INFORMATION IS A KEY: SYSTEMATIC LITERATURE REVIEW AND EMPIRICAL RESULTS ON ROLE CONFIGURATIONS OF CHIEF INFORMATION OFFICERS AND CHIEF DIGITAL OFFICERS

Patrick Ulrich [*], Sonja Lehmann [**]

[*] *Corresponding author*, Aalen University, Aalen, Germany; University of Bamberg, Bamberg, Germany
Contact details: Aalen University, Beethovenstraße 1, 73430 Aalen, Germany
[**] Independent researcher and former Research Assistant at Aalen University, Aalen, Germany

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Abstract

In the context of the digitization of companies, the executive positions of chief information officer (CIO) and chief digital officer (CDO) are becoming more important. Based on a systematic literature analysis and an empirical survey among German companies, this article shows that there are clear overlaps and role conflicts between CIOs (Hunter, 2010) and CDOs (Kunisch et al., 2020) in company practice. However, the CDO in particular has some areas of responsibility, such as communicating the need for digitization in companies, which are not attributed to the CIO. These might therefore be seen as new tasks. In contrast, topics such as information technology (IT) costs and efficiency as well as strategy orientation, but also cybersecurity and IT governance are more likely to be seen as the responsibility of the CIO. Judging by the results of the literature analysis and the empirical study, it might be feasible to maintain both positions in the future.

Keywords: Board Dynamics, CIO, CDO, Systematic Literature Analysis, Empirical Study

Authors' individual contribution: Conceptualization — P.U. and S.L.; Methodology — P.U. and S.L.; Formal Analysis — S.L.; Writing — Original Draft — P.U. and S.L.; Writing — Review & Editing — P.U.; Visualization — S.L.; Supervision — S.L.

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1. INTRODUCTION

Digitization, one of the most controversially discussed topics of the present time, presents companies with both opportunities and challenges (Legner et al., 2017). Even though digitization already gained importance in the 1980s when information started to be stored in a digital instead of an analogue format (Koller, 2018), the pressure for companies to become more digital has increased considerably during the last years because of major advances in technology (Giones & Brem, 2017). Yet, many companies face the challenge of how to adequately deal with the digital world and successfully transform their business (Kraus et al., 2022), well knowing that the transition (Matt et al., 2015) requires significant resources (Li et al., 2018) and investment (Nwankpa & Merhout, 2020). Increasingly, they begin to adapt management structures to support and provide leadership in the context of digital transformation (Benitez et al., 2022).

Due to the growing dependence of business on information technology (IT), the IT function (Ding et al., 2014) and the role of the chief information officer (CIO) (Nissen et al., 2017; Toole, 2009) have

changed significantly over the last years (Kratzer et al., 2022; Peppard et al., 2011). Originally being seen as a technician who is in charge of data processing (Thatcher et al., 2011; Chun & Mooney, 2009), the CIO (Kettinger et al., 2011) took on responsibility as technical manager and eventually as business visionary, innovator and strategist, driving both change and strategic initiatives (Kratzer et al., 2022). A considerable number of information system researchers have empirically examined CIO roles (Gerth & Peppard, 2016; Waheed, 2022), which resulted in a multitude of different role typologies and a rather ambiguous image of the CIO (Chawla et al., 2022; Kratzer et al., in press).

Increasing the complexity to an even higher level, companies do not only adjust existing management positions in the course of digitization but also create new ones, such as the position of the so called chief digital officer (CDO) (Singh et al., 2020). The CDO is usually responsible for implementing the digital strategy (Becker & Schmid, 2019, 2020), executing the organization´s digital transformation and creating new digital capabilities (Singh & Hess, 2017).

Having similarities with the CIO, such as technical competence, business knowledge and leadership skills (Tumbas et al., 2018, 2020), there is great controversy among researchers and practitioners about whether the position of the CDO is indeed necessary (Tumbas et al., 2020). While some of them claim that the functions of CIOs and CDOs are distinct and complement each other (Horlacher & Hess, 2016), others argue that CIOs are most qualified to manage digital initiatives and that therefore there is no need to introduce the CDO position (Culasso et al., 2023; Singh et al., 2017). The diverse views on CIO and CDO roles lead to the question of whether both managerial positions can coexist, as overlapping responsibilities could lead to struggles for power (Heinrich & Leonhard, 2020).

Until now, there are very few academic works that have researched both the roles of CIOs and CDOs within the context of digital transformation in a profound manner (Ulrich & Lehmann, 2018; Walchshofer & Riedl, 2017), as most studies concentrate on either the CDO or the CIO and cover the respective other position only to a marginal extent (Haffke et al., 2016). In general, as the CDO is a relatively new management position (Firk et al., 2021; Hermes & Riedl, 2022), scientific publications in this field are scarce. Although research on the CIO function is far more progressed, its role in digital transformation has rarely been the subject of in-depth investigations (Haffke et al., 2016).

