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A Cubic Framework for the Chief Data Officer (CDO): Succeeding in a World of Big Data

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ABSTRACT

A new breed of executive, the Chief Data Officer (CDO), has stepped onto the stage, emerging as a key leader in the organization. To help readers understand this development, we provide a three-dimensional framework that describes the role of the CDO. The three dimensions include: (1) collaboration direction (inward vs. outward), (2) data space (traditional data vs. big data), and (3) value impact (service vs. strategy). We illustrate the framework with examples from early adopters and provide recommendations to help organizations assess and strategize the establishment of their own CDOs.

Keywords: chief data officer, CDO roles, big data, data management practice, enterprise data strategy, extended-enterprise data strategy, data quality, data architecture, data governance, business analytics

A Cubic Framework for the Chief Data Officer (CDO): Succeeding in a World of Big Data

EMERGENCE OF CHIEF DATA OFFICERS

Increasingly, companies expect that "big data," with its focus on volume, velocity, variety, value, and veracity,[1] will be a powerful strategic resource for uncovering unforeseen patterns and developing sharper insights about customers, businesses, markets, and environments. For example, some hospitals are using machine learning algorithms on patient data and insurance claims data to find unforeseen patterns and insights. Mountains of patient satisfaction survey data, a kind of unstructured big data, can now be text-mined for sensitivity analysis. As a result, hospitals can now determine how to improve their patient satisfaction scores, which are directly tied to the federal government's reimbursement to the hospitals.

Who can manage providing this insight from data for organizations? Data scientist roles have emerged to capitalize on the analytical opportunities of big data. However, hiring data scientists into operational business units without leadership at the corporate level might be insufficient for a corporation to harness the full value of big data. A recent survey[2] of over 500 global executives reveals that most companies are still learning how to manage big data at the enterprise level. The survey also reveals that companies that have a top executive responsible for its data management achieve higher financial performance than their peers.

Who is this top executive? In response to the influx of big data, leading organizations have established a new breed of executive, the Chief Data Officer (CDO). Wikipedia defines the CDO role as follows: "This role includes defining strategic priorities for the company in the area of data systems, identifying new business opportunities pertaining to data, optimizing revenue generation through data, and generally representing data as a strategic business asset at the executive table."[3] In reality, some CDOs strive to exploit big data for business strategy, while others focus solely on data preparation for external reports, overseeing compliance, and establishing data governance.

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[1] Almost everyone agrees that Big Data is important, but few can agree as to what defines Big Data. In our research, we define Big Data to have five key characteristics, known as "the five Vs": Volume, Velocity, Variety, Veracity, and Value. Note Veracity and Value, which are often omitted in Big Data definitions. Regarding veracity, it is not enough to have lots of high speed diverse data if the data is of poor or uncertain quality.

[2] A summary of current global practice with regard to big data can be found in "Big data: Harnessing a game-changing asset" *Economist*, August, 2010. It explains in detail the current practices of over 500 global companies with easy-to-understand tables and figures that are based on a large sample survey.

[3] The Wikipedia page on the Chief Data Officer is a good starting point for scanning the industry's current trends, but it does not provide a complete picture: http://en.wikipedia.org/wiki/Chief_data_officer .

WHY A CHIEF DATA OFFICER?

Leading organizations have learned an important lesson – that seemingly-tedious data problems are often fundamentally business problems. As such, data problems can reflect weaknesses in business strategy and operations. Traditionally, organizations have addressed data problems by assigning a small group within the IT department to clean up data. As it has become evident that data problems, particularly business problems rooted in data problems, cannot be solved by the IT group alone. Organizations have appointed data managers with various data-related titles, such as data quality managers, data quality analysts, and data stewards. Data governance mechanisms, committees, councils, and workgroups have also been developed to identify and solve data-related problems and resolve data-related conflicts. Finally, enterprise architecture and data architecture have also been employed to align data, IT, and business processes and strategies.

Despite these efforts, organizations have continued to face data issues, and their ongoing concerns have led a growing number of organizations to establish an enterprise-level, executive-rank CDO. Some might argue that traditional data-related managers and data governance mechanisms can deliver the same results as a CDO. However, there are critical differences between the efforts of low-level data managers and those of executive-rank CDOs. The key contrast lies in organizationally-sanctioned leadership and accountability appropriated to the executive level CDOs.

