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Chief digital officers: An exploratory analysis of their emergence, nature, and determinants

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ABSTRACT

With the transition from the industrial age to the digital age, a notable phenomenon is the adoption of the chief digital officer—a senior executive position dedicated to digital issues—in large firms. To explore this phenomenon, we conduct a large-scale, empirical study of the emergence of the chief digital officer position, potential variations of this role, and the conditions under which firms choose to have this position. Our exploratory analysis of all firms in the S&P 1500 index between 2000 and 2018 offers unique insights. In descriptive terms, we find that chief digital officers did not appear until 2003 and their prevalence has increased notably since 2010. In addition, an analysis of these executives' titles and role descriptions alludes to two conceptually different types of chief digital officers: generalists and domain specialists. In prescriptive terms, we reveal several factors related to firms' performance, strategic leadership, task demands, task environments, and mimicry behavior that influence the likelihood of chief digital officer presence. The combined empirical insights call for nuanced theoretical explanations of the chief digital officer phenomenon. Our study informs research on chief digital officers and functional executives in general. More generally, it provides a window into the larger issue of the microfoundations of digital transformation and strategic change in large firms, and it points to new strategy actors and practices.

Introduction

With the transition from the industrial age to the digital age, the adoption of the chief digital officer (CDO)—a senior executive position dedicated to digital issues—by large firms is a notable phenomenon. *Prima facie* evidence in the business press and consulting reports suggests that this executive role can now be found in many firms across numerous industries (e.g., Friedrich et al., 2016; Friedrich et al., 2015; Péladeau et al., 2017). Prominent examples of firms that have appointed CDOs include Burberry, L'Oréal, McDonalds, Pfizer, Starbucks, and The Guardian. Despite its visibility, the phenomenon is still rather new. For example, according to a recent global study by the executive search firm Egon Egon Zehnder (2019), 84% of newly appointed CDOs are the first to hold this title in their firms.

Motivated by this observation, management and strategy scholars have started to explore the emerging role of the CDO (see Reck and Fliaster, 2019; Singh and Hess, 2017; Singh et al., 2020; Tumbas, Berente and vom Brocke, 2017). These studies demonstrate that the CDO position, which focuses on moving the company towards a digital mindset and launching digital initiatives, is distinct from

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other functional roles (Dumeresque, 2014; Singh and Hess, 2017). The extant work also suggests that although the CDO position is distinct, not all CDOs are alike (Singh and Hess, 2017; Singh et al., 2020; Tumbas et al., 2017). In other words, the CDO position can differ across firms. Finally, these studies suggest that CDOs have an impact on organizational outcomes, including digital innovation, data analytics, customer engagement and, more generally, strategic change (Singh and Hess, 2017; Singh et al., 2020; Tumbas et al., 2017). Despite these studies' valuable insights, we still lack systematic, large-scale evidence of the emergence, nature, and determinants of the CDO position.

Against this backdrop, the purpose of this study is to explore two interrelated questions. First, with the aim of offering *descriptive* evidence of the CDO's origins and diffusion in firms, we ask how the CDO's presence and role has evolved in large firms over time. As exemplified by the seminal historical studies by Zorn (2004) and Bertrand (2009), an effort to trace the origins and evolution of a key senior executive role like the CDO promises to reveal new insights about the functioning of large firms. Second, with the aim of providing *prescriptive* evidence of the factors that influence decisions regarding CDOs, we ask under which conditions firms choose to have CDOs. Having a CDO represents an important (structural) choice that is likely to have consequences for the firm's strategy, organization design and, ultimately, performance (Singh and Hess, 2017; Singh et al., 2020; Tumbas et al., 2017). While many firms grapple with various aspects of digital transformation,¹ including new business models, changing consumer demands, and new ways of producing and selling goods and services (Davenport and Westerman, 2018; Fitzgerald et al., 2013), certain contingencies in the firms' internal and external environments can be expected to influence the decision to have a CDO.

To examine these questions, we used an exploratory quantitative approach, which focuses on identifying facts and patterns in the data rather than on testing formal hypotheses based on theory (Helfat, 2007; Oxley et al., 2010). This approach is suitable when relatively little is known about a phenomenon and/or no theory can fully explain that phenomenon (Hambrick, 2007; Van de Ven, 2015, 2016). The nascent knowledge about the CDO combined with the various possible explanations of the CDO's presence and role on the executive team (Menz, 2012) motivated our methodological approach. Our explorative approach, which uses archival data for S&P 1500 firms from 2000 to 2018, comprised two sequential steps. First, we explored the occurrence of CDOs and analyzed their roles. Second, based on those insights, we undertook a quantitative exploration of factors potentially related to the likelihood of CDO presence in firms. The insights from these two steps provide a more comprehensive understanding of CDOs than would have been possible using a deductive-theory-testing approach and a single theoretical lens (Sparrowe and Mayer, 2011).

We believe that our study is important in at least four ways. First, our paper provides empirical insights on the emerging CDO phenomenon. Specifically, our study reveals descriptive insights on the emergence of the CDO position as well as prescriptive insights into the factors that influence the likelihood of CDO presence. Thereby, our exploratory, quantitative study extends the insights provided by the relatively scarce qualitative, case-based work in this area (Singh and Hess, 2017; Singh et al., 2020; Tumbas et al., 2017) and may motivate future theory-testing studies. Second, the study contributes to research on functional executive roles (Guadalupe et al., 2014; Menz, 2012). More specifically, by tracking the evolution of the adoption and presence of CDOs over two decades, our study complements prior longitudinal efforts that examine the emergence and institutionalization of functional executive roles in large firms (Whittington et al., 2017; Zorn, 2004). Third, the study informs research on digital transformation (e.g., Birkinshaw, 2018; Lanzolla et al., 2018). In particular, it pinpoints the multifaceted task demands related to digital transformation and the CDO position as a structural choice. As such, our study offers a window into the micro-foundations of digital transformation in large firms. Fourth, our study adds to our understanding of strategy actors and agency in research on strategic change (Kunisch et al., 2017; Müller and Kunisch, 2018), as well as in research at the intersections of strategy process and practice (Burgelman et al., 2018). By accounting for the new strategic realities of the digital age, we turn the spotlight to the CDO as an actor focused on digital strategy.

The structure of this article follows a "just-the-facts" (Oxley et al., 2010) empirical approach. After a brief discussion of the CDO phenomenon in the broader context of digital transformation and the emergence of other functional executive positions, we describe the study's method, present the results, and discuss how the findings inform extant knowledge and implications for future research.

Background

As the transition from the industrial age to the digital age continues, digital technologies are transforming economies and societies (e.g., Barley et al., 2017; Iansiti and Lakhani, 2020; Laamanen et al., 2018; Phan et al., 2017). The history of evolution in the industrial age demonstrated that as the types of products and services changed and the wider business context shifted, firms adapted their structures and capabilities (Birkinshaw, 2018; da Silva Lopes, Casson and Jones, 2018).

In particular, distinct executive roles emerged in the industrial age. For example, the chief financial officer (CFO) position appeared in the post-World War II era due to the rise of capital markets (Zorn, 2004). Moreover, the positions of chief operating officer (COO) (Hambrick and Cannella, 2004), chief supply chain officer (Roh et al., 2016), and chief strategy officer (CSO) (Angwin et al.,

¹ While the term "digital transformation" is somewhat ambiguous, for the purposes of this study, we focus on the managerial and organizational implications of the use of digital technologies to conduct business activities (Reis et al., 2018; Singh et al., 2020). Therefore, the common ground lies in digital technologies, the history of which started with the invention of electronic computers in the 1940s and 1950s, followed by the development of personal computers in the 1970s and 1980s, the rise of the internet in the 1990s, and the emergence of artificial intelligence and robotics in the 2000s and 2010s (Phan et al., 2017; von Krogh, 2018). Although knowledge about digital transformation is still fairly scarce (Reis et al., 2018), many scholars believe that digital technologies have had and will continue to have profound effects on the nature of firms (e.g., Birkinshaw, 2018, 2020).

2009; Menz and Scheef, 2014) represent important structural choices that affected firms' abilities to meet their task demands in their task environments (e.g., dynamic and complex environments). As environmental, sustainability and workforce diversity concerns rose in importance, firms increasingly introduced chief sustainability officers (Fu et al., 2019; Kanashiro and Rivera, 2017) chief diversity officers (Shi et al., 2018), and chief human resources officers (Abt and zu Knyphausen-Aufseß, 2017). As such, research into functional executives has provided a window into the nature and micro-foundations of contemporary firms (Guadalupe et al., 2014; Menz, 2012; Svejenova and Luis Alvarez, 2017).

