EXPERIENCE: Succeeding at Data Management—BigCo Attempts to Leverage Data

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In a manner similar to most organizations, BigCompany (BigCo) was determined to benefit strategically from its widely recognized and vast quantities of data. (U.S. government agencies make regular visits to BigCo to learn from its experiences in this area.) When faced with an explosion in data volume, increases in complexity, and a need to respond to changing conditions, BigCo struggled to respond using a traditional, information technology (IT) project-based approach to address these challenges. As BigCo was not data knowledgeable, it did not realize that traditional approaches could not work. Two full years into the initiative, BigCo was far from achieving its initial goals. How much more time, money, and effort would be required before results were achieved? Moreover, could the results be achieved in time to support a larger, critical, technology-driven challenge that also depended on solving the data challenges? While these questions remain unaddressed, these considerations increase our collective understanding of data assets as separate from IT projects. Only by reconceiving data as a strategic asset can organizations begin to address these new challenges. Transformation to a data-driven culture requires far more than technology, which remains just one of three required “stool legs” (people and process being the other two). Seven prerequisites to effectively leveraging data are necessary, but insufficient awareness exists in most organizations—hence, the widespread misfires in these areas, especially when attempting to implement the so-called big data initiatives. Refocusing on foundational data management practices is required for all organizations, regardless of their organizational or data strategies.

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1. CASE INTRODUCTION

Good technology in the hands of an inexperienced user rarely produces positive results.

Everyone wants to “leverage” data. Today, this is most often interpreted as investments in warehousing, analytics, business intelligence (BI), and so on. After all, that is what you do with an asset—you leverage it—so the asset can help you to attain strategic objectives; see Redman [2008] and Ladley [2010]. Widespread and pervasive

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foundational challenges are preventing most organizations from achieving results from data-leveraging activities. Overcoming these challenges will enable organizations to better leverage their data assets and increase the productivity of all knowledge workers but especially those referred to as “data scientists”; see Economist [2010] and Economist_Intelligence_Unit [2013]. Organizations are able to achieve leveraged data but only at a higher organizational price tag than if they had built these capabilities on top of the mature, foundational data management practices.

This experience article¹ covers a two-year period as BigCo attempted to obtain better leverage of its data. During this period, the BigCo data management (DM) team (a dedicated team of associates supplemented by consultants) attempted to implement what was thought to be the appropriate approach to improving data leverage—an IT project-based, data management program. They were unsuccessful. The case pauses as BigCo reaches the beginning of the third year with little to show for its multi-million-dollar investment. Here, the reader is invited to design solutions that will permit BigCo to achieve its two-year-delayed objectives.

The next section of this case provides some background on the state of data management in general. This section reveals that BigCo is doing only as well as their competition, that it does not know that its data management practices are immature, and that its competition is in relatively the same situation. The following section (Section 3) introduces BigCo and the DM team. In Section 4, the case narrative continues with a description of the plans and activities that occurred during Year One. Year Two (Section 5) is described as an increasingly frustrating and wasted effort—in spite of a dramatic project re-scoping. The correct prerequisites for this (and all) organization(s) are presented in Section 6, along with a challenge to develop plans required to change the concept of data from an IT component to a strategic asset.

2. THE STATE OF DATA MANAGEMENT IN ORGANIZATIONS

BigCo is not alone in their desire to leverage data. What they do not realize is that they are also not alone in their frustration at not being able to better leverage their data. Few studies have focused on the maturity of organizational data management practices, and the results are not known outside of the academic outlets where they have been published. In summary²:

- Non-information-technology (IT) students learn virtually nothing about how to manage their data. They reinvent and/or discover well-established practices on a project-by-project basis. This represents a huge source of untapped productivity from both an individual project basis and from a greater contribution to the research community as increasingly prestigious journals and grant funding institutions require more stringent levels of dataset sharing, transparency, and availability.³
- IT students take typically one course that is focused on development of a new, physical database, learning in the process that data management is a technical skill required for the development of new databases. Unfortunately, this has sent the message that data management is a technical (rather than a strategic) discipline and it not worthy of management attention. As evidence of this incorrect focus, in the early 1980s, three quarters of data managers reported directly to the organizational Chief Information Officer (CIO) but by the mid-2000s they were typically reporting three levels down from the CIO.

¹This experience material is provided to be the basis for learning discussions rather than to illustrate either effective or ineffective handling of any specific situation.