Therefore, the focus of this paper lies on the following research question:

RQ: What are the roles of CIOs and CDOs in the digital transformation of enterprises and do they differ?

In order to find answers to this question, we conducted systematic literature reviews (SLR) on both CIO and CDO roles and, building on the literature findings, an online survey among CIOs and CDOs to compare and contrast the results.

The research question is relevant to both theory and practice: For the theory, it will be worked out which areas of responsibility and role (conflicts) exist between CIO and CDO. In practice, these findings can help companies to design their organizational structures in the information sector.

The study argues that the designations of CIO and CDO are not chosen arbitrarily by companies. On the one hand, companies associate the positions with different areas of responsibility and requirements in some cases. Secondly, from an empirical perspective, the personnel profiles (age, career) and competencies of the respective CIOs and CDOs also differ. CIOs are usually older and have an IT background, while many CDOs are younger and have a background in strategy or business administration.

The structure of this paper is as follows. Section 2 reviews the relevant literature. Section 3 analyses the methodology of the systematic literature review and the online survey. Section 4 depicts the results of those two empirical sub-studies. Section 5 contains a discussion and Section 6 presents a short conclusion.

2. LITERATURE REVIEW

Role theory serves as a theoretical basis for our research. The origins of the term "role" can be traced back to Linton's work "*The Study of Man: An Introduction*" (1936). According to Linton (1936), the term stands for "[…] the dynamic aspect of status" (p. 212), whereby the individual's status is comprised of duties and rights. Carrying these out, the individual performs a role.

In social science, the notion of "role" is typically defined as a bundle of normative expectations, which are placed upon the holder of a position (Rössel et al., 2010). This means that individuals expect certain behaviors of the holder of a role, to which the respective person should adhere (Merton, 1957). However, a role may not only be ascribed to an individual but may also be achieved due to specific personal abilities, skills and performance (Linton, 1936). Consequently, each person performs various, distinct roles, which may change over time (Merton, 1957).

In literature, there are different approaches to conceptualize roles, which are reflected in various perspectives of role theory. The emphasis of our work lies on functional and organizational role theory. Functional role theory associates roles with specific functions to be fulfilled (Biddle, 1986). Performing a particular role, responsibilities and tasks to be carried out are assigned to the holder of the role (Wickham & Parker, 2007).

Conceptualizing roles as the reflection of organizational norms of behavior and culture, organizational role theory connects work-roles with the achievement of the organization´s objectives (Welbourne et al., 1998). The organization can be seen as a system that is comprised of complementary roles. Whether the organization operates in an efficient manner depends on how explicitly tasks are assigned to distinct roles and on how motivated and capable the holders of roles are to perform their designated roles. Hence, employee performance is a function of both, the organization and the individual (Weill & Woerner, 2013).

Thus, we understand role performance as carrying out the expected tasks, objectives and responsibilities (Rieg et al., 2022).

Also relevant to our analysis is the construct of role conflict following Katz and Kahn (1966). Here,

very different intrapersonal and interpersonal conflicts can arise in the context of information processing and the performance of tasks by different task managers in practice (Wolf et al., 2020).

In addition, our analysis is based on the theoretical view of digital transformation. Here we distinguish between digitization in the narrower sense and digitization in the broader sense. We will continue to pursue the latter under the umbrella term digital transformation.

The terms "digitization" and "digital transformation" are often used interchangeably. However, they can be distinguished from one another. Digitization has several meanings. First, it refers to the transition from storing information in a digital format instead of an analog one. Second, it is related to the exponentially growing technological progress in terms of the power of computers and digital storage media. Third, it describes the IT-based automation of tasks that were previously performed by humans. In this sense, technological and economic aspects are combined (Ritter & Pedersen, 2020).

Digital transformation refers to the change triggered by digitization (Becker, 2019). From a business perspective, it can be understood as the use of technology to radically improve the performance or reach of companies (Terras, 2011). In this context, it often refers to the transformation of business models (Rachinger et al., 2019). Although the term is not yet uniformly defined, it emphasizes the transformative nature of technology for businesses.

Digital transformation involves connecting machines, IT systems, people, and processes (Schallmo et al., 2017). As a result, physical distances are becoming increasingly irrelevant, and new digital ecosystems are emerging that link different value chains (Weill & Woerner, 2015). Modern technologies enable companies to collect and analyze large volumes of data (Storey & Song, 2017).

This is where the traditional position of the CIO and the new position of the CDO come into conflict. It will be interesting to see who takes on which areas of responsibility in the context of digital transformation (Berbel-Vera et al., 2022), whether one position replaces the other, and whether there will be complementarities or even role conflicts.