Notably, with the coming of the digital age, a new functional role has emerged—that of chief digital officers. The extant knowledge about this increasingly important role stems from consulting surveys and a few academic studies, which are summarized in Table 1.

The consulting studies focused on CDO adoption and responsibilities. First, the CDO phenomenon is increasingly prevalent among large firms, as more and more firms are hiring CDOs to manage their digital transformation (e.g., Pachmajer and Curran, 2016; Friedrich et al., 2015). For example, Friedrich et al. (2015) reported that approximately 6% of the 2500 largest public firms in the world had CDOs, while the corresponding figure in Péladeau et al. (2017) was 19%. The latter authors also indicated that 60% of the “digital leaders ... identified in our most recent study have been appointed since 2015” (Péladeau et al., 2017, p. 1). Second, the adoption of CDOs may vary across industries and firm characteristics (e.g., Pachmajer and Curran, 2016; Friedrich et al., 2015). Third, CDOs can differ in terms of their responsibilities and tasks (e.g., Péladeau et al., 2017). These reports also suggest that while the primary responsibilities of CDOs relate to “digital transformation,” their exact tasks and responsibilities can differ significantly. For example, Friedrich et al. (2015, p. 4) observe that CDOs “come from a variety of backgrounds, but by far the most common is marketing and sales, followed by technology. This suggests just how differently the chief digital officers and the companies that hire them imagine the role, and how varied the digital needs and pace of transformation are from one company to another.”

The few academic works are qualitative studies exploring specific CDO cases (Singh and Hess, 2017; Singh et al., 2020; Tumbas et al., 2017). A first important insight from these studies is that the CDO position is distinct from presumably related roles, such as the chief information officer (CIO), the chief data officer, the chief innovation officer, the CSO, and the chief transformation officer (Dumeresque, 2014; Singh and Hess, 2017). For example, the CDO's role concerns the mobilization of the whole company in relation to digital topics, especially digital initiatives. More specifically, the CIO and the chief data officer typically lead functional silos. As such, they mostly cope with specialist task demands. In contrast, the CDO often has a company-wide perspective and fosters cross-functional collaboration in the digital domain. This implies that CDOs face substantial generalist and specialist task demands. This is an important insight that substantiates our motivation to explore the CDO as a distinct phenomenon and, as we discuss below, it has implications for our research design.

A second important insight from these qualitative studies is that CDOs matter, which means that they can have an impact on various organizational outcomes, including digital innovation, data analytics, customer engagement, and strategic change in general (Singh and Hess, 2017; Singh et al., 2020; Tumbas et al., 2017). In fact, CDOs are considered agents of change (Dumeresque, 2014). Thus, the decision to have a CDO represents an important structural choice for firms that face digital transformation challenges. For example, Singh et al. (2020) use a multi-case study to explore how the CDO makes an impact. The study suggests that a core aspect of the CDO's role is to coordinate horizontally between organizational units and vertically across hierarchical levels. The study indicates that the effectiveness of the CDO's organizational anchoring depends on the firm's digital-transformation strategy and the CDO's task focus.

Despite these valuable insights about CDOs, the extant knowledge is limited. In particular, we lack systematic, large-scale evidence of the emergence, nature, and determinants of the CDO position. Moreover, consulting surveys often lack the rigor required to draw conclusions regarding the phenomenon's nature and implications. For example, Friedrich et al. (2016) treat a range of titles, including chief marketing officer, chief innovation officer, and CIO, as equivalent to CDO. Such an approach makes the CDO role indistinguishable and fails to take into account the fact that it is a distinct role, as demonstrated in academic studies (Singh and Hess, 2017). In addition, it suggests that the comparably high numbers of CDOs reported in consulting studies may not accurately reflect the magnitude of the phenomenon. Given this backdrop, we see a need for large-scale empirical research into the emergence and prevalence of CDOs and the factors that may influence the likelihood of their presence.

Empirical approach

In accordance with the study's phenomenon-driven motivation, we opted for an exploratory approach to our empirical research that comprised two steps. In the first step, we identified CDOs and analyzed their roles using titles, role descriptions, and secondary data from company websites, press releases, and job descriptions. In the second step, we explored certain factors that could potentially affect the presence of CDOs in firms. By combining the insights from these two steps, we are able to generate a more comprehensive understanding of the CDO phenomenon than would have been possible by applying a deductive-theory-testing approach with a single theoretical perspective (Sparrowe and Mayer, 2011). Exploratory studies of this type are used in strategy and organization research, especially as a means of opening up new lines of inquiry into poorly understood issues (e.g., Ancona and Caldwell, 1992; Arino et al., 2016; Hatch et al., 2015; Menz and Barnbeck, 2017; Vissa, 2012).

Sample and data

To explore the emergence and presence of the CDO, we focused on large, listed US firms. We first considered all firms included in the S&P 1500 at any time between 2000 and 2018 to avoid potential survivorship bias. The relatively long timeframe enabled us to

Table 1
Prior studies on chief digital officers.

Study	Outlet	Focus	Method (qual/quant; sample; region)	CDO Identification (i.e. "measure")	Key insights
Singh et al. (2020)	LRP	Organization design related to CDOs	Qualitative: Multiple-case study (4); interviews with CDOs and colleagues; for triangulation, secondary data, including media releases, company websites, business publications, industry experts' and management reports, etc.	No information provided	<ul style="list-style-type: none"> • CDOs are embedded in different ways in the firm structure, depending on the firm's DT strategy and the CDO's task focus. • CDOs use different formal and informal activities to coordinate between employees working on DT activities in different units and at different hierarchical levels.
Reck and Fliaster (2019)	SMR	Typology of "effective" CDOs	Quantitative: survey data for 211 CDOs in firms in GER, AUT, and CH of different sizes (mostly medium or large with 100 to 5000 employees) and various manufacturing industries; 97 "effective" CDOs as the sample for fuzzy-set QCA	Based on tasks of those who are responsible for DT (not just title); C-suite (including the CEO) and direct reports	<ul style="list-style-type: none"> • There are four types of effective chief digital officers: Networker & catalyst; insider expert; innovation evangelist; lone ice-breaker. • These types provide different strengths and performance gains for organizations, depending on the context.
Dooman (2018)	SHRR	Organizational context	Qualitative: interviews with over 100 senior digital and workforce technology executives.	No information	<ul style="list-style-type: none"> • Firms need a proper support function for DT. • Different firms need different types of CDOs.
Singh and Hess (2017)	MISQE	CDO role; CDO skills and competencies	Conceptual and empirical Qualitative: six case studies of CDOs in retail, tourism, education, market research, financial services and publishing; 10 semi-structured interviews	No information provided	<ul style="list-style-type: none"> • The right expectations and support is important for success. • The CDO role is distinct from related roles such as CIO, chief data officer, chief innovation officer and CSO. • Certain DT tasks drive the presence of CDOs including customer and online business focus. • There are three generic CDO roles: entrepreneur; digital evangelist; coordinator.
Tumbas et al. (2017)	MISQE	CDO tasks; CDO skills and competencies	Qualitative: exploratory interviews with 35 CDOs from various industries incl. automotive, financial services, healthcare, software, publishing, governmental and not-for-profit organizations in North America, Europe; Australia; South America	CDO network (http://cdoclub.com), members on LinkedIn; "chief digital officer" as the job titles of all informants	<ul style="list-style-type: none"> • CDOs foster firm's digital capabilities (digital innovation, data analytics and customer engagement). • There are three types of CDOs: digital accelerators, digital marketers and digital harmonizers.
Dumeresque (2014)	SD	CDO tasks and competencies; organizational design	Viewpoint	n/a	<ul style="list-style-type: none"> • The competencies of a CDO are quite different to those of other executives.
Pélaudeau and Acker (2019)	Consulting study	Descriptive trends	See Pélaudeau et al. (2017)	See Pélaudeau et al. (2017)	<ul style="list-style-type: none"> • Given the strategic importance of the position, the CDO should report directly to the CEO, with a position in the boardroom, or at least on the Executive Committee.
Pélaudeau et al. (2017)	Consulting study	Descriptive trends	the 2500 largest public firms by market capitalization in 2016	Executive for digital topics incl. C-suite (a chief digital officer, CTO, CIO, and others), VP, director of digital operations See Friedrich et al. (2015)	<ul style="list-style-type: none"> • In 2018, 21% of the world's 2500 largest public firms have a CDO. • In 2016, 19% of the large firms world-wide have designated an executive for digital topics. • 40% of CDOs are TMT members; Director 17%; Vice President: 19%; other: 24% (e.g., "global head of digital transformation"). • The CDOs' roles and responsibilities can vary substantially across firms. • There are five CDO "archetypes": the progressive thinker, the creative disrupter, the customer advocate, the innovative technologist, and the universalist.
Friedrich et al. (2016)	Consulting study	Descriptive trends	See Friedrich et al. (2015)	Not clear	<ul style="list-style-type: none"> • The adoption of CDOs is higher in firms in consumer-focused industries, including media, entertainment, food and beverage, and consumer products, and larger firms companies.
Friedrich et al. (2015)	Consulting study	Descriptive trends	1500 of the largest public and private firms in 2013 and 2014 across 25 industries in Asia-Pacific, Europe, MENA, and North and Latin America Company filings and records and publicly available information; in-depth telephone interviews by in 2015 with several CDOs	Not clear	