***First*,** unlike data managers, the CDO can lead the effort to build an organizational capability that can energize and sustain the entire organization and extended enterprise. More importantly, CDOs are responsible for communicating and collaborating with internal and external partners and stakeholders.

One representative case clearly speaks to the inherent challenges that data managers face during such projects. While attempting to reexamine the business processes that collect, store, and use customer data, one data quality manager (lacking the authority of a CDO) in a major healthcare institution recalled receiving this complaint from an executive: *"You are digging in my backyard – Get out of my backyard!"* One data manager recalled the project as: "*A huge responsibility without authority."* As a result of these obstacles, the entire project was discontinued; the group working on the project was dismantled; and some members left the company. Indeed, working at the low data-manager level limits the reach of communication and collaboration because managers are not in a position to dictate business process changes to higher rank executives, let alone external sources.

The ***second*** critical difference between a CDO and traditional data managers or data governance mechanisms is that the CDO can be held accountable for a failure of leadership in resolving data problems. Data governance mechanisms, such as data quality and governance councils, committees, and workgroups, can be useful for continuous improvement of data policies or standards, conflict resolution, reconciling and authorizing data sources. However, because members have their own responsibilities outside of the committee or workgroup, they are usually not held accountable for governance results.

To be clear, the CDO does not replace the need for data managers or data governance. Rather, the CDO leads data managers and enhances the effectiveness of existing governance by putting data on the organization's business agenda and in the minds of other executives and officers. Under the leadership of a CDO, business strategies reflect and exploit data, particularly big data, instead of treating data merely as a by-product of running the business[4].

The History of the CDO

The first recognized CDO was established nearly a decade ago at Capital One in 2003. Yahoo! and Microsoft Germany were also early adopters of the CDO position. More recently, CDOs have been established at global investment banks, consumer banks, consumer credit institutions, financial institutions, IT and data companies, healthcare organizations, US federal and state governments, and US military organizations. For example, the US Federal Communications Commission (FCC) created in each of its Bureaus a Chief Data Officer with varying rank and scope, such as a the CDO of Public Safety and Homeland Security; in total, the FCC created 11 CDOs. According to GoldenSource's annual client survey, "over 60% of firms surveyed are actively working towards creating specialized data stewards, and eventually Chief Data Officers."[5]

Many organizations recognize that they need an executive who should lead data management for the organization, but not necessarily a "CDO" by name. These executives (a CDO equivalent) are assigned to take on full-time positions leading enterprise-wide initiatives on data quality and analytics, data governance, data architecture, and data strategy. We use "CDO" to refer to all executives who are serving the CDO role at the enterprise level, even if they may not be formally assigned the title "CDO" yet.

Reporting Relationship

As organizations attempt to use more advanced business analytics, often there is a need to redirect the flow of information horizontally across the enterprise. Thus, many of the CDOs and executives that we interviewed advocated for formal organizational power to exert influence on company strategy. This power and authority is often reflected in reporting relationships, membership on senior management committees, and authority over budget and employment.

Of the CDOs that we interviewed in our study:

- 30 percent of the CDOs report directly to CEOs
- 20 percent to COO
- 18 percent to CFO

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[4] Company examples and discussions on managing information as product vs. by-product can be found in Lee, Y., Pipino, L., Funk, J., and Wang. R., Journey to Date Quality, MIT Press, 2006.

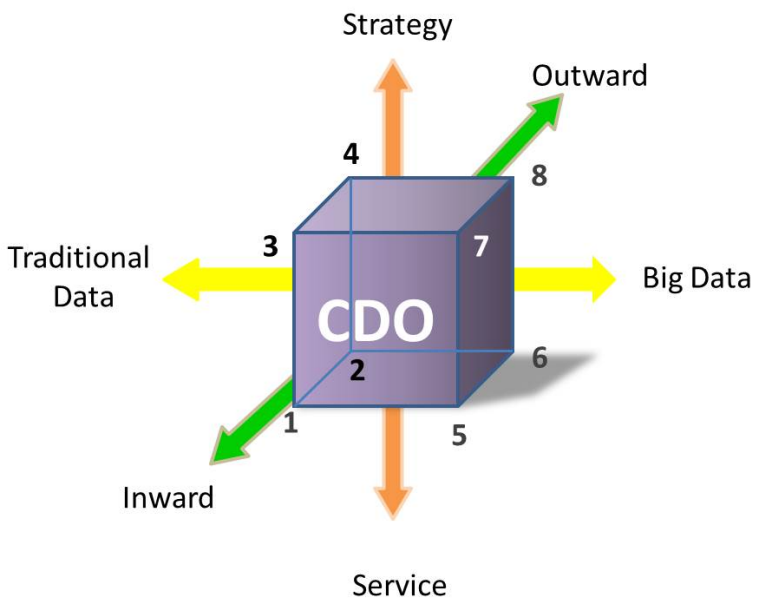
[5] Fernandez, T. "Chief Data Officers Becoming Crucial: Golden Source," *Securities Technology Monitor*, June 18, 2012. http://www.securitiestechnologymonitor.com/news/GoldenSource-Chief-Data-Officers-30775-1.html, accessed in December 8, 2012.