In general, IT can be understood as the study or use of systems (especially computers and telecommunications) for storing, retrieving and sending information. The term information system (IS) can be defined as a computer-based application system, i.e., a software system determined for the execution of operational tasks (Wood-Harper et al., 1985). Such a system encompasses machines and humans who are linked to each other as they create, use and exchange information. In recent years, along with the increasing importance of information as a valuable resource, IT developed from being a background support function, which enables automation of previously manual tasks, to a strategic business function, which provides innovation and competitive advantages.

Bimodal IT (Horlach et al., 2016) means an IT that runs on two different speeds. Therefore, it is also referred to as two-speed IT. The two speeds are called mode 1 and mode 2. While mode 1 ensures the smooth operation of the existing system at "traditional" speed, mode 2 operates nonlinear in multiple iterations. Running parallel, mode 1 represents accuracy and reliability, whereas mode 2 aims at providing flexibility and agility. This way, the elements that are needed to guarantee the integrity of back-end transactions are separated from those that are needed to adapt the customer experience in a fast manner.

We assume that CIOs and CDOs follow different development paths in the area of tension between IT, information systems and digital transformation. To analyze this, several SLRs and an empirical study were conducted.

3. RESEARCH METHODOLOGY

3.1. Systematic literature review

In order to review the existing literature on CIO and CDO roles and to receive a reliable and holistic picture of the current state of research (Bramer et al., 2017; Fisch & Block, 2018; Kraus et al., 2020; Paul & Criado, 2020; Thomé et al., 2016; Tranfield et al., 2003), we conducted four SLRs. Two of them aimed at identifying existing studies on CIO role types and two on CDO role types.

On the one hand, we searched for articles published in academic journals using the databases of JSTOR, Business Source Premier and EconBiz, as these are accepted in business administration research and provide coverage of the most relevant material. On the other hand, we looked for publications of professional service firms, whereby we addressed the websites of the top ten German professional service firms (headquartered in Germany) and the top ten international firms operating in Germany, both measured in yearly turnover. These are included in Table 1:

Table 1. Largest consulting firms in Germany in the year 2017

Firm name	*Sales in million euros (2016)*	*Employees (2016)*
PwC	1,898	10,364
KPMG	1,600	10,464
Ernst & Young	1,573	9,437
Deloitte	963,4	5,731
BDO	214,9	1,690
Rödl & Partner	201,9	1,810
Ebner Stolz	180,7	1,178
Baker Tilly	139,8	1,030
Roever Bronner Susat Mazars	124,4	1,163
Warth & Klein Grant Thornton	87,8	749

Source: Lünendonk (2017).

For the search on CIO role types, the publication date was limited to the period between 1980 and 2017, due to the fact that the position of the CIO emerged in the 1980s. As the CDO position is a relatively new phenomenon the publication date was not limited. We restricted the publication language to English and German (Macleod et al., 2020) and performed the SLRs during December 2017.

Searching for publications on CIO roles, the keywords *Chief Information Officer** and *CIO** were both separately combined with the keywords

*Role** (*Rolle**), *Digit**, *Tasks* (*Aufgaben*), *Requirements* (*Anforderungen*), *Responsibility** (*Verantwort**), *IT*, *Leader** (*Führung*), *Job*, *Information System** (*Informationssystem**) using the *and* operator, which searches for both keywords, and the wildcard "*", which allows the researcher to search for several variations of words. Additionally, the keyword *Leader* (*Leiter*) was combined and with the keywords *IT* and *Information System** (*Informationssystem**). Details are mentioned in the following table:

Table 2. Search results on CIO roles

Categories	*No. of papers*
Total search results	510
After exportation to CITAVI (with CITAVI automatically deleting directly found duplicates)	440
After deletion of duplicates	384
After ranking (A+, A, B, C, D)	117
After title analysis	47
After abstract analysis = **Final result**	**14**

Regarding papers on CDO roles, the keywords *Chief Digital Officer** and *CDO** were combined with the same keywords that have been used for the search on CIO roles. In addition, the combinations of the words *Digit** and *Leader**, *Officer**, *Führung*, *Leiter*, *Direktor* were searched. The last search requests were *Chief Information Officer** combined with *Chief Digital Officer** and *CIO** with *CDO**, yet, there were zero findings.

Table 3. Search results on CDO roles

Categories	*No. of papers*
Total search results	98
After exportation to CITAVI (with CITAVI automatically deleting directly found duplicates)	89
After deletion of duplicates	70
After ranking (A+, A, B, C, D)	21
After title analysis	15
After abstract analysis = **Final result**	**2**

To determine whether there are similarities between the role types, the respective role descriptions were analyzed and categorized by means of coding. We applied the coding procedure of grounded theory, which consists of the following steps: open coding, axial coding, selective coding (Corbin & Strauss, 2015). This means we first condensed the role descriptions by developing broad categories. As a next step, we compared the categories with each other and assigned those, which were similar, to root categories. We further analyzed the root categories to detect potential relationships and then aggregated them into core categories, in other words, new role types. Each of the SLR role types belongs to one particular core category.