LRP = Long Range Planning; MISQE = MIS Quarterly Executive; s + b = strategy & business; SD = Strategic Direction; SHRR = Strategic HR Review; SMR = MIT Sloan Management Review.
Other useful sources: <http://cdoclub.com>; <https://www.zdnet.com/article/what-is-a-chief-digital-officer/>; <https://www.cxotalk.com/slideshare/20-influential-chief-digital-officers>; <https://www.strategyand.pwc.com/cdo>; <https://theleadershipnetwork.com/article/the-rise-and-role-of-the-chief-digital-officer/>; <https://www.cio.com/article/2380788/why-the-chief-digital-officer-role-is-on-the-rise.html>; <https://employee-engagement.hrtechoutlook.com/cxoinsights/the-rise-and-impending-fall-of-the-chief-digital-officer-nid-170.html>; <https://www.egonzehnder.com/cdo-decoded>.

trace the first occurrences of CDOs in the S&P 1500. In order to lag some variables, we collected financial data from 1999 to 2018. We used the BoardEx database to collect information about firms' senior executives and Compustat to gather financial data, which is a common approach in strategic leadership research (Finkelstein et al., 2009; Menz, 2012). The BoardEx data included information about 245,336 executives in 2339 firms, from which our descriptive statistics were derived. After excluding cases lacking the firm-level data necessary for our predictor variables, our dataset included 18,259 firm-year observations from 1755 firms.

Step 1: presence and nature of the CDO

We used a systematic and formalized approach to measure the study's main variable: the presence of a CDO. For the firms included in our sample, we considered all senior executives listed in BoardEx. This inclusive approach allowed us to consider all senior executives who were deemed important by their firms, which is in line with our CDO definition, without initially relying on their firm-specific hierarchical designations (e.g., vice president versus senior vice president). To identify the CDO within a firm, we built on prior research on specific incidences of CDOs (Singh and Hess, 2017; Singh et al., 2020; Tumbas et al., 2017) and other senior executives (Menz, 2012). We also inspected descriptions of CDOs' roles and titles found on firm websites and in press releases. While firms may use different titles for CDOs, the term "digital" is considered a common denominator. Consequently, we categorized those senior executives with the term "digital" in their titles as CDOs. While this relatively restrictive definition may neglect CDOs who have similar roles but different titles, it ensures that those senior executives who are identified as CDOs are actually CDOs. As such, it allows for a more conservative analysis of the emergence and presence of CDOs, which is warranted in an early study of a new phenomenon.

Based on this approach, we identified 217 CDOs in the firms included in our sample. To analyze these CDOs, we used a content analysis of their roles and titles. This involved the manual inspection of the various terms used to designate the CDOs' responsibilities. In line with prior research (Hambrick and Cannella, 2004; Menz and Scheef, 2014), we assumed that firms can revisit the appointments of senior executives annually, which allowed us to pool the data for our analyses. We used a binary variable assigned a value of 1 if a CDO was present at the end of a given year, and 0 otherwise.

Step 2: determinants of CDO presence

In the second step, we explored a set of factors that may influence the likelihood of a CDO's presence following the recommendations for fact-based research (Hambrick, 2007; Helfat, 2007; Oxley et al., 2010). While there are many possible determinants of CDO presence, we considered the firm's performance, strategic leadership, task demands, task environments, and mimicry behavior. We relied on a structured approach to identify variables that may predict CDO presence.

First, the selection of determinants was informed by prior qualitative field-based research on CDOs (Singh and Hess, 2017; Singh et al., 2020; Tumbas et al., 2017) and by studies on other functional executive positions, such as the CFO (Zorn, 2004), the COO (Hambrick and Cannella, 2004), the CSO (Menz and Scheef, 2014), the chief supply chain officer (Roh et al., 2016), the chief marketing officer (Nath and Mahajan, 2008), the chief diversity officer (Shi et al., 2018), the chief human resources officer (Abt and zu Knyphausen-Aufseß, 2017), and the chief sustainability officer (Fu et al., 2019; Kanashiro and Rivera, 2017).

Second, in line with the exploratory nature of this study, we considered the findings of the descriptive analysis of the CDO roles conducted in the first step. The analysis of the secondary data from company websites, press releases, and job descriptions verified our initial choice of variables (e.g., CDO's task demands) and provided complementary information that led to the consideration of additional determinants, such as factors concerning the firm's strategic leadership.

Third, although fact-based inquiry does not rely on formal hypotheses, our variable selection was implicitly guided by theory-based considerations from, for instance, the contingency, capabilities, and diffusion perspectives, as the literature on functional executives points to these perspectives (Menz, 2012). We therefore find it appropriate to not only describe the data and the measurement of each of the variables, but to also briefly discuss the rationale for their inclusion and potential associations with CDOs' presence, as in prior research using an exploratory approach (Menz and Barnbeck, 2017).

As a result of our approach, we found it necessary to include both more general and more function-specific factors in the analysis. For example, firm performance, strategic leadership, and mimicry behavior have previously been identified as important determinants of senior executive roles (Abt and zu Knyphausen-Aufseß, 2017; Hambrick and Cannella, 2004; Kanashiro and Rivera, 2017; Menz and Scheef, 2014; Shi et al., 2018; Zorn, 2004). In addition, as we discussed in the background section and summarized in Table 1, the consulting reports and the few academic studies on CDOs suggest that we should consider the task demands and task environments associated with digital transformation in firms as well as the presence of CIOs.

Performance. In addition to the aforementioned factors, we considered firm and industry performance as potential factors. Although less central for the main purpose of this study, these factors have frequently been included in prior studies (Abt and zu Knyphausen-Aufseß, 2017; Hambrick and Cannella, 2004; Kanashiro and Rivera, 2017; Menz and Scheef, 2014; Shi et al., 2018; Zorn, 2004). With regard to the decision to have a CDO, poorly performing firms may face greater pressure for digital transformation and strategic change (Kunisch et al., 2017; Müller and Kunisch, 2018). Therefore, such firms might be more likely to use a dedicated CDO. Starbucks serves as an illustrative example. After its stock price plunged in 2009, the company hired Adam Brotman as its CDO with the aim of embracing the impacts of new digital technologies on customer relationships (Fitzgerald et al., 2013; Singh et al., 2020). At the same time, well-performing firms may have the resources necessary to create a dedicated CDO position. Successful firms may have slack resources that enable them to experiment with new management practices, like having a CDO. We measured firm performance as the *return on assets* (ROA) in t-1 and as *sales growth* from t-2 to t-1. Following a similar logic, we measured industry

performance as the median *industry ROA* in t-1 and the median *industry market-to-book value* (MTB) in t-1.

Strategic leadership. Prior research suggests that a firm's strategic leadership can influence the presence of a dedicated functional executive (Hambrick and Cannella, 2004; Marcel, 2009; Menz and Scheef, 2014; Shi et al., 2018). Therefore, we explored two aspects of strategic leadership in relation to digital transformation and the adoption of a CDO.

First, we examined several general factors related to openness to change and the adoption of a CDO. Age has previously been used as a proxy for executives' willingness to take risks and their openness to change (Kunisch et al., 2017). Similarly, digital capabilities and decisions in favor of digital transformation might be associated with age. More specifically, executives who are relatively young are regarded as more open and proactive with regard to the adoption of digital technologies. We therefore considered the ages of top management teams (TMTs) and boards of directors (BoDs). We calculated *TMT age* as the average age of the firm's five highest-paid executives in t-1 (Shi et al., 2018) and *BoD age* as the average time to retirement of the BoD members in t-1 compared to a typical retirement age of 70 years. We calculated *BoD age diversity* as the standard deviation of the ages of the directors on a firm's board in a given year.