Others report to the CIO, CTO, CMO (Chief Medical Officer), or CRMO (Chief Risk Management Officer). Many CDOs are members of senior management committees and have the authority to establish policies and strategies. Currently, the power and authority of the CDO is evolving from data policy towards business strategy.

THE THREE DIMENSIONS OF THE CDO

In order to provide more structure and a better understanding of CDO roles, we identified three key dimensions, as shown in Figure 1: (1) collaboration direction, (2) data space, and (3) value impact. We describe each dimension below.

Figure 1: The CDO Cube - Role of Chief Data Officer
Dimensions: Collaboration Direction (Inward/Outward), Data Space (Traditional Data/Big Data), Value Impact (Service/Strategy)



CDO ROLES:

1 Coordinator	**2** Reporter
3 Architect	**4** Ambassador
5 Analyst	**6** Marketer
7 Developer	**8** Experimenter

1 Collaboration Direction: Inward vs. Outward

The collaboration direction captures the focus of the CDO's engagement, either inside or outside of the organization. Collaborating inward means focusing on internal business processes associated with internal business stakeholders. In contrast, collaborating outward implies that the CDO's focus is on stakeholders in the external value chain and environment, such as customers, partners, suppliers, or non-profit regulatory entities.

Initiatives led by internally-focused CDOs typically include developing data quality assessment methods or mechanisms; cataloguing data products, sources, and standards; creating processes for managing metadata or master data; engaging in information product mapping; and establishing data governance structures. These initiatives seek to deliver consistent data inside the organization and to address root causes of various data quality issues. Streamlining the internal business process associated with key data flows takes cross-functional cooperation, and it can yield efficient and effective business operations. The CDO's success in these initiatives depends heavily on ability to effectively lead the relevant internal stakeholders and map out the transformation journey.

In contrast, outwardly-focused CDOs strive to persuade and collaborate with external partners. For example, an outwardly-focused CDO of a global manufacturing company led a business process-embedded "global unique product identification" initiative, geared towards improved collaboration with external global partners. Outward CDOs may also focus on external report submission activities, particularly if the company has experienced an external embarrassment or a sizable disaster, such as being exposed by poor-quality reports.

2 Data Space: Traditional vs. Big Data

The data space that a CDO focuses on can either be transactional data, typically in relational databases, or the newer and more diverse big data.

Many CDOs focus on traditional data, as it is the backbone of the organization's operation. Without a strong foundation in traditional data, an organization's most basic capabilities are hindered, and thus the need for a leader such as a traditional data focused CDO arises.

In contrast, big data are usually not connected with the organization's transactional data or database systems, but offer innovative opportunities in further improving operations or developing new business strategies based on new insights that traditional data cannot provide. Big data CDOs provide the leadership to adapt to and manage the analysis of this new, diverse type of data and the implementation of insights from these analyses.

3 Value Impact: Service vs. Strategy

The CDO's role can focus on improving services or on exploring new strategic opportunities for an organization. This dimension reflects the impact desired from a CDO. In many cases, the CDO role is a direct response to the on-going need for an executive's oversight and accountability to improve existing functions of the organization. Increasingly, however, CDOs are sought who can add strategic value to their organization by taking advantage of new tools such as data aggregators[6] or other data products based on digital streaming data[7]. These CDOs are also exploring ways to develop new market niches, or transform the company in order to develop smarter products and services.

For example, one strategy-oriented CDO led an initiative to identify new information products, advancing the company's position in the financial industry. This CDO led a cross-organizational collaboration initiative to create a strategic vision for managing the new information products at the enterprise level. We have observed that the CDOs who are positioned higher in terms of corporate rank are better suited for taking on a strategy-oriented role.