3.2. Survey

To determine which roles CIOs and CDOs assume in business practice, we conducted an online survey among managers who work as CIO or CDO. Being a research method to investigate opinions, attitudes or trends of a population, we consider the survey approach to be particularly suitable in this case, as above all in the field of CDO research, qualitative methods are dominating until now. We apply an exploratory examination approach, as it serves to investigate new research areas and to receive first insights regarding mechanisms of actions. In order to generate contact data of potential participants, we used various sources. As we assumed that, in particular, larger companies employ CIOs and CDOs, we searched for contact data, i.e., email addresses, of companies listed on the German stock market (DAX, MDAX, SDAX and TecDax companies). Due to the relatively low number of CDOs and to increase the chances of participation, managers with the CDO title were searched in a CDO group of the social media platform Xing. Afterwards, the contact data of the companies they work for was searched on the internet. Likewise, CIOs were searched in a CIO group of Xing and contact data of their companies were taken from the corporate websites. Further data was randomly generated using the NEXIS database. Applying the company classification logic of the European Competence Center for Applied SME Research, we restricted the search to German companies with a yearly turnover larger than 6 million euros and a number of employees exceeding 30. This means that we did not include microenterprises.

In general, there are various ways to collect data, for instance by mail, by telephone, face-to-face, or online. In the present case, the inquiry was conducted as an online survey and the questionnaire was created with the help of the software SoSciSurvey. The questionnaire contained 16 questions, which were divided into five sections. In the beginning, the participants were asked to indicate their current position and management level. The questions of the second section addressed the topic of digital transformation (the current phase the company operates in and the distribution of responsibilities). The next section examined the objectives, tasks and roles of the participants. Referring back to the upper echelons theory (Hambrick & Mason, 1984), the participants were subsequently asked to indicate personal attributes, such as age, sex and education. At the end of the questionnaire, there were questions concerning company characteristics, for instance, size and legal form.

The survey was conducted between February 13 and 28, 2018. Before that, we conducted a pre-test with five company executives. In total, we contacted 1953 companies via email and invited their CIO and/or CDO to participate in the survey. Even though 57 questionnaires were completed, the final sample size only amounts to 33, as some of the respondents show other job titles than CIO or CDO. The questionnaire contained 16 questions, addressing the topic of digital transformation including tasks, objectives and responsibilities. In this context, it has to be mentioned the questionnaire did not contain mandatory questions, as some questions asked for sensitive data (such as personal attributes). This is why the item non-response was not considered, which means that the number of responses might vary slightly with respect to single questions (Armstrong & Overton, 1977). In the following, the results of the survey are presented in detail.

The variables of the survey are stated below:

Table 4. Specification of variables

Independent variable	***Specification***
Job title	Binary variable that takes the value of 1 if the respondent is CIO and 0 if he/she is CDO.
Dependent variables	***Specification***
Cost-oriented technologist	Metric variables that indicate in percentage the extent to which respective role is fulfilled by the respondent. The values of all role types combined yield 100 percent.
Business-oriented strategist	
Innovation driver	
Change agent	
External relationship driver	
Internal collaborator	
Transformation coordinator	
Agility-oriented technologist	
Phase digital transformation	Coded variable that indicates the company´s digital transformation phase: 1 = not yet an issue, 2 = decision phase, 3 = planning phase, 4 = execution phase, 5 = control phase (no company has already completed the digital transformation).
Age	Coded variable that indicates the respondent´s age: 1 = between 20 and 29, 2 = between 30 and 39, 3 = between 40 and 49, 4 = between 50 and 59 (none of the respondents is 60 or older).
Yearly turnover	Metric variable that indicates the company's yearly turnover.
Number of employees	Metric variable that indicates the company's number of employees.

Out of the 33 respondents, 20 work as CIOs and 13 as CDOs. The companies of the participants who are CIO generate on average revenues of 1,867 million euros per year, while those of the CDOs have on average revenues of 1,268 million euros. The average total number of employees amounts to 5,968 in CIO companies and to 3,964 in CDO companies. Around 40 percent of the CIOs and 60 percent of the CDOs work in the industrial sector; other sectors were mentioned less frequently.

Most of the CIOs (39 percent) are professionally educated in computer sciences. 38 percent of the CDOs have a business sciences/economics background, followed by 23 percent who have a professional education in engineering. 67 percent of the CIOs are between 50 and 59 years old. In contrast, 46 percent of the CDOs are between 40 and 49 years old and 31 percent are between 30 and 39 years old.