²More detail is available in the Appendix.

³See, for example, <http://www.nature.com/authors/policies/availability.html> and <http://www.nsf.gov/eng/general/dmp.jsp>.

- A study by the international professional organization for data managers (DAMA.org) reveals that most seek out data management as a profession after 10 years in IT, frustrated that more is not done to support data management [Perez 2006]. When combined with results showing that the scope of CIO responsibilities is vast and diffuse, it is no wonder that the number of self-rated successful data management practices has fallen from more than 43% in 1981 to less than 15% in 2007 [Aiken et al. 2011].

With a limited, largely technical educational focus, organizations and individuals are clearly unaware of the existence of data management as a formal, professional discipline. This accounts for the largely immature data management practices existing in most organizations. Specifically, on the widely used Software Engineering Institute/Capability Maturity Model Integration (SEI/CMMI) scale, the typical organizational data management practice maturity is self-reported to exist between managed and defined (2 and 3) on that scale [Aiken et al. 2011].

3. INTRODUCTION BIGCO AND THE DATA MANAGEMENT TEAM

3.1. BigCo: Background

BigCo had achieved considerable growth and, at times, had led its sector. It relied on highly complex but effective logistics expertise to feed an ever-increasing number of outlets, including extensive automation and customer facing components. Hundreds were employed in a headquarters IT group, working on many simultaneous projects. An increased need for architectural-based disciplines became evident and BigCo responded by hiring a new Chief Architect (CA) in Year Zero. The CA faces two data-related challenges, in addition to many others.

In Year Zero, BigCo faced a substantially different operational environment due to the rise of online competition and innovative internet-based business models. The competitive environment was evolving in substantive ways and BigCo was struggling to meet these challenges. As its operational environment increased in complexity, BigCo's ability to manage its intricate technical environment had not increased. Dependency on the tacit knowledge possessed by the organization's knowledge workers was acknowledged to be a high business continuity risk. A conscious organizational decision to not pay competitive rates compounded the challenge of retaining the current, knowledgeable staff. Internal phrases such as "tribal knowledge" and "kick the can down the road" were used to describe this situation.

In addition, BigCo was facing a major, systemic data issue (literally overflowing a key, fixed-length ID variable) that required re-specification of one of their most fundamental business objects: LOCATION. This LOCATION reengineering involved identifying, managing, and controlling the evolution of a widely implemented, organizationally common variable: a "master" data item. The cost of this issue had been estimated to vastly exceed the millions of dollars spent on the year 2000 fix. The proposed redress threatened to consume a large portion of future IT budgets and, in turn, resources needed for new business-driven initiatives. The business side of BigCo articulated constant frustration with IT's inability to deliver satisfactory plans for resolving this issue.

3.2. Year Zero (Context): Leadership, the Data Management Team, and BigCo's Organizational Structure

3.2.1. Chief Architect. During Year Zero, the CA was a new organizational hire, charged with recruiting an associate to be the Enterprise Data Executive (EDE)⁴ and

⁴This position is also sometimes referred to as the Chief Data Officer (see <http://iscdo.org>) or often more simply as the Top Data Job (TDJ).

implementing the DM team, among many other initiatives. The new CA was aware that the organization was neither making use of nor recognizing the value of its data, but his understanding of how to resolve this was limited. Understanding the organizational way of getting things done, the CA spent a full calendar year (Year Zero) working within the existing BigCo IT bureaucracy to hire an EDE who was to be responsible for implementing the new organizational data management program. For BigCo, structure reflected strategy. Creating a position and working that position into the existing organizational structure was a formal expression of organizational power and commitment. Funding the position represented an agreed-on response and, thus, acknowledging the need for more organizational data expertise. Wanting new concepts to be introduced into the IT environment, the CA hoped to fill the EDE position from outside of BigCo.

3.2.2. Enterprise Data Executive. Unfortunately, the organization had never had a senior person in charge of data. It was unable to conduct a competent interview for the EDE. Challenged technically, the CA selected an individual with the optimal organizational/culture fit. The selectee, a long-term associate with proven management skills, had recently been in charge of a team that installed a complex IT system for a single business area. The individual did not have a background or experience in data and subsequently chose not to learn more about it, believing that demonstrated project management skills would suffice. Most importantly, the selectee was unaware of the fundamental challenges arising from reporting to the existing organizational IT structure.