CDO ROLE PROFILES

We have identified eight different role profiles for a CDO based on the three dimensions described above: collaboration direction, data space, and value impact. These roles correspond to the eight corners of the CDO Cube depicted in Figure 1. For convenience, we have assigned names to each of the corners, such as "Coordinator" for the corner with Inward Collaboration Direction, Traditional Data space, and Service Value Impact.[8] However, these names should not be taken too literally; they are simply intended to be a short-hand notation for each of the corners. Each of the eight roles is explained in more detail in the sections below.

It is important to note that, at any one time, a CDO may take on multiple roles. However, a CDO inevitably has one primary role. Moreover, it is common for a CDO to take on several different primary roles during his or her tenure as a CDO. Many CDOs that we interviewed noted that their primary role evolutions were punctuated by key initiatives or big changes in the environment or the broader marketplace.

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[6] Madnick, S. and Siegel, M., *MISQE* article, "Seizing the opportunity: exploiting web aggregators", *MSQE*, March 2002: 1,1pp 35-46 explains web aggregators and their strategic business opportunities using publicly available internet data.

[7] Picoli, G., and Pigni, F., "Harvesting External Data: The Potential of Digital Data Stream," MISQE, March 2013 (12:1), pp 53-64, explains new value-creating opportunities from digital data streams. One of the five value archetypes is aggregation of digital data stream.

[8] Note that "Coordinator" is much shorter than saying "Inward Collaboration Direction, Traditional Data space, and Service Value Impact."

1 Coordinator: Inward / Traditional Data / Service:

The *Coordinator* CDO manages enterprise data resources and sets up a framework that optimizes collaboration across internal business units (inward). This allows for the delivery of high quality data to data consumers in the organization for their business purposes, thereby improving business performance (service). The *Coordinator* works with traditional data, such as customer information and other transactional data (traditional data).

For example, the CDO at a US government agency identified common critical data elements across the enterprise with which to set the foundation for data sharing and integration at the agency level. The agency then led the identification of authoritative sources for these critical data elements. This work on common data elements set the stage for other data improvement initiatives. Part of this CDO's responsibility was to oversee the governance process for data management.

In another example, the CDO of a healthcare institution established data governance councils and workgroups. She also led the group responsible for enterprise-wide data quality assessment and improvement initiatives.

2. Reporter: Outward / Traditional Data / Service:

In heavily regulated industries, such as finance and healthcare, an emerging trend in the CDO role is a focus on enterprise data to fulfill external reporting and compliance requirements. Like the *Coordinator*, the *Reporter* CDO fulfills a business obligation (service) through the delivery of consistent transactional data (traditional data). However, the *Reporter's* ultimate goal is high quality enterprise data service delivery for external reporting purposes (outward).

For example, the CDO equivalent at a healthcare institution oversaw the preparation of a selected set of data for regular reporting to the state government. She worked closely with other corporate officers, such as the Chief Medical Officer and Chief Financial Officer, as well as with external officials, to ensure that reports were delivered in a timely manner and that they accurately and effectively represented the activities of the institution.

Similarly, *Reporter* CDOs are often found in financial service organizations, working with compliance or risk management groups to fulfill external reporting requirements. Typically these CDOs are established when the company has experienced difficulties in producing these reports, and often they play an important role in integrating the data and information silos of recently merged companies, as is required for external reporting purposes.

3. Architect: Inward / Traditional Data / Strategy:

An *Architect* CDO's direction and data space are the same as the *Coordinator* CDO (inward, traditional), but the value impact is focused on using data or internal business processes to develop new opportunities for the organization (strategy).

As an example, the CDO of a data company was responsible for establishing an enterprise architecture that would yield value-added customer data products. Under the CDO's leadership, the company developed a blueprint that described the business processes for delivering a new data product, the time required for each process, and the individual responsible for each process. This blueprint, which we call their "map,"[9] was used to collaborate with the members of the organization on a daily basis. This CDO recalled: "*We made [the map] everybody's map*. *Everyone knows their data role in the company*." Suggestions for improvement to data products were also attached to the "map." This CDO reported that the "map" reduced time to market for new products by 50%. In addition, the company produced better data products, and did so before competitors could, thus gaining strategic advantage in the market.