4. RESULTS

4.1. Systematic literature review

The final research result consists of 14 journal and 6 professional service firm articles containing CIO role types and four journal and two professional service firm articles presenting CDO role types. The identified articles on CIO roles were published between 1993 and 2016, and those on CDO roles between 2016 and 2017. Overall, the publications comprise 84 roles for CIOs and 21 for CDOs.

By analyzing and categorizing the role descriptions of the SLR results, we identified eight different role types, whereby seven apply to CIOs and six to CDOs, which means that five of them are equal for both parties (see Table 2). Thus, each of the 84 CIO roles and 21 CDO roles described in the literature belongs to one of these eight role types. Table 1 and Table 2 give an overview of the categorization.

Figure 1 depicts how often each of the role types appears in literature for CIOs and CDOs, respectively. The most pronounced CIO roles are the roles of the cost-oriented technologist (26 percent), the business-oriented strategist (21 percent) and the agility-oriented technologist (19 percent). CDO roles that occur most frequently are the roles of the transformation coordinator, innovation driver and change agent (all 24 percent).

Table 5. Summary of role types

Role type	***Main objective***	***Main tasks***	***Identified for***
Cost-oriented technologist	Minimization of IT costs/ensuring cost efficiency of IT systems	Provision of fundamental IT services	CIO
		Stabilization and maintenance of IT systems	
Business-oriented strategist	Significant influence on the company's strategic direction	Participation in corporate strategic planning and decision-making	CIO
		Participation in specifying the company's mission and vision	
Innovation driver	Increase in the company's degree of innovation and ability to innovate	Development of innovative technology solutions for business	CIO/CDO
		Development of innovative products/services/business models	
Change agent	Change in mindset/cultural change within the company	Recruitment, training and motivation of IT/digital specialists	CIO/CDO
		Education on technology potentials for business	
External relationship driver	Improvement of external relationships (customers, suppliers partners, etc.)	Execution of digital marketing measures	CIO/CDO
		External relationship building (customers, suppliers, partners, etc.)	
Internal collaborator	Improvement of internal cross-functional relationships	Regular exchange with other divisions/departments	CIO/CDO
		Collaboration with other divisions/departments	
Agility-oriented technologist	Improvement of business processes and company performance	Company-wide integration of IT applications	CIO/CDO
		Development of an agile IT architecture	
Transformation coordinator	Company-wide transformation and interlinking of single areas	Company-wide coordination of digitization projects and measures	CDO
		Monitoring and prioritization of digitization projects and measures	

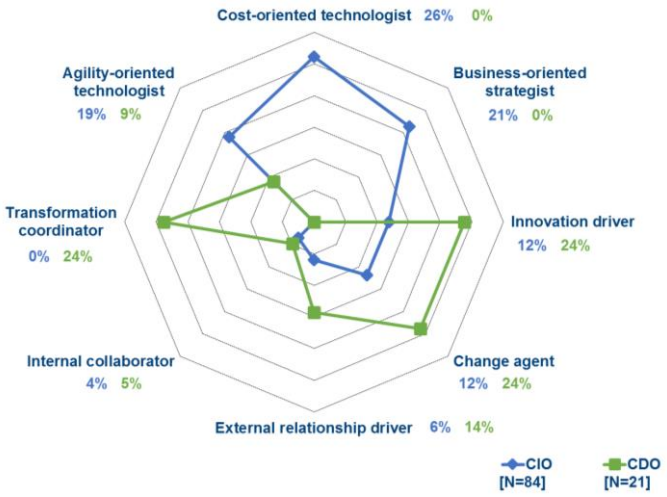
Table 6. CIO role types based on the SLR and coding