Second, as digital transformation is interwoven with information and communication technologies, we were particularly interested in the role of the CIO (Ding et al., 2014) in the adoption and presence of a CDO. Prior research suggests that firms differ with respect to the role of information and communication technologies and the use of a CIO, which, in turn, may affect the use of a dedicated digital role like the CDO. We captured the role of information and communication technologies by accounting for *CIO presence* (Ding et al., 2014) with a binary variable assigned a value of 1 if a CIO was present at the end of t-1, and 0 otherwise.

Task demands. We explored two aspects of firms' task demands in relation to digital transformation and the presence of a CDO. On the one hand, we considered digital transformation task demands in general—the extent and scope of digital transformation challenges facing a firm as a whole. Because of the organizational complexity and the greater struggle to engage with digital transformation, larger firms may opt for centralized digital resources and a CDO role to cope with the challenges. We considered *firm size* to capture the organizational complexity of the digital transformation task demands. Firm size is one of the most obvious drivers of organizational complexity (Josefy et al., 2015). We followed related studies in measuring firm size as the natural logarithm of the firm's total assets (Shi et al., 2018).

On the other hand, we considered digital transformation task demands related to specific functional domains. In this regard, we explored three functional domains that might be affected by digital transformation and may, therefore, influence the likelihood of a CDO's presence. First, we used *sales intensity* to capture digital transformation task demands related to customers and sales. In this regard, we relied on an established measure (Baysinger and Hoskisson, 1989; Shi et al., 2018)—the median industry SGA to sales ratio in t-1. Second, we utilized *marketing intensity* to capture digital transformation task demands related to distribution channels and marketing. In this regard, we also used an established measure—the median industry ratio of advertising expenses to sales in t-1. Third, we used *innovation intensity* to capture digital transformation task demands related to innovation, including open innovation. Again, we used an established measure—the median industry ratio of R&D expenditure to sales in t-1.²

Task environments. We explored two aspects of firms' task environments in relation to digital transformation and the adoption of CDOs. Certain characteristics of the task environment can influence firm behavior and structural choices owing, for example, to increased external pressure or the diffusion of specific behaviors (Dess and Beard, 1982, 1984).

First, we considered *environmental dynamism* in order to include pressures for digital transformation in the external environment that may affect the decision to have a dedicated CDO. In highly dynamic environments, such as quickly growing or volatile markets, digital transformation may require dedicated CDOs to ensure that firms can keep pace with changes in the environment. In this regard, we used *industry growth*. In line with prior studies (Hambrick and Cannella, 2004), we measured industry growth as the median sales growth between t-2 and t-1.

Second, we considered *environmental munificence*, which characterizes the extent of resource abundance in the firm's external environment. This may, in turn, influence pressure for structural changes, like the adoption of a functional executive position. For this purpose, we used *industry (in)stability*. As in prior studies (Hambrick and Cannella, 2004), we measured industry instability as the absolute difference in the industry growth rate between t-2 to t-1 and t-1 to t.

Mimicry. In addition, the broader institutional environment may affect choices regarding the adoption of a new senior executive role (e.g., Hambrick and Cannella, 2004; Zorn, 2004). Therefore, we explored the likelihood that decisions to have a CDO are driven by the mimetic behavior of firms within an industry. To do so, we measured the number of firms in an industry with a CDO in t-1.

Analyses

In accordance with the binary nature of the dependent variable, we applied logistic regression analyses to explore the relationships between the presence of CDOs and the contingencies in the firms' internal and external environments (Menard, 1995; Wiersema and Bowen, 2009). In line with prior research on senior functional executives (e.g., Hambrick and Cannella, 2004; Menz and Scheef, 2014; Nath and Mahajan, 2008), we pooled the data. While the use of pooled data may result in more precise estimates due to the larger sample size, the estimates may be biased as the observations are not completely independent (Haleblian and Finkelstein, 1993). To account for this possibility, we used generalized estimating equations (GEE) (Liang and Zeger, 1986). GEE

² By focusing on industry-level variables, we could explore the effect of domain-specific task demands on the presence of CDOs for the full sample of firms without being overly affected by firm-specific factors. However, a robustness check using these variables at the firm level, which substantially reduced the number of observations because of missing firm-level data, yielded results that were consistent with those reported here.

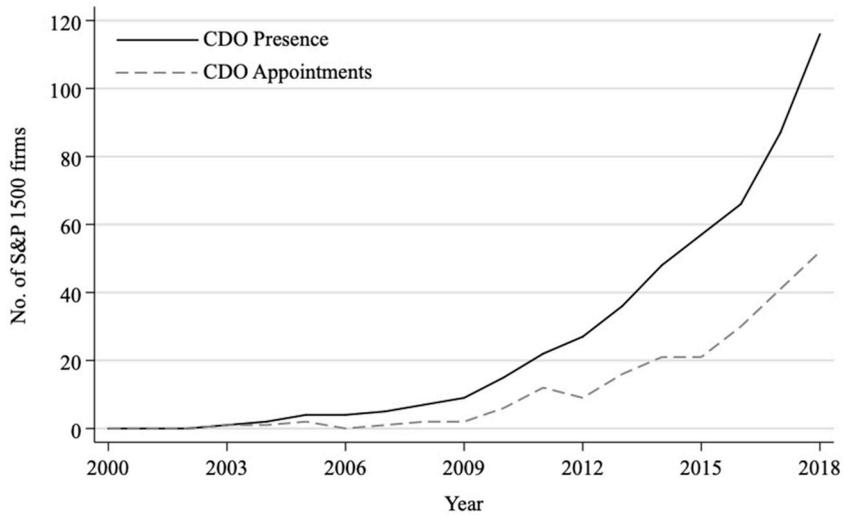


Fig. 1. Chief digital officer incidences in S&P 1500 firms.

require the specification of a distribution family, link function, and correlation structure. As we are testing a binary outcome variable, we utilized a binomial distribution and log link function. We chose an autoregressive correlation structure that accounts for time-related correlations within each panel. We also estimated all models using robust standard errors. Finally, we accounted for time trends using a continuous year variable (Hambrick and Cannella, 2004) and for potential reverse causality by lagging all independent variables by one year.

Empirical insights

In line with the study's two purposes, we present the empirical insights derived from the two steps in our empirical approach. First, we describe the findings concerning the emergence and prevalence of CDOs in large firms over time. Second, we discuss the conditions that affect the likelihood of having a CDO.

Step 1: presence and nature of the CDO

The first set of insights results from our analysis of CDO presence in firms as well as these officers' titles, role descriptions, and hierarchical levels.

Incidence. As displayed in Fig. 1 and Table 2, the presence of CDOs in large US firms is a relatively new and emerging

Table 2

Chief digital officer incidences in S&P 1500 firms.

Year	Appointments	Exits	Change	Presence
2000	0	0	0	0
2001	0	0	0	0
2002	0	0	0	0
2003	1	0	1	1
2004	1	0	1	2
2005	2	0	2	4
2006	0	0	0	4
2007	1	0	1	5
2008	2	0	2	7
2009	2	0	2	9
2010	6	4	2	15
2011	12	1	11	22
2012	9	4	5	27
2013	16	6	10	36
2014	21	9	12	48
2015	21	16	5	57
2016	30	23	7	66
2017	41	21	20	87
2018	52	30	22	116
Total	217	114	103	N/A

Table 3
Chief digital officer titles and roles in S&P 1500 firms.