4 Ambassador: Outward / Traditional Data / Strategy:

An *Ambassador* CDO promotes the development of inter-enterprise data policy for business strategy and external collaboration (outward, strategy) and focuses on traditional data (traditional). For example, the CDO in a financial services institution defined common datasets for risk management. He promoted a set of data standards and data assessment measures for financial data exchange among peer financial institutions.

As a second example, an international bank in South America went through a strategic transformation that required significant process improvement and the establishment of data governance mechanisms. During the transformation, the CDO, reporting to the CFO, led a significant collaboration with other financial institutions to improve data security for electronic international money transfer processes and information exchange. This transformation was critical for the bank's business strategy and opened up opportunities to provide their customers with new services, which were previously not possible due to data security weaknesses.

5 Analyst: Inward / Big Data / Service:

The *Analyst* CDO resembles the *Coordinator*, except that he or she focuses on improving internal business performance by exploiting big data, thus requiring different data management and data analysis capabilities. The need for an *Analyst* CDO often emerges after an organization hires data analysts or data scientists but does not designate an executive leader to provide an enterprise perspective to their efforts.

For example, a credit card company established a CDO who was responsible for overseeing internal teams evaluating and analyzing big data, such as geo-tagged data about credit card use and data from online customer surveys. This CDO

[9] A pseudonym is used to denote the specific artifact at the request of the company.

collaborated with the Chief Risk Management Officer, and provided the direction to the data scientists. Subsequently, the company implemented enterprise-wide policies to improve risk management and fraud detection.

6 Marketer: Outward / Big Data / Service:

The *Marketer* CDO develops relationships with external data partners and stakeholders to improve externally provided data services using big data. CDOs in data product companies are often *Marketer* CDOs. They develop working relationships with retailers, financial institutions, and transportation companies that are purchasing their company's data.

For example, the CDO of a data product company worked closely with the company's customers, in this case healthcare institutions, to help extract insights from big data in the form of unstructured patient feedback data. The *Marketer* CDO led the analysis of this data in order to identify ways to alleviate key weaknesses of the healthcare institution. While few CDOs may currently claim this role, we observe that the *Marketer* CDO is an emerging trend that is important for managing supply chain partners and customers.

7 Developer: Inward / Big Data / Strategy:

The *Developer* CDO navigates and negotiates with internal enterprise divisions in order to develop new opportunities for the organization to exploit big data.

For example, the CDO in a retail organization, acting as a *Developer*, worked with the Chief Marketing Officer to find opportunities for new products and services based on the mining of consumer behavior data from geo-tagging along with consumer feedback data taken from social media sites. Using this vast source of information, the *Developer* CDO developed a personalized marketing strategy for the company.

8 Experimenter: Outward / Big Data / Strategy:

The *Experimenter* CDO engages with external collaborators, such as suppliers and industry peers, to explore new, unidentified markets and products based on insights from big data. Through strong collaborative relationships across industries, the *Experimenter* CDO maintains access to various sources of data and uses them for creating new markets and identifying innovative strategies for organizational growth.

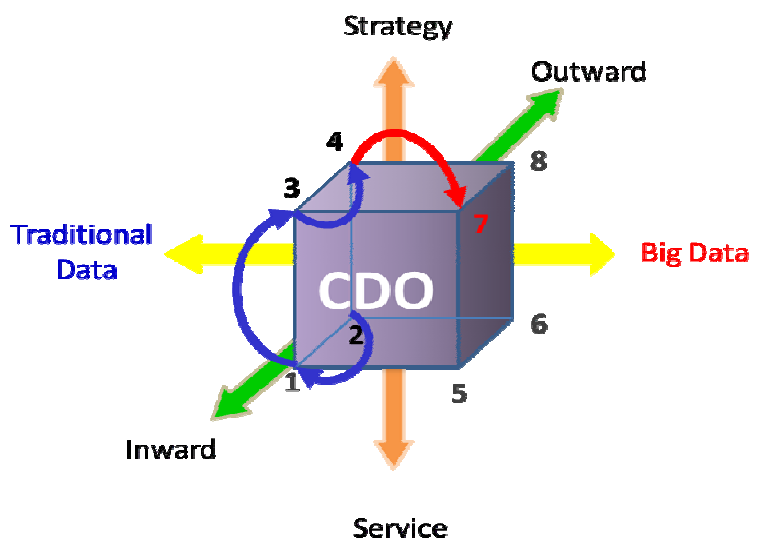
For example, the CDO of a financial institution experimented with developing marketable information products for the broader financial industry and its prospective clients. In preparation, the *Experimenter* CDO proposed the idea of creating new information products by transforming, integrating, and reusing data from multiple sources of consumer-generated data. More importantly, the CDO provided this new product concept to the organization's clients to gain their feedback. This *Experimenter* CDO subsequently developed information products based on various data sources and marketed them to client organizations. He argued: "*We should be a revenue center, not a cost center.*" By taking advantage of insights from the organization's diverse data set and guided by his knowledge of shared industry needs, this CDO expanded the organization's capability to conceive and experiment with new products, thus adding strategic value.