Cost-oriented technologist	*Business-oriented strategist*	*Agility-oriented technologist*	*Innovation driver*	*Change agent*	*External relationship driver*	*Internal collaborator*
Resource allocator [21]	Chief operating strategist[20]	Chief architect [20]	Monitor [21]	Leader [21]	Liason [21]	Spokesman [21]
Information steward [41]	Technology provocateur [20]	Integrator [41]	Entrepreneur [21]	Change leader [20]	Relationship architect [41]	Relationship builder [9]
Utility provider [41]	Business strategist [41]	Big-Bang CIO [28]	Product developer [20]	Coach [20]	Savvy value creator [25]	Participative leader [27]
Keep-IT-running CIO [28]	Educator [41]	Opportunity seeker [10]	Value-adding CIO [28]	Inspiring IT manager [25]	Transform [26]	
IT Laggard [37]	IT advisor [37]	Able pragmatist [25]	Innovator & creator [10]	Pioneer [26]	External customer CIO [46]	
IT mechanic [37]	IT orchestrator [37]	Business system thinker [9]	Insightful visionary [25]	Evangelist CIO [36]		
Triage nurse & firefighter [10]	Collaborative business leader [25]	Organizational designer [9]	Entrepreneur [9]	Value configurator [9]		
Lanscape cultivator [10]	Business technology strategist [8]	Expand [26]	Innovator CIO [36]	Catalyst [14]		
Relentless cost cutter [25]	Business visionary [9]	Agility IT director /CIO [36]	Product manager [32]	Recruiter [32]		
Leverage [26]	Transformational leader [27]	Facilitator CIO [36]	Change instigator [15]	Venture capitalist [32]		
Infrastructure builder [9]	Embedded CIO [46]	Enterprise process CIO [46]				
Informed buyer [9]	Strategist [14]	Technologist [14]				
Servant leader [27]	Business strategist [17]	IS strategist [17]				
Utility IT director [36]	Technology advisor [7]	Business leader [32]				
IT services CIO [46]	Business co-creator [15]	Solution provider [19]				
Operator [14]	Strategic contributor [19]	Result-oriented CIO [35]				
Trusted operator [15]	IT economist [35]					
Service provider [19]	IT strategist [35]					
IT architect [35]						
IT project manager [35]						
Technical pragmatist [35]						
Head of computer center [35]						

Table 7. CDO role types based on the SLR and coding

Transformation coordinator	*Innovation driver*	*Change agent*	*External relationship driver*	*Agility-oriented technologist*	*Internal collaborator*
Digitization coordinator [22]	Digital innovator [22]	Digital transformation strategist [16]	Ex-agency [16]	Technologist [16]	Digital advocate [22]
Spokesperson [24]	Entrepreneur [24]	Digital evangelist [22]	Creative disrupter [38]	Innovative technologist [38]	
Universalist [38]	Progressive thinker [38]	Leader [24]	Digital marketer [44]		
Digital harmonizer [44]	Digital accelerator [44]	Customer advocate [38]			
Coordinator [40]	Entrepreneur [40]	Digital evangelist [40]			

Figure 1. Comparison of CIO and CDO role profiles —SLR results



The maximum expression here is based on the number of relative mentions, and here in Figure 1, the outer line equals 30 percent. The respective value for the individual roles and the CIOs and CDOs is calculated for the share of coded mentions in the total mentions, here as an example for the CIO mentions in journals.

Table 8. CDO role types based on the SLR and coding in journals

Role label	*Number of occurrences*	*Percentage share*
Cost-oriented technologist	18	29%
Business-oriented strategist	14	23%
Agility-oriented technologist	12	19%
Innovation driver	7	11%
Change agent	5	8%
Internal collaborator	3	5%
External relationship driver	3	5%
Total	**62**	**100%**

Thus, the existing literature highlights particular roles for CIOs on the one hand and CDOs on the other hand. However, regarding the CIO, it has to be considered that the SRLs delivered articles that go back to the 1990s. Since then, companies have experienced major advances in technology and increasing pressure to keep up with technological changes. Hence, within the context of digital transformation, the emphasis on particular roles might have changed.

The results of the various SLRs have shown that there appears to be very little overlap between the CIO and the CDO, at least from the literature perspective. At least from the perspective of the literature, complementary role profiles and positions could be assumed here.

Consequently, in order to verify which roles are currently relevant in business practice, we conducted a survey among CIOs and CDOs.

4.2. Survey results

As a start, the participants were asked to indicate the phase of digital transformation their respective company currently operates in. The distribution of the answers given by the respondents who are CIOs looks like this: 25 percent of the companies are currently making the decision whether to digitally transform or not, 15 percent are planning digital transformation and 50 percent are in the execution phase. Five percent already have completed the digital transformation and are in the control phase. According to another five percent, digital transformation is not yet an issue in the organization. In comparison, 85 percent of the CDO companies are currently in the execution phase of digital transformation, 15 percent are in the planning phase.

Those respondents, whose company either operates in the decision, planning, execution or control phase of digital transformation, were invited to specify how the competencies regarding digital transformation are distributed among the company's chief executive officer (CEO), CIO, CDO and chief financial officer (CFO). For each of the positions, they could select one of the following answer options: accountable, responsible, informed, consulted, position does not exist.