Hierarchical Designation			Additional Role Designation		Actual Titles			
Term in Title	Number	Frequency	Functional (area) term in title	Number	Frequency	Title	Number	Frequency
Chief Digital Officer	155	71.4%	Information	20	9.2%	Chief Digital Officer combined with another C x O title	55	25.3%
Executive Vice President	32	14.7%	Technology	11	5.1%	Vice President - Digital	46	21.2%
Senior Vice President	44	20.3%	Marketing	8	3.7%	Chief Digital Officer	37	17.1%
Vice President	62	28.6%	Experience	5	2.3%	Senior VP/Chief Digital Officer	34	15.7%
Division	12	5.5%	Risk	2	0.9%	Executive VP/Chief Digital Officer	13	6.0%
Regional	3	1.4%	Strategy	2	0.9%	VP/Chief Digital Officer	10	4.6%
Other	5	2.3%	Innovation	2	0.9%	Division Chief Digital Officer	5	2.3%
			Development	2	0.9%	Chief Digital Marketing Officer	3	1.4%
			Media	2	0.9%	Global Head of Digital	2	0.9%
			Revenue/eBusiness	2	0.9%	Regional Chief Digital Officer	2	0.9%
			Product	1	0.5%	Senior Executive VP/Chief Digital Officer	2	0.9%
			Transformation	1	0.5%	VP/Division Chief Digital Officer	2	0.9%
			Platform	1	0.5%	Digital Platform Officer	1	0.5%
			Health	1	0.5%	ED - Digital	1	0.5%
			Administrative	1	0.5%	Head of Digital	1	0.5%
			Privacy	1	0.5%	Division Executive VP/Chief Digital Officer	1	0.5%
			Total	62	28.6%	Division VP/Chief Digital Officer	1	0.5%
						Group VP/Chief Digital Officer	1	0.5%
						Total	217	100%

phenomenon. The first occurrence of a CDO position in an S&P 1500 firm dates back to April 2003, when Mike Cooley was appointed as Vice President – Digital at Sprint Nextel. This was followed by the appointment of Bruce Spatz as Vice President – Digital at John Wiley & Sons Inc. in August 2004 and Bruce D. Marcus as Executive VP, Chief Information and Digital Officer at McGraw Hill in January 2005. The latter was the first with an actual *chief digital officer* title. While little information is available regarding Cooley's role at Sprint Nextel, useful details are available about Spatz's and Marcus' roles. Spatz was in charge of all digital products and the launch of “WileyPLUS, an integrated online learning environment for higher education,” while Marcus was “responsible for leveraging existing digital platforms and capabilities across the organization, and identifying and developing key technology solutions for K-12, higher education and professional markets worldwide” (see Appendix). Notably, two of the first three instances of CDOs were in the area of learning and education.

In the subsequent years, the number of CDOs increased slowly. By 2009, only nine firms had CDOs in their senior management ranks. However, starting in 2010, the number of firms with CDOs began to increase substantially. In 2018, the number had increased to 116 (nearly 5% of firms). Notably, 2018 was also the year with the highest net change in CDO presence to date. By the end of the year, 22 additional firms had CDOs—a 25% increase from 2017. Hence, the role is already a notable addition to firms' senior management teams and its prevalence continues to rise. As such, this study of an emerging management role promises to offer important insights into how firms make decisions about new senior executive positions.

Role features. Our analysis of CDO titles and roles descriptions provided a couple of generalizable insights into the nature of this emerging functional executive position (see Table 3). First, CDOs play prominent roles in the firms' hierarchies, as suggested by their designations of (executive/senior) vice president or CDO (more than 90% of cases). The CDO is typically on the firm's second or third hierarchical level. Notably, about 71% of CDOs in our sample hold the title of *chief digital officer*, which indicates their prominence in their firms. It is noteworthy that occurrences of the CDO title have risen over time. Between 2003 and 2010, the frequency of appointments with the CDO title was 53%, while the frequency with the title of Vice President – Digital was 47%. Between 2011 and 2014, the corresponding figures were 64% and 36%, respectively. From 2015 to 2018, 85% of appointments included the CDO title, while only 13% had the title of Vice President – Digital. This shift suggests that the CDO position has grown in importance over time and is becoming institutionalized as a top management role.

Second, in terms of tasks and responsibilities, our analysis alludes to conceptual variations in the CDO role. While CDOs all share a digital role, more than 28% have an additional functional role designation, such as marketing, innovation, or technology. To dig into this observation, we considered secondary data about the appointments available in firms' press releases and in individuals' job descriptions on social networking platforms (for examples, see Appendix).

Our analysis of this data supported our initial observation. On the one hand, there are *generalist* CDOs who assume roles and responsibilities related to a broad range of cross-functional digitalization topics in their firms. On the other hand, there are *domain specialist* CDOs who assume roles and responsibilities focused on specific functional areas. While variations in functional executive roles are not uncommon (Hambrick and Cannella, 2004; Menz and Scheef, 2014), this was an important insight that also influenced the choice of variables for the second step of our empirical study.

Table 4
Descriptive statistics and correlations.

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Chief digital officer (CDO)	0.02	0.13	1.00															
2. Year	2009.92	4.50	0.13	1.00														
3. ROA	0.04	0.14	0.01	0.03	1.00													
4. Sales growth	0.36	27.57	0.00	-0.01	0.00	1.00												
5. Industry MTB	2.29	0.84	0.00	0.02	0.10	0.01	1.00											
6. Industry ROA	4.54	2.45	-0.01	0.00	0.20	0.00	0.49	1.00										
7. Firm size	7.67	1.73	0.14	0.13	0.08	0.00	-0.14	-0.18	1.00									
8. BoD ave. age	62.24	4.28	0.01	0.28	0.03	0.00	-0.06	-0.06	0.15	1.00								
9. BoD age diversity	7.59	2.51	-0.03	-0.02	-0.01	0.00	0.00	0.00	-0.15	-0.03	1.00							
10. TMT ave. age	53.30	4.91	0.01	-0.02	0.04	0.00	-0.01	-0.01	0.16	0.43	-0.01	1.00						
11. CIO presence	0.38	0.48	0.08	0.12	0.04	-0.01	-0.02	0.02	0.29	0.00	-0.07	0.00	1.00					
12. Marketing intensity	1.70	2.27	0.03	-0.09	0.02	0.00	0.13	0.08	0.01	-0.05	0.03	0.02	0.01	1.00				
13. Sales intensity	0.25	0.10	0.01	-0.13	-0.02	-0.01	0.22	0.08	-0.10	-0.13	-0.01	-0.07	-0.04	0.04	1.00			
14. Innovation intensity	4.38	4.58	-0.04	-0.11	-0.04	-0.01	0.26	0.01	-0.16	-0.10	-0.01	-0.09	-0.10	-0.11	0.61	1.00		
15. Cum. CDO adoption	0.85	1.61	0.22	0.47	0.01	-0.01	0.00	-0.12	0.17	0.07	0.00	-0.01	0.11	-0.03	0.16	0.08	1.00	
16. Industry growth	-0.07	0.08	-0.06	-0.28	0.05	0.01	0.16	0.26	-0.09	-0.12	0.02	-0.04	-0.05	0.00	0.07	0.15	-0.15	1.00
17. Industry instability	0.00	0.15	0.00	0.02	-0.02	0.00	-0.02	-0.07	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	-0.19

N = 18,259.

Note: Correlations $\geq |0.02|$ are statistically significant at $p < 0.05$.

Table 5
GEE logit Estimations of Chief Digital Officer Presence in S&P 1500 Firms.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Year	1.374*** (0.046)	1.426*** (0.054)	1.357*** (0.047)	1.373*** (0.046)	1.198*** (0.033)	1.206*** (0.037)
Performance						
ROA	1.612 (0.772)	1.685 (0.922)	1.766 (1.774)	1.586 (0.764)	1.637 (0.640)	1.942 (1.837)
Sales growth	0.764* (0.098)	0.716* (0.118)	0.770+ (0.103)	0.784+ (0.103)	0.778* (0.079)	0.811* (0.086)
Industry MTB	0.974 (0.073)	0.971 (0.084)	1.002 (0.049)	0.968 (0.077)	0.939 (0.069)	1.048 (0.041)
Industry ROA	1.041 (0.033)	1.036 (0.036)	1.062+ (0.034)	1.039 (0.033)	1.050 (0.034)	1.064+ (0.037)
Strategic leadership						
BoD avg. age		0.929** (0.021)				0.913*** (0.023)
BoD age diversity		0.923** (0.028)				0.931* (0.031)
TMT avg. age		0.997 (0.020)				0.985 (0.022)
CIO presence		1.833** (0.352)				1.593** (0.265)
Task demands						
Firm size			1.448*** (0.085)			1.395*** (0.092)
Marketing intensity			1.062*** (0.014)			1.065*** (0.018)
Sales intensity			4.247+ (3.330)			1.240 (1.334)
Innovation intensity			0.935+ (0.034)			0.851*** (0.031)
Task environments						
Industry growth				0.521 (0.329)		0.354 (0.298)
Industry instability				0.823 (0.158)		0.829 (0.224)
Mimicry behavior						
Cum. CDO adoption					1.291*** (0.033)	1.375*** (0.052)
Observations	18,259	18,259	18,259	18,259	18,259	18,259
Number of firms	1755	1755	1755	1755	1755	1755
Wald X ²	108.58***	116.11***	159.89***	108.15***	259.07***	224.00***

Robust standard errors in parentheses.