EVOLUTION OF THE CDO ROLE: An Example Path

Not all companies have the same needs and priorities, and thus the role of the CDO differs from case to case. Furthermore, the role of the CDO can change as the needs of the organization change.

Figure 2 depicts the role development of a healthcare CDO we studied for over a decade. In this case, this CDO started with a focus on providing good service to external recipients of traditional data. Gradually the CDO's role took on a more strategic focus, both internally and externally, and presently she is concerned with exploiting big data. Over a ten year period, this CDO's role evolved from *Reporter (role #2)*, to *Coordinator (role #1)*, to *Architect (role #3)*, to *Ambassador (role #4)* and now to *Developer (role #7)*. Below, we briefly discuss the CDO's role over time, and explain: (1) what triggered or prompted the CDO to transition to a subsequent new role; (2) why that role was chosen; and (3) what was accomplished by carrying out the new role.

Figure 2: Example Role Profile and Path



1 Coordinator **2** Reporter
3 Architect **4** Ambassador
5 Analyst **6** Marketer
7 Developer **8** Experimenter

Sequence of an Example CDO's Primary Roles

- *Reporter* CDO (Role #2): At the start of this journey, the CDO, acting as a "Reporter," oversaw the provision of data to state regulators, especially regarding reimbursements since these were essential to the business. This was a challenge because the data, generated internally from the hospital's operations, often was not ready for external reporting purposes. There were multiple sources of the same or similar data, producing inconsistent results. Several data sources were not trusted by internal data consumers, and thus some groups in the organization were reluctant to release that data for external purposes without further review. Every time there was a need for external reporting, the CDO had to go through all of the data, cleaning it up and preparing it for external submission.
- *Coordinator* CDO (Role #1): After being fined for submitting poor-quality data to the state government, the hospital realized that, in order to report good quality data externally, it needed to turn its attention to internal data quality. Given a mandate from the CEO to improve the quality of organizational data, the CDO transitioned from being just a "Reporter" to being a "Coordinator" as well. She established an enterprise-wide data quality improvement framework, coordinating across functional business units to systematically address the "cleaning up and preparing the data for submission." In addition, she developed procedures to assess data quality techniques periodically and established enterprise-wide data problem identification and resolution dashboards. Internal data consumers subsequently felt they could trust their data sources, and the external reporting process was also streamlined.
- *Architect* CDO (Role #3): Having successfully improved organizational data both for internal and external services, the CDO realized that there should be a sustainable structure and capability for data practice. This realization triggered the CDO to fill the gap of sustainability by strengthening the alignment of data practices with business processes by people, changing focus from service to strategy and assuming the role of "Architect". In this role she established governance for data quality as well as standards committees and working groups. She also established and maintained an enterprise level data quality problem-solving process and aligned business roles with data roles for all members of the organization. She implemented a policy for each member of the organization to have a specific data role, such as a data collector, data custodian, or a data consumer, in addition to a business role, thus strengthening the business-data alignment. In order to reinforce the importance of data roles, each member's contribution to the quality of enterprise data was factored into their annual bonus.
- *Ambassador* CDO *(Role #4)*: Increased pressure from insurance companies for comparable measurements required that the CDO improve collaboration between institutions. The CDO thus became an "Ambassador," engaging in industry benchmarking and the establishment of shared data practices through a consortium and various forums. She participated in setting the industry's data roadmap, organizing and training other data practitioners and collaborating with other instutions to promote data quality across all other hospitals. Through these efforts,

the CDO transformed standards setting for business processes and for various healthcare industry indices.