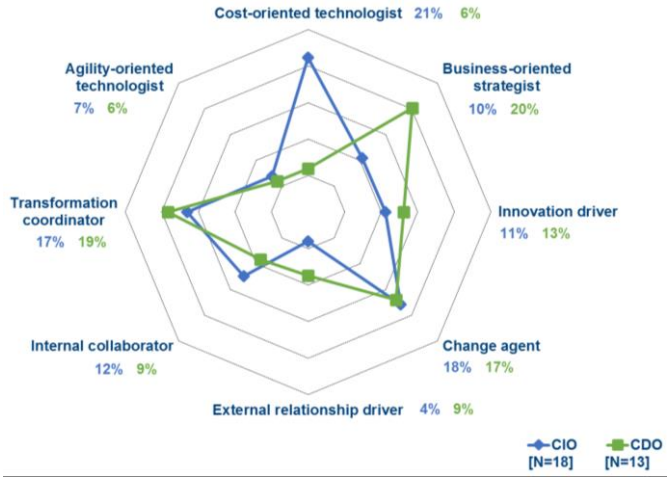
As for their own competencies, 76 percent of the respondents who are CIOs state that they are responsible for digital transformation, and the other 24 percent point out that they are consulted. Interestingly, 87 percent of them indicate that the CDO position does not exist in the company. In the rest of the cases (13 percent), the CDO is responsible for digital transformation.

Regarding the answers given by the group of CDOs, 90 percent specify to be responsible for digital transformation, and 10 percent to be consulted. With respect to the position of the CIO, 38 percent of the CDOs state that it does not exist in their company. If the CIO position exists, the respective person is mainly consulted (50 percent). In most companies (independently of whether the respondent is CIO or CDO), the CEO is accountable for digital transformation and the CFO is either informed or consulted.

Next, presenting the survey participants with 8 CIO and CDO role types that emerged from the SLRs, they had to estimate in percentage which roles they fulfill to which extent, whereby in total 100 percentage points could be distributed among all eight role types. Figure 2 depicts the average answers (mean values) in a spider chart.

As Figure 2 shows, the role profile of the CIOs is relatively similar to the role profile of the CDOs. The transformation coordinator and the change agent are among the three frequently mentioned role types of both groups. The largest differences occur with respect to the role of the cost-oriented technologist (CIOs: 21 percent, CDOs: 6 percent) and the role of the business-oriented strategist (CIOs: 10 percent, CDOs: 20 percent). Interestingly, the role of the business-oriented strategist did not appear in the literature for CDOs and the role of the transformation coordinator was not for CIOs. However, the respondents put quite a lot of emphasis on the respective roles. According to the answers of the CIOs, they are highly engaged in "traditional" IT management tasks, such as the provision of fundamental IT services, but concentrate as well on change management activities and coordination of digitization projects. The latter two tasks also apply to CDOs. At the same time, CDOs have a strong focus on designing the company's strategic direction, in other words, on corporate strategic planning.

Figure 2. Comparison of CIO and CDO role profiles — Survey results



In order to statistically verify whether CIOs and CDOs differ in role-taking, we conducted two-tailed t-tests at a significance level of 5 percent. Normal distribution as a requirement for the t-test was assumed and tested for. In the table, the significance of the t-test is listed under t-statistic. Taking the job title (CIO vs. CDO) as an independent variable and the role types as dependent variables, we determined that CIOs and CDOs only differ significantly in the extent to which they fulfill the roles of the cost-oriented technologist and the business-oriented strategist (see Table 4). With regard to the other six role types, there is no significant difference. Thus, overall, CIO and CDO role profiles are relatively similar.

Table 9. T-test statistics for all variables

Dependent variable	*Independent variable*	*Mean*	*Standard deviation*	*t-statistic*	*r*	*Effect size*
Cost-oriented technologist	Job title: CIO	21,11	21,07	0,009	0,53	Large
	Job title: CDO	6,00	6,36			
Agility-oriented technologist	Job title: CIO	6,89	6,56	0,827		
	Job title: CDO	6,38	5,85			
Transformation coordinator	Job title: CIO	16,50	9,08	0,497		
	Job title: CDO	19,23	13,08			
Business-oriented strategist	Job title: CIO	10,39	10,69	0,018	0,42	Medium
	Job title: CDO	20,23	10,86			
Innovation driver	Job title: CIO	10,56	10,79	0,477		
	Job title: CDO	13,15	8,51			
Change agent	Job title: CIO	18,72	14,97	0,782		
	Job title: CDO	17,38	10,06			
External relationship driver	Job title: CIO	3,94	5,99	0,108		
	Job title: CDO	8,77	10,17			
Internal collaborator	Job title: CIO	12,33	11,86	0,0375		
	Job title: CDO	9,15	5,26			
Phase digital transformation	Job title: CIO	3,25	1,07	0,031	0,41	Medium
	Job title: CDO	3,85	0,38			
Age	Job title: CIO	3,61	0,61	0,002	0,55	Large
	Job title: CDO	2,69	0,85			
Yearly turnover	Job title: CIO	5.567.178.571	17.713.790.590	0,479		
	Job title: CDO	1.268.222.222	1.146.411.115			
Number of employees	Job title: CIO	5.967,65	7.766,11	0,434		
	Job title: CDO	3.964,09	3.704,68			

5. DISCUSSION

This paper aimed at investigating the roles of CIOs and CDOs in the digital transformation of enterprises, in terms of tasks, objectives and area of responsibility. Conducting SLRs, we identified seven role types for CIOs and six for CDOs, whereby five of them are equal. Building on that, we conducted a survey among CIOs and CDOs to check the results.