***p < 0.001, **p < 0.01, *p < 0.05, + p < 0.10.

Step 2: determinants of CDO presence

Building on the insights from the first step of our analysis, in the second step we explored the conditions that might influence firms' decisions to have a CDO, especially factors related to a firm's performance, strategic leadership, task demands, task environments, and mimicry. Table 4 shows the correlations and descriptive statistics for all of the variables. While the correlation between sales and innovation intensity is 0.61, most correlations are less than 0.50. The variance inflation factors (VIFs) did not exceed 1.95, indicating that multi-collinearity was not an issue (Chatterjee and Hadi, 2012).

Table 5 displays the results of the pooled regression analysis with CDO presence as the dependent variable. We report odds ratios from our GEE analyses in Table 5. While coefficients only enable us to interpret the direction of an effect, odds ratios enable us to interpret the size of an effect—an odds ratio of 1 indicates no effect, while an odds ratio greater (smaller) than 1 indicates a positive (negative) effect. For example, an odds ratio of 1.20 indicates that a one-unit increase (decrease) in the independent variable corresponds to a 20% increase (decrease) in the likelihood of observing the outcome. Models 1 to 5 include the variables for each of the different sets of factors that we considered, while Model 6 includes all variables in the study. In discussing the results, we focus on the results from Model 6.

Performance. Our analysis reveals mixed findings concerning the performance variables. While we find no empirical evidence that firm profitability measured as ROA matters (odds ratio = 1.942; p > 0.1), firm sales growth is negatively associated with CDO presence (odds ratio = 0.811; p < 0.05). Moreover, although we find no empirical support that industry MTB is associated with the

likelihood of CDO presence (odds ratio = 1.049; $p > 0.1$), there is weak evidence that industry ROA may play a role (odds ratio = 1.064; $p < 0.1$). This may suggest that firms suffering from falling sales look towards new, digital means to enhance their sales. Hence, decisions regarding the need of a CDO appear to be informed by specific top-line (sales) task demands rather than because of bottom-line (profitability) performance conditions in the firm or industry.

Strategic leadership. The results related to the firm's strategic leadership are also interesting. While we find no significant relationship between TMT age and CDO presence (odds ratio = 0.985; $p > 0.1$), the average age of the board of directors (odds ratio = 0.913; $p < 0.001$) as well as the board's age diversity (odds ratio = 0.931; $p < 0.05$) are negatively related to CDO presence. These results indicate that the board of director's composition, as reflected in its age characteristics, is associated with structural choices in large public firms (Westphal and Fredrickson, 2001). Moreover, we find that CIO presence is positively related to CDO presence (odds ratio = 1.593; $p < 0.01$). This indicates that the CDO is used as a complement to, rather than a substitute for, the CIO. Our findings suggest that CIO presence increases the likelihood of CDO presence by 59.3% ($1.593 - 1 = 0.593$).

Task demands. The results for the firm's task demands reveal several insights. The first relates to *general* task demands. Firm size is positively associated with the likelihood of CDO presence (odds ratio = 1.395; $p < 0.001$). Hence, firms with higher levels of organizational complexity are more likely to use a CDO to tackle task demands associated with digital transformation.

The second relates to *specific* task demands in the functional domains of marketing, sales, and innovation. While marketing intensity is positively associated with CDO presence (odds ratio = 1.065; $p < 0.001$), sales intensity is not (odds ratio = 1.240; $p > 0.1$). In addition, innovation intensity is negatively related to CDO presence (odds ratio = 0.851; $p < 0.001$). These results suggest that although domain-specific task demands affect the decision to have a CDO, they do so in different ways. Firms facing greater task demands in externally-oriented functional domains, such as those related to customers and marketing, are more likely to use CDOs than those facing more internally-oriented task demands.

Task environments. Notably, our analyses suggest that neither industry growth (odds ratio = 0.354; $p > 0.1$) nor industry instability (odds ratio = 0.829; $p > 0.1$) influence the likelihood of CDO presence. This suggests that firms' task environments do not play an important role in their decisions to introduce CDOs.

Mimicry. The results related to possible mimicry behavior shed additional light on the diffusion of the CDO role. We find that the adoption of the CDO position is positively related to CDO presence in the focal industry (odds ratio = 1.375; $p < 0.001$). Therefore, we find some evidence that the decision to have a CDO could, at least in part, be driven by mimetic behavior.

Table 6 provides a summary of the empirical findings and effect sizes (based on Model 6 in Table 5). The table indicates the average effect of a 1-unit change in each of the predictor variables on the likelihood of the presence of a CDO. For example, a 1-unit increase in marketing intensity is associated with 6.5% increase in the likelihood of CDO presence. Similarly, if a firm has a CIO, it is 59.3% more likely to have a chief digital officer.

Table 6
Summary of results and effect sizes.

Factors influencing the likelihood of CDO presence	Average effect	- 1 SD	+ 1 SD
Year	20.6%	-72.1%	113.3%
Performance			
ROA	No significant effect		
Sales growth	-18.9%	6.6% ^a	-44.4% ^a
Industry MTB	No significant effect		
Industry ROA	6.4%	-9.3%	22.1%
Strategic leadership			
Bod avg. age	-8.7%	28.5%	-45.9%
BoD age diversity	-6.9%	10.4%	-24.2%
TMT avg. age	No significant effect		
CIO presence	59.3%	N/A	N/A
Task Demands			
Firm size	39.5%	-28.8%	107.8%
Marketing intensity	6.5%	-8.3%	21.3%
Sales intensity	No significant effect		
Innovation intensity	-14.9%	53.3%	-83.1%
Task environments			
Industry growth	No significant effect		
Industry instability	No significant effect		
Mimicry behavior			
Cum. CDO adoption	37.5%	N/A	N/A

The above table indicates the effect of a 1-unit change in the predictor variables on the likelihood of the presence of a CDO. For example, a 1-unit increase in industry ROA is associated with 6.4% increase in the likelihood of CDO presence.

^a Two of the firms experienced extreme sales growth fluctuations. In order to present more conservative results, we excluded these two cases here.

Discussion

As the digital age continues, an important phenomenon is the emergence of the CDO position in large firms. To explore this phenomenon, we engaged in an exploratory empirical study in which we analyzed a sample of 2339 S&P 1500 firms. Our exploratory, two-step approach revealed several important insights. In *descriptive* terms, we found that the first CDO appeared in 2003. Since then, the adoption of CDOs has increased, especially since 2011. Moreover, our analysis suggests that while the majority of CDOs are generalists, about 25% of them are domain specialists. In *prescriptive* terms, our analysis revealed that the firm's performance, strategic leadership, task demands, task environments, and mimicry behavior play distinct roles in decisions to have a CDO. Combined, the empirical insights advance our understanding of the CDO phenomenon.

Explanation of the empirical findings

We motivated our study's exploratory approach with the various possible theoretical lenses, none of which can fully explain this still emerging CDO phenomenon. In particular, we view the contingency, capability, diffusion, and behavioral perspectives as particularly useful and complementary in a more holistic explanation of the presence of CDOs in firms.

Contingency perspective. Overall, the study's findings suggest that firms opt to have a CDO to meet their task demands. Contingency theory (Burns and Stalker, 1961; Chandler, 1962; Child, 1975; Donaldson, 2001; Galbraith, 1973), which postulates that appropriate structural choices depend on the organization's external and internal context, offers a possible explanation for this finding. Specifically, our study sheds light on how *general* and *domain-specific* digital transformation task demands affect the likelihood of CDO presence in distinct ways. While organizational complexity as a general task demand increases the likelihood that a firm will have a CDO, domain-specific task demands play different roles depending on whether they are internally focused (e.g., innovation) or externally focused (e.g., marketing). Our findings suggest that a contingency logic matters, i.e. the firms' digital transformation task demands influence their decisions to have CDOs.

Capability perspective. Our findings also indicate that firms regard the CDO as a position that provides them with valuable digital capabilities. Qualitative and consulting studies have frequently noted that the CDO is expected to possess digital-transformation skills that other senior executives may lack (Friedrich et al., 2015, 2016; Péladeau et al., 2017; Reck and Fliaster, 2019; Singh and Hess, 2017; Singh et al., 2020; Tumbas et al., 2017). Our study reveals that firms opt for a CDO when their sales growth is below average and when marketing intensity is high. For example, when Sprint announced the appointment of Rob Roy as a new CDO in 2016, the title of the press release indicated that the goal was “to drive digital sales for the always connected customer.” (<https://newsroom.sprint.com/sprint-appoints-rob-roy-chief-digital-officer-to-drive-digital-sales-for-always-connected-customer.htm>) Therefore, according to the capability perspective, the decision to have a CDO appears to be motivated by a lack of digital competence. The fact that firms with a CIO may still opt for a CDO points to the importance of capabilities concerning the externally-focused aspects of the latter's role, which are closely related to the firm's business model and growth. This finding corroborates insights from qualitative research on digital transformation. For instance, Hess et al. (2016) note that “companies whose digital focus is on the interface with customers often appoint a chief digital officer (CDO) to work alongside the CIO” (p. 134).