- *Developer* CDO (Role #7): The hospital eventually reached a plateau in performance from the use of its internal data. Consequently, the CDO took on the role of "Developer", exploring the use of big data generated by patients in order to improve hospital performance. In particular, she focused on developing various methods for analyzing unstructured patient feedback data in order to identify specific factors associated with poor performance. These analyses included data mining techniques such as sensitivity analysis. In combination with analysis of standard numerical assessments, such as the Hospital Consumer Assessment of Healthcare Providers and Systems report, the methods that the CDO developed led to actionable recommendations for doctors, nurses, and other units within the hospital. In further pursuing such opportunities, the CDO is currently developing new measurements to provide more tailored feedback to the clinical team for improving patient care and safety.

MAKING THE CDO CUBE ACTIONABLE[10]

The Cubic Framework can be used to identify focused roles of a CDO, a key to successful data practice. Below we provide a pragmatic three step guide, based on the Cubic Framework. The three steps, listed below, are Assess, Determine, and Strategize. We briefly list the steps here, followed by further elaboration.

1. ***Assess*** current status of your organization's data-related business practices (based on the three dimensions of the CDO Cube).

2. ***Determine*** the CDO role profile needed for your organization (based on the eight roles described), and whether an executive-level CDO is required to fulfill these needs.

3. ***Strategize*** the likely path for the CDO based on a projection of organizational future needs

Step 1: Assess current status of your organization

Assessment of the current status of your organization will help to highlight weaknesses your organization should focus on. The CDO Cube provides a framework with which an organization can identify their current needs with respect to collaboration direction (inward vs. outward), data space (traditional data vs. big data), and value impact (service vs. strategy).

In Table 1, we provide twelve assessment questions based on the cubic framework. Specifically, questions 1-4 deal with collaboration direction; questions 5-8 address data space; and questions 9-12 investigate value impact. To further

[10] The authors benefited greatly from the advice, discussion and input from the MISQE workshop in December 15, 2012, in Orlando, Florida.

demonstrate the assessment process, we have also included sample responses in the two rightmost columns.

Note that most organizations have needs that apply to every corner of the CDO Cube; these assessment questions will help to prioritize which roles (e.g., corners of cube) are most critical. These assessment questions are also an excellent opportunity to engage many members of the organization from cross-functional business units on all levels. The varied perspectives will strengthen CDO discussions, and in the case that a CDO is established, it can be done so with organizational-wide endorsement.

Table 1:		
Collaboration Dimension: Inward vs. Outward *High score for #1 and #2 implies inward direction.* *High score for #3 and #4 implies outward direction.*	**Assessment Score (1-7)** **1** Strongly disagree **4** Neutral **7** Strongly agree	Assessment discussion notes Why section: explain reason for Assessment
1. It is critical that our organization uses data effectively for internal business operations.	*3*	*We do this well, thus, not critical at this point.*
2. Our company has the opportunity to significantly improve internal operations.	*3*	*Maintain what we do well.*
3. It is critical that our organization collaborates with other value chain enterprises, such as suppliers, customers, distributors, or competitors.	*6*	*We need to know our suppliers and customers much better.*
4. Our organization's success is critically interlocked with other companies, market changes, external situations or environments.	*7*	*Our procurement can be vastly improved with better understanding our suppliers.*
Data Space Dimension: Traditional Data vs. Big Data *High score for #5 and #6 implies traditional data; High score for #7 and #8 implies Big Data.*		
5. Our organization's transactional data should be more effectively used to address the enterprise's needs	*6*	*We need to know more about aggregated amounts of materials for different suppliers.*
6. It is critical for our organization to use the transactional data in an integrated fashion across different business areas.	*7*	*To negotiate with our suppliers, we need to get all divisions to use the information we have already in a consistent way.*
7. Our company needs to identify opportunities for using big data and data analytics.	*5*	*We may not be there yet to go for this direction.*
8. It is critical for our organization to understand external sources of data, such as social media for engaging customers.	*6*	*Our customers might be ready for new sources in the future and we need to explore and exploit social media.*
Value Impact Dimension: Service vs. Strategy *High score for #9 and #10 implies Service; High score for #11 and #12 implies Strategy.*		
9. Our organization's data efforts should be largely initiated or requested by the enterprise's business units.	*4*	*We do this well.*
10. It is critical for our organization to improve the efficiency of the data service for operation.	*5*	*We can still improve, but we do well on serving data for the internal business units.*
11. Our organization's data efforts should be largely initiated by the need for changes in the way we do business.	*6*	*We can use the data for changing the way we do procurement planning with our global suppliers.*
12. Our organization must achieve its strategic business goals with better data.	*7*	*We must figure out who our best business customers are and set different strategies for different customers.*