The EDE reported to the CA, who reported to a VP, who, in turn, reported to the CIO (see Figure 1). Through an unfortunate historic accident, the database administrators reported through a different VP position (Senior VP Technology), to the CIO rather than through the CA. This structural misalignment left the two groups often competing for resources and with reduced incentives to cooperate. The tension was exacerbated by the reality that the database administrators (DBAs) could hold up business initiatives, giving them concrete “wins” when contending against the EDE’s team by claiming holdups were due to the DM team delays. Prior to the establishment of the DM team, the DBAs considered themselves the DM team, further adding to tensions between the groups.

3.2.3. The Data Management Team. Previously, DM had been an informal activity, (as mentioned) carried out by the existing DBA team. They believed they were performing adequately. At the beginning of Year One, the EDE formed the DM team of existing associates. Six data architects and business analysts were invited to join the DM team and six more were hired during Year One. Some were well-qualified DM team members by an external, objective standard⁵ and others were under-qualified.

Two additional issues hurt the recruiting/selection/acclimation processes. First, the EDE insisted (as was the culture) on hiring personally. Lack of DM knowledge again prevented the individual from conducting meaningful technical interviews. Second, recruits found the competition between the database administration team and data architecture implementation team confusing and unsettling and several qualified applicants declined the offer to join the DM team.

3.2.4. External Consultants. A final DM team component was the addition of two types of external consultants: Senior Consultants (SCs) and Data Consultants (DCs). First, three SCs were repurposed from an existing effort. Already under contract to “define information as an organizational asset,” they were asked to provide strategic guidance

⁵An objective standard is considered to be the knowledge required to pass DAMA International’s CDMP exam see <http://www.dama.org/content/certification> for more detail.

Fig. 1. A portion of organizational chart illustrating the position of the DM team within the BigCo IT Organization.

and mentor the DM team. The initial plan was to develop an overall data strategy based on a series of PILLARS, representing various aspects of data management with titles like “Governance and Oversight,” “Data Quality,” “Data Architecture,” and so on. Each PILLAR represented a set of competencies required by the organization.

While Figure 2 uses the word “managed” twice, a perhaps better choice would have been “governed,” connoting oversight by a body that is not necessarily technical in nature. With further hindsight, the graphic failed to distinguish between mandatory and optional PILLARS and did not illustrate interdependencies among the PILLARS. This led to the mistaken general belief that PILLARS could be done in any sequence or skipped altogether. Unfortunately, the (underqualified) EDE decided which PILLARS were optional or could be addressed first, often against the advice of the SCs.

In addition to the SCs, the EDE obtained authority to hire a number of additional data consultants (DCs) to supplement the existing associate-based team and to help it

Fig. 2. DM team Initial Planning Document for BigCo.

to ramp up quickly. The argument persuasively reflected the volume of work that had to be done rapidly.

4. YEAR ONE: SUPPOSED FIRST STEPS

4.1. An Overview of the Initial Plan

The plan for Year One was to:

- form and implement a DM team,
- identify and provide training for the BigCo DM team,
- develop, obtain approval for, and implement an organizational data strategy,
- develop pillar-specific strategy and tactics,
- implement enterprise data modeling, and
- begin to engage the business on multiple projects.

Each is described below.

4.2. Form and Implement a DM Team

When using consultants, one of the most important aspects of any engagement is to agree on their primary role. The SCs were hired by the CA specifically to mentor the EDE. While this seemed both appropriate and unambiguous, the BigCo culture did not support this process.

BigCo's culture was obsessed with demonstrating its capacity to succeed. This culture dictated not looking to consultants for answers but as labor. There was much to celebrate, as BigCo was widely recognized for achieving impressive success. What was not as widely known was how frequently that expensive, brute force was employed when compared to better-engineered solution alternatives. The IT knowledge workers, and indeed the entire organization, was smart but had been with the organization (and been inculcated in its culture) for much longer than a typical workforce. This left them more knowledgeable about BigCo's internal workings and systems but also subject to pressure to being "team players" and they were not willing to "rock the boat." While this instilled a positive belief in the organizational capabilities, it also left them resistant to new ideas.

As a result, all consultants were viewed as order takers who did the work to be supervised by associates. The DM team members were dis-incentivized to spend time learning from the consultants, as that would decrease their productivity as project participants. Having to stop and learn from the consultants might move their task to a "red" status or reduce the amount of time they spend on "engagements," a crucial

objective for the EDE. The role confusion continued throughout the 2 years, with the EDE having to spend time weekly sorting out individual points of confusion instead of setting clear guidelines.

