness, and deriving a requirement profile for municipal CDOs as a preliminary finding. This procedure is certainly not complete and certainly still offers downsides at the current state. Future research may complement this work by selecting a stronger emphasis on the potential disadvantages of the presence of a CDO.

In order to achieve a complete location of the profile of CDOs, it seems helpful to discuss a reference to digitization in German municipalities, on which theoretical basis guidelines for CDOs in public administration are based. In this work, the public values theory was used as such a basis as an alternative means to locate the objectives. In the profiling of CDOs and their field of action, however, it also became clear that the analysis of the medium- and long-term effects, and the intended and unintended effects, on an individual, organizational and social level requires further foundation. The management of a variety of approaches and methods of impact research will be an important aspect related to the study of CDO profiles.

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