Table 1 can be used both quantitatively and qualitatively. A simple quantitative analysis can be accomplished by assigning a score (on a 7-point scale) for each response. Comparing the sum of the first 2 scores and the last 2 scores for each dimension will reveal a bias in each dimensional space. For example, question 1 and 2 (emphasizing inward) may have scores of 3 and 3, respectively, and question 3 and 4 (emphasizing outward) may have scores of 6 and 7. The sum of questions 1 and 2 (3+3=6) is less than the sum of questions 3 and 4 (6+7=13), suggesting that collaborating *inward* is less critical than collaborating *outward*. This same process can be repeated with questions 5-8 to determine a focus on traditional vs. big data, and questions 9-12 to determine a focus on service vs. strategy. Taken together, these computations will identify a single, most critical CDO role.

A qualitative analysis can be accomplished by explaining the "why" in the "Assessment Discussion Notes" column for each of the questions . This helps to determine the criticality of each dimensional direction. The examples shown in the rightmost columns of Table 1 are very terse; more comprehensive notes could be used to further elaborate.

Step 2: Determine whether a CDO is needed

Based on the initial assessment, an organization can then tackle Step 2, which is to ***determine*** the CDO role profile needed and whether an executive-level CDO is required to fulfill these needs. Note that it may take considerable discussion before an organization can decide which roles are most important; the scores from Step 1 should not be taken as an immediate solution. Rather, the assessment questions should be used as a tool to initiate conversations among members of the organization on data practice and the implications for the organization's overall performance.

Establishing a new CDO requires serious consideration because it implicates a change in resource allocation and reporting relationship. Therefore, before creating a CDO position, an organization should review the effectiveness of other data practice mechanisms, such as governance committees, workgroups, data and business process conflict resolution mechanisms. On the other hand, often data practice initiatives alone, without assigned accountability, do not yield effective results.

Additionally, in some cases, organizations may already have leaders who can take on the role, or parts of the role, of a CDO. For example, the CFO may be able to take on the work which Step 1 Assessment would assign to a Reporter CDO or Coordinator CDO, in which case focus on traditional data and service may not be as critical as the assessment numbers suggest. We have also seen cases where the CMO has taken on the role of a Developer CDO or Experimenter CDO role. These are instances of effective collaboration amongst senior executives, in which case establishing a separate CDO may not be necessary. More often, however, such collaboration efforts among executives can be short-lived and ad hoc. If so, there is need for sustainable leadership made possible by a CDO..

Step 3: Strategize the CDO transitional path

The step of ***strategizing*** for future needs can be broken down into two processes. First, the organization should create a projected timeline for addressing the needs discussed in steps 1 and 2. For example, as illustrated in the right-most columns of Table 1, during steps 1 and 2, an organization might determine that the most needed CDO role profile is that of an Ambassador (outward, traditional, strategy). In this situation, the organization may propose an 18-month plan to closely align data practice with business processes.

Second, based on quantitative and qualitative measures, the organization can determine how crucial other roles in the Cubic Framework are relative to the primary role assigned. Alternatively, the organization may determine that there are no other highly critical needs which must be addressed at this time. In either case, based on the projected timeline the organization can either determine that the planned CDO will need to transition from one role to another or it can decide to reassess organizational needs by repeating steps 1 and 2 in the future.

In the example from Table 1, further analysis may suggest that big data demands are almost as critical as the traditional data needs which the future Ambassador CDO plans to address (e.g. summed score 13 vs. 11). The organization could plan for the CDO to transition from Ambassador CDO to Experimenter CDO (outward, big data, strategy) at the end of the 18 months in order to address external needs.

An implicit, yet key strength of the three-step process is that it is a collective endeavor which engages all cross-functional business units. Enterprise support and approval for the establishment of a CDO lays the groundwork for the CDO to be an effective leader.

CONCLUDING COMMENTS

As an organization's strategies for achieving success become increasingly dependent on data, organizations must position themselves to harness the value of data. To this end, establishing a CDO has been an emerging trend in industry and government. Soon, more and more organizations will need to exploit the critical value that the CDO can provide. We present the CDO Cube framework to provide a guide for those organizations to help analyze the need for a CDO and the profile for the CDO, along the three dimensions that we have identified.