CA disengagement caused a final structural issue. Having recruited the EDE, hired consultants, and lined up training, the CA assumed that assigning a team to the effort would be sufficient. Instead of being concerned with the reality of implementation difficulties, the CA focused on forward-thinking, radically different ways the organizational data could be used to support the strategy. The data management practices foundation inspection subsequently revealed that the organization was incapable of supporting these initiatives.

4.3. Identify and Provide Training for the BigCo DM Team

Associate external training was restricted; for example, most of the DM team had not been to training or an industry conference for more than 5 years.

During Year Zero, generalized IT architecture training was delivered to the entire IT staff. The associates procuring the training were not qualified to judge the content of the purchased product. The training provided a good overview of IT architecture and process architecture but devoted less than 1% of its content to data and data architecture issues. Of more than 500 training slides, only 5 referenced data's role in architecture—a necessary prerequisite to obtaining data leverage. Since all organizational architects (including the data architects) received this 5-day training course, the organization had incorrectly educated its architects due to the inaccurate training that diminished the role of data.

After observation, the SCs identified additional, corrective training as a major organizational need. They specified a training plan containing classes at initial, intermediate, and advanced levels. They noted in order for the DM team to function as a productive, cohesive group, it would need common understanding. The proposed classes reflected the gap between current and required knowledge, skills, and abilities.

Only one of the classes was developed and it was never delivered, leaving the rest with the status of “need to be developed” as other tasks demanded resources. This deprived the newly formed DM team of many learning opportunities and, perhaps most importantly, the opportunity to converse using the same organization-wide vocabulary to agree on what they were supposed to be doing and how they were supposed to accomplish it.

4.4. Develop, Obtain Approval for, and Implement an Organizational Data Strategy

The SCs charged with “developing the organizational data strategy” began by asking the question, “What is BigCo's business strategy?” And to the surprise of all, no one was able to provide an answer. The reason was the complex internal communication structure implemented by BigCo. Outside of the reporting structure shown in Figure 1, BigCo employed business systems analysts (BSAs) to facilitate the transfer of business requirements into technical requirements capable of accomplishing the business requirements—BSAs speaking, in effect, both “business” and “IT.” However, the BSAs reported to IT and were more fluent in IT than in business talk. By the time a BSA had internalized those components of organizational strategy that were relevant to a specific IT project, it became an instance of seeing only the trees instead of the forest. If they existed, then organizational strategy elements and specific sets of goals/objectives were not well perceived at the IT project level, and what did exist was confused, inaccurate, and incomplete. For example, one BI-flavored problem initially appeared to be a bottleneck/throughput problem but instead turned out to be a logistic/value chain problem. As a result, IT projects did not well reflect organizational strategy.

SCs were unable to obtain even a vague picture of the strategy that was to be supported by leveraging organizational data assets. When they approached the business directly, they were admonished to “remain within IT.” Higher-ups subjected the CA to harsh criticism for attempting to engage on business strategy. At one point the senior consultants drafted a pro forma strategy based on public filings, annual reports, and trade press. When it was presented as a potential foundation for the data strategy, the first question asked was, “Where did you get that? No one is supposed to have that information!”

While this hindsight-based realization appears clear and decisive, the reality was that it took the SCs almost the entire year to understand that no one in IT could provide the holistic picture required to marshal data in support of strategy and develop an organizational data strategy [Kavanagh and Jozwiak 2011] and the SCs would not to be permitted to reach out to the business directly.

4.5. Develop Pillar-Specific Strategy and Tactics

Lacking the ability to successfully develop an enterprise data strategy, the SCs were told to develop individual strategies for each of the pillars. These were accomplished devoid of useful strategic business input. Initially labeled as (for example) “Data Quality Strategy,” all work products were eventually blandly relabeled (for example, “Data Quality—Executive Summary”) and became unused shelfware (see Pipino et al. [2002] and Kahn et al. [2002] for examples of what was proposed). Production of each PILLAR SUMMARY became the sole focus of individual DM subteams, supplemented by senior consultants leading the efforts.