Behavioral perspective. At the same time, our study suggests that the decision to have a CDO may not always be a purely rational choice. For example, we observe that firms with relatively old and age-diverse boards of directors are less likely to opt for CDOs. Considering age as a proxy for openness to strategic change (Kunisch et al., 2017), firms with older boards seem to see less need to use a CDO for digital transformation. While these findings indicate the role of boards for firms' decisions regarding the adoption of a CDO, they also point to a less “rational” behavioral perspective on CDO presence.

Diffusion perspective. Finally, our study reveals that the adoption rate of CDOs in an industry affects CDO presence in firms in that industry. Consistent with the literature on the adoption and diffusion of management practices and management innovation (Abrahamson, 1991; Birkinshaw et al., 2008; Piazza and Abrahamson, 2020) this finding reveals the mimetic behavior of firms. According to the contingency and capability perspectives, in some industries (e.g., media and financial services) the decision to have a CDO may be more useful than others and, thus, firms are more likely to introduce this new senior executive role. Moreover, according to the diffusion perspective, the decision to have a CDO is, to some extent, influenced by what other firms in the same industry do and, thus, by mimetic behavior. This shows that firms consider their competitors in their search for tackling the challenges of digital transformation.

Contributions to management and strategy research

Our exploratory study offers systematic, large-scale insights about the origins, evolution, and nature of the CDO position. The study's descriptive and prescriptive insights shed light on the emerging CDO phenomenon, complement knowledge on functional executive roles, and inform our understanding of the organization of the firm's digital transformation.

Chief digital officers. Our study extends the few qualitative, case-based works undertaken in this area to date (Singh and Hess, 2017; Singh et al., 2020; Tumbas et al., 2017). Building on a large-scale sample of firms, our study demonstrates that the CDO has recently become an important senior executive position in many firms. However, while research often assumes that the CDO position is already widespread, our analysis (based on a relatively restrictive definition of CDOs) reveals that only about 5% of S&P firms had a CDO by the end of 2018. Although scholars have started to explore the role and influence of the CDO, our results suggest that this senior executive position is not yet fully established.

Nevertheless, the decision to have a CDO is an important choice for large firms. We complement prior research on CDOs by

exploring the relationship between CDO presence and various internal and external contingencies, namely firms' performance, strategic leadership, task demands, task environments, and mimicry behavior. By offering large-scale evidence regarding the factors that drive decisions to have a CDO, we substantiate the few qualitative, case-based studies in this area (Singh and Hess, 2017; Singh et al., 2020; Tumbas et al., 2017). As such, our study informs future CDO research on multiple theoretical explanations for CDO presence.

Functional executives. More broadly, our study informs research on functional executive roles (Guadalupe et al., 2014; Menz, 2012; Svejenova and Luis Alvarez, 2017). Particularly, by revealing that some factors facilitate and others impede the adoption of CDOs in firms, we complement the few longitudinal efforts that have traced the origins and evolution of functional executives (Whittington et al., 2017; Zorn, 2004). Our study adds to the sparse knowledge on how new C-suite positions emerge, which is foundational for developing a better understanding how the nature of top management teams changes over time, and their impact on organizations (Guadalupe et al., 2014; Menz, 2012).

Moreover, our study shows that the contingency perspective is useful for explaining firms' decisions in the digital context (i.e., considering general and domain-specific factors representing task demands). While other studies focused on traditional functional roles in operations (Hambrick and Cannella, 2004; Marcel, 2009), supply chain management (Roh et al., 2016), strategy (Menz and Scheef, 2014; Whittington et al., 2017), marketing (Nath and Mahajan, 2008), and human resources (Abt and zu Knyphausen-Aufseß, 2017), this study suggests that the contingency lens is also useful for studying the presence of newly emerging senior executive roles like the CDO. At the same time, our study points to the importance of additional explanations, such as those offered by the capability, behavioral, and diffusion perspectives. More specifically, while some factors are positively associated with CDO presence (i.e., industry ROA, firm size, marketing intensity, CIO presence, cumulative CDO adoption in an industry), others are negatively associated with it (i.e., sales growth, innovation intensity, board of directors' average age and age diversity).

Digital transformation. Our study also informs research on the nature and organization of firms' digital transformation (e.g., Birkinshaw, 2018). While some authors argue that the rise of "born globals" in the mid-2010s (e.g., Braunerhjelm and Halldin, 2019) changed the playing field and constituted the "real" beginning of the digital era, others suggest that digital transformation began much earlier (e.g., Birkinshaw, 2018). In fact, pioneering work on the (organizational) implications of digital technologies dates back at least to the 1990s and early 2000s (Afuah, 2003; Brynjolfsson et al., 1994; Sampler, 1998). While we cannot entirely resolve this debate, our study finds that in S&P 1500 firms CDOs started to appear in 2003. As such, revealing the origins and evolution of this central digital position enhances our understanding of the microfoundations of digital transformation in contemporary firms.

Moreover, our study sheds light on the nature of digital transformation tasks. While some scholars have argued that digital transformation affects various elements of the value chain and business models and, thereby, different functional domains (e.g., Birkinshaw, 2018; Fitzgerald et al., 2013; Teece and Linden, 2017), we distinguish between *general* and *domain-specific* digital transformation task demands as influencing the likelihood of CDO presence. More specifically, our study reveals that different facets of domain-specific digital transformation task demands exist, such as internally-focused (e.g., innovation, manufacturing) versus externally-focused (e.g., marketing and sales) functional domains. As such, various functional domains, such as marketing or sales, might serve as catalysts for managing digital transformations in firms.

Strategy actors and agency. Finally, our study responds to recent calls for a better understanding of strategy actors and agency in research on strategic change (Kunisch et al., 2017; Müller and Kunisch, 2018), as well as in research at the intersections of strategy process and practice (Burgelman et al., 2018). While prior research has focused predominantly on the more general strategists like CSOs (Angwin et al., 2009; Menz and Scheef, 2014; Whittington et al., 2017), our study turns the spotlight on CDOs as a new type of "strategist" focused on digital strategy. In the digital age, competition and strategy work may be different, for example, because of blurring industry and firm boundaries that enable new business models and ways of strategizing that build on digital technologies (Hess et al., 2016; Iansiti and Lakhani, 2020; Teece and Linden, 2017). Our study reveals that firms increasingly rely on CDOs to tackle the opportunities and challenges of digital transformation as an important concern in strategy. Thereby, our study points to the questions of what CDOs regard as the concept of strategy and how they use it in their digital transformation practices (Lanzolla et al., 2018; Paroutis and Heracleous, 2013).

Implications for management practice

We believe that the insights of our study offer several implications for practitioners and management consultants. More specifically, our study suggests that practicing managers and consultant should carefully assess the need for a CDO, know the diverse CDO roles, and consider CDO interfaces.

Need for a CDO. While consulting reports and the business press often suggests that the CDO position is already widespread, our analysis (based on a relatively restrictive definition of CDOs) reveals that only about 5% of S&P firms had a CDO by the end of 2018. Our study shows that even though CDOs are on the rise, this position is not yet fully established across firms. While creating an innovative senior executive position like the CDO may be advantageous for a firm's digital transformation, it remains a discretionary choice. Thus, the first question for firms is to decide whether or not to appoint a CDO. Our study finds that multiple internal and external contextual factors influence the decision to have a CDO, especially with regard to firms' performance, strategic leadership, task demands, task environments, and mimicry behavior. Notably, our study suggests that not only broader strategic and structural factors, such as the performance conditions and firm size, should be considered, but also more specific factors, such as board characteristics and whether a firm already has a CIO position.