The survey reveals that some companies have created the CDO position to steer digital transformation, while others put their CIO in charge of it. Most of the companies with a CIO as the responsible manager for digital transformation do not employ a CDO. In contrast, some of the companies that have a CDO do as well have a CIO who, in most cases, has an advisory function regarding digitization. Hence, these companies rely on both functions with the CDO managing the organization's digital transformation and the CIO managing the IT architecture. Within this constellation, cooperation and consultation between CIO and CDO take place.

Moreover, the survey results show that CIOs and CDOs have similar roles, and hence similar tasks and objectives within the context of digital transformation. Both groups, CIOs and CDOs highlight their role as transformation coordinator, coordinating, monitoring and prioritizing digitization projects. CIOs and CDOs act to a large extent as change agents, educating the organizational members of the business potentials of technology to achieve a change in mindset. To a lower degree, they perform the roles of the innovation driver and develop innovative business solutions, products, services or even entire business models. While CIOs slightly more emphasize company-internal, cross-functional collaboration, CDOs are a bit more engaged in building and improving relationships with external parties, for instance with customers, suppliers and partners. CIOs and CDOs hardly assume the role of agility-oriented technologist focusing on the development of agile IT architecture. With regard to the group of CIOs, the result is surprising as this role type appears quite often in journal and professional service publications. Yet, it could be that, although literature highlights the benefits and advantages of agile methods and business analytics applications, companies are not yet fully prepared to implement and deploy them in daily business. Hence, "agile" might be a buzzword in the discussion on digital transformation, which is not yet practicable in any organization. This might be a reason why the survey participants hardly see themselves as agility-oriented technologists.

As the analysis shows, there is only a significant difference in the extent to which CIOs and CDOs fulfill the roles of the cost-oriented technologist and the business-oriented strategist. While CIOs have a stronger focus on technical aspects and IT efficiency, CDOs are more oriented towards business and strategic aspects. This finding coincides with the educational background of the survey participants: most of the CIOs are professionally educated in computer sciences, whereas many CDOs have a business sciences/economics background.

With CIOs and CDOs having rather similar roles, and thus similar tasks, objectives and responsibilities within the context of digital transformation, the emergence of a conflict seems possible. An appropriate solution could be a clearer separation of tasks and responsibilities to create a symbiotic, complementary relationship. Yet, our results rather support the assumption that CIOs and CDOs potentially end up in struggles for power on responsibilities and resources, which might eventually stimulate the debate on whether both managerial positions are indeed necessary.

The paper highlighted a large discrepancy between the existing findings and the survey conducted specifically for this purpose: The analysis of the (mainly older) literature still showed a significantly different profile of CIO and CDO. The empirical analysis, on the other hand, shows an almost congruent picture. These two contradictory findings should be discussed in detail and taken up in a qualitative follow-up study.

6. CONCLUSION

The divergence in the literature and survey findings shows that there is a need for further research on this topic. CIO roles seem to have changed in the era of digitization and research on the CDO function is still in its infancies. The question is how both managerial positions develop in the future and whether both can coexist.

The fact that some companies have a CDO and others a CIO as responsible manager for digital transformation leads to the question as to what have been the reasons for the respective decision. Moreover, it would be interesting to know if there are differences in effectiveness, meaning whether either CDOs or CIOs more successfully transform their companies. In doing such research, other factors that have not been part of this work, such as capabilities and skills, should be considered as well.

In the field of CIO and CDO role research, a very interesting, yet open research avenue would be to look at companies that have both a CIO and a CDO position and look at the respective personal profiles, roles and organizational department structure adhering to the respective officers. Here, human resources (HR) theories such as the dyadic leadership theory or conflict theory could generate insight into the dynamics of role development between the CIO and the CDO. In addition, one must not forget that there is an ongoing debate not only as to the respective profiles of the CIO and the CDO but the CFO as well. There are still many companies where the CIO and the CDO are only subordinate positions to the CFO. In the context of the rising importance of digital transformation, it should be analyzed whether this arrangement is still valid for the future.

Our study is subject to some limitations. As the sample size is relatively small, results can only be generalized to a limited extent. Therefore, we recommend verifying the findings with a larger sample of CIOs and CDOs and doing extended statistical analysis. In addition, we suggest triangulating the data with data based on qualitative research to increase the reliability and validity of the results and receive a more comprehensive image of the current situation. In addition, we conducted the study using primarily single-item scales and only at one point in time, and that was back in 2017. Thus, limitations of validity and reliability have to be expected.

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