Diverse CDO roles. Our study reveals that the CDO position is not uniform across firms but rather diverse. Even though there are common features across CDOs, such as that they are all concerned with the firm's digital transformation, there are different facets of

CDO titles and roles with different foci and responsibilities. Our study shows that CDOs face a range of *general* and *domain-specific* digital transformation task demands. While our findings indicate that CDOs should cope with digital transformation challenges related to specific external functional domains, such as marketing and sales (Uphoff, 2019), they are often also responsible for more general business-related tasks, such as new business development. For example, when announcing the appointment of Adam Sussman as CDO in 2016, Nike explained that “Sussman will lead the team responsible for the development of industry-leading digital products and services across Nike.com, Nike+ and Brand Digital platforms.” (<https://news.nike.com/news/names-adam-sussman-as-chief-digital-officer>) Thus, when thinking about the creation of a CDO position, knowing the different facets of the CDO role will allow practitioners to familiarize themselves with the range of options they have concerning this position.

CDO interfaces. Our study also suggests that firms not only need to make a decision about having a CDO or not, but also about how to define the CDO's interfaces within the firm. While related research provides in-depth insights on how to embed a CDO within the firm (Singh et al., 2020), our study indicates that firms need to pay particular attention to the CDO-CIO relationship. Interestingly, a CDO position is created when there is already a CIO present in the firm. Based on our study, 50% of new CDO positions were created in firms in which a CIO was already present. In addition, 64% of firms in our sample that have a CDO also have a CIO. Clearly, even though these two senior executive positions concern digital/information technologies, they are distinct (Singh and Hess, 2017). Our study suggests that firms should consider the complementary nature the CDO and the CIO, especially the task division and interplay between them, when designing the CDO position.

Limitations and research opportunities

Of course, the present study has several limitations, which also point to opportunities for future research. Notably, several boundary conditions must be considered when using our study's insights (Busse et al., 2017). First, our study centers on the CDO position as an important structural choice in firms. In line with research on other functional executives (Hambrick and Cannella, 2004; Menz and Scheef, 2014), we deliberately focus on aspects of the CDO *position*, especially aspects of CDO titles and the CDO role, while we neglect the *person* holding that position. Obviously, filling the CDO position with a suitable candidate will make a difference for the effectiveness of the firm's digital transformation. Therefore, future studies should consider exploring the individual characteristics of the CDO, which may also improve our understanding of the differences between generalist and specialist CDOs. In other words, what does it take to become a CDO? Which capabilities are required? What career paths have they followed? What characteristics do CDOs have in terms of their backgrounds, prior experience, and personalities? As prior research indicates, the qualifications and backgrounds of senior executives can also play a signaling role (Zhang and Wiersema, 2009).

Second, even though our exploratory study considers a range of factors related to firms' performance, strategic leadership, task demands, task environments, and mimicry behavior, there are many other possible determinants of CDO presence. We thus encourage scholars to extend our study by exploring other factors in the firms' internal and external environments. For example, future research could study the CEO's, TMT's, and BoD's functional experiences with IT. Our finding that CIO presence is positively associated with CDO presence suggests that existing senior executive positions, especially in IT, can affect the decision to introduce a CDO. For another example, future research should explore the linkages between the CDO position and other related functional roles focused on digital transformation's domain-specific tasks, such as chief marketing officers and chief innovation officers. Such studies would also help advance a more comprehensive understanding of the configuration of executive roles (e.g., Menz, 2012).

Third, future research is needed to explore whether our findings are generalizable to firms that are smaller, private, or in other geographical contexts. Our study relies on a sample of S&P 1500 firms, which are large, publicly listed US firms. While this choice was in line with many prior studies of strategic leadership (Menz, 2012; Simsek et al., 2018), some of our findings may not be generalizable across institutional contexts as, for example, corporate governance models and digital maturity differ (e.g., Chakravorti et al., 2017). Thus, we encourage further research, especially research that considers the country-specific institutional factors that may affect the presence of the CDO.

Fourth, our study focuses on the emergence, nature, and determinants of the CDO position. As such, we deliberately neglect the consequences of CDO presence for firms. As prior qualitative studies indicate that CDOs matter, future research should examine the impact of CDOs on intermediate and performance outcomes at various levels, including their impact on strategic decisions and corporate strategies (Birkinshaw et al., 2018; Iansiti and Lakhani, 2020; Nielsen and Meehan, 2015). Future studies along these lines could also help us understand to what extent the use of a CDO position is merely symbolic (i.e., signals priorities and capabilities to stakeholders) (Connelly et al., 2011; Drover et al., 2018; Hambrick and Lovelace, 2018) and to what extent it is functional (i.e., having an impact on digital transformation outcomes).

Conclusion

As the prevalence of CDOs is on the rise, we need scholarly knowledge regarding their occurrence and their merits. This paper, which offers a systematic large-scale study of the emergence, nature, and determinants of the CDO position, demonstrates that firms have increasingly implemented this functional executive role. Our study provides novel insights into the origins and nature of this emerging phenomenon, and those insights provide a window into the microfoundations of digital transformation in contemporary firms. We hope that our study motivates others to look closely at this and related phenomena.

CRedit authorship contribution statement

Sven Kunisch: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Validation, Writing - original draft, Writing - review & editing. **Markus Menz:** Conceptualization, Methodology, Validation, Writing - original draft, Writing - review & editing. **Robert Langan:** Methodology, Software, Investigation, Formal analysis, Writing - review & editing.

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Appendix. The First Three Chief Digital Officer Incidences in S&P 1500 Firms

Mike Cooley at Sprint Nextel VP DigitalDates employed: 2003–2012

Michael serves at the Chief Revenue Officer for NTENT, responsible for all sales, marketing, customer support and revenue generation. For more than 20 years, Michael has led mobile and digital growth and strategy operations in the telecom marketplace. He co-founded and led digital/ad tech startups including Sundial.com and Pinsight Media, a subsidiary of Sprint. He previously served as VP of Business Development for Neustar and VP of Digital at Sprint Nextel, with additional management roles at Fortune 500 companies like Motorola and Deloitte Consulting.

Michael holds an MBA from the University of Michigan and a Bachelor of Arts degree in Economics from Tufts University.

Source: <https://ntent.com/management/>

Bruce Spatz at John Wiley Inc. VP Digital Publishing Group, Higher EducationDates Employed: 2004–2011

Innovation & Entrepreneurial Management

Responsible for all digital products (eLearning, assessment, eBooks, digital licensing and custom products): business models, market research, product management, product design and development, software requirements, learning design, media and assessment content assets, product delivery to end-users, training and customer support.

- Founding head of eLearning start-up, through market launch and success as the core product strategy for Wiley Global Education, used in 26 countries, supporting 300+ online course products, and helping over 700,000 learners each year. P&L responsibility to \$50M with sustained revenue growth averaging over 35% each year since launch.
- Created and launched WileyPLUS online learning environment: the first online courseware system for higher education, integrating text content, learning resources, automated assessment and course management to support education workflow. This digital business model propelled market share gains and enabled business transformation.
- Built and directed a team of 49 talented professionals across four departments. Created new capabilities and roles in product management, sales, marketing and customer support for eLearning products. Exceptional record of hiring and developing talent for promotions and greater contributions in management.
- Led cross-functional teams to develop multiple new business processes, workflows and supporting business systems for content technology, software and content QA, hosting infrastructure, eCommerce, fulfillment systems and technical support.
- Negotiated contracts and managed partnerships for software, content licensing, eBook distribution, learning management systems and major vendor relationships.

Source: <https://www.linkedin.com/in/brucemspatz/>

Bruce D. Marcus at S&P Global Inc (formerly McGraw Hill Inc) Executive VP, Chief Information Officer, Chief Digital OfficerDates employed: 2005–2010

Bruce D. Marcus is chief digital and information officer for McGraw-Hill Education with overall responsibility for the acceleration of the company's continued digital transformation. He is responsible for leveraging existing digital platforms and capabilities across the organization, and identifying and developing key technology solutions for K-12, higher education and professional markets worldwide.

Before joining McGraw-Hill Education, Bruce was executive vice president and chief information officer for The McGraw-Hill Companies, providing overall technology leadership for the corporation and its businesses and working with business management to expand the application of effective technology solutions across the enterprise. He also served as a member of the corporation's CEO Council.

Earlier, he was senior vice president, Enterprise Systems, with responsibility for systems development across The McGraw-Hill Companies. Before that, as vice president of Business Operations and Technology for Platts, he was responsible for Platts' global

technology development, administration, and operations, as well as its Content Management Services and Internet businesses.

Bruce also served as a business systems consultant for McGraw-Hill Higher Education and as senior director of software systems development for Standard and Poor's. Prior to joining The McGraw-Hill Companies, he served as the managing editor of Pathfinder Press, a small trade publishing house.

Source: <https://www.eiseverywhere.com/ereg/popups/speakerdetails.php?eventid=24240&speakerid=35446>.

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