4.6. Implement Enterprise Data Modeling

It was assumed that the organization required an enterprise data model to guide future development efforts. The organization had procured a copy of a reference model and another DM subteam focused on making the reference model more organization-like—a process referred to as ORGANIZATIONALIZING; for more see Aiken et al. [2014]. The team ran into the same lack of business insight as those charged with developing the data strategy. Upon this realization, the SCs futilely attempted to raise the alarm with the EDE that the associates were driven by more tactical priorities such as reporting project progress.

4.7. Begin to Engage the Business on Multiple Projects

BigCo had recently discovered “project management” and was finding it useful to manage a multitude of IT projects. Nine months into Year One, a project manager was appointed who reworked tasks and deliverables without understanding the nature of the work. For example, the enterprise data modeling subteam (Section 4.6) was asked the following: “How long will it take to ORGANIZATIONALIZE the reference model?”

- Programs are Ongoing, Projects End
 - Managing a program involves long term strategic planning and continuous process improvement that is not required of a project
 - Programs are Tied to the Financial Calendar
 - Program managers are often responsible for delivering results tied to the organization's financial calendar
 - Program Management is Governance Intensive
 - Programs are governed by a senior level board that provides direction, oversight, and control while projects tend to be less governance-intensive
 - Programs Have Greater Scope of Financial Management
 - Projects typically have a straight-forward budget and project financial management is focused on spending to budget while program planning, management and control is significantly more complex
 - Program Change Management is an Executive Leadership Capability
 - Projects employ a formal change management process while at the program level, change management requires executive leadership skills and program change is driven more by an organization's strategy and is subject to market conditions and changing business goals
- Adapted from http://www.broadbusiness.com/program_vs_project.html and <http://management.italialife.com/management/program-management-vs-project-management>

Sidebar: Differences between Programs and Projects

While it was reasonable to ask how long until an effort produces results, it is incorrect to require program-based results from a project because of the fundamental differences between the two (see the sidebar “Differences between Projects and Programs”). As a result, when the associate in charge of the ORGANIZATIONALIZING effort was asked when it would be complete, the individual was ill equipped to respond. When

pressured, the associate gave an end date that was several quarters in the future. The project manager pushed back, insisting on specific weekly deadlines. In this repeated scenario, two unknowledgeable individuals were establishing arbitrary time deadlines and effort requirements to avoid being reported as “red” in the weekly progress assessment meetings. (This process also included once “approving” a model that had no contents.) This sort of unnecessary confusion crippled each pillar and was worsened by a combination of the EDE (unable to offer substantive guidance) and by the organizational culture that reinforced treating the consultants as “order takers” (providing hourly services instead of expert guidance).

4.8. Year One Brief Recap

At the end of Year One, critical components of the effort were stuck:

- the organizational culture was not helping the data strategy effort,
- planned team training and other development activities had not materialized,
- various attempts to build a DM program had been turned into projects, and
- the consultants were being “managed” by unknowledgeable associates.

As a result, BigCo had made no tangible progress toward its goal of elevating the way it treated its data assets toward that of a strategic asset.

5. YEAR TWO: RE-SCOPING

5.1. Reassessment

At the end of Year One, the SCs asked for a one-year checkpoint/assessment meeting. They met with the EDE, CA, and the Senior VP Architecture (Figure 1). The consultants gave themselves and their efforts so far a grade of “C.” This was based on having made frustratingly little tangible progress, noting:

- missing business engagement,
- no sense of business strategy,
- lack of progress implementing needed programs, and
- inability to provide training or discipline.

After BigCo’s commitment to the program was questioned by the SCs, it was conveyed to the group that no additional guidance/support from upper management would be forthcoming. To quote the Senior VP Architecture, the highest ranking executive in the meeting, “that stuff does not happen here and you will have to make do with what you have.”

5.2. Refocus

As a result, the original concept was re-scoped around two of the original PILLARS (GOVERNANCE & OVERSIGHT and DATA ARCHITECTURE). These were selected because they were perceived as being immediately relevant to the organization and the effort was formally reclassified from a program into projects. At this point, one of the SCs disengaged, noting that, “There wasn’t any use for my abilities in the re-scoped effort.” The two remaining SCs were refocused on the two remaining “projects.”

The rest of the DM team was reorganized around the specific pillar/projects, as were the plans and consulting resources. Further guidance came from management that there had been “too much fooling around during the first year and that the organization wanted the second year to be more results oriented.” So intense was the pressure that a long-planned, weeklong data architecture course—designed to address the identified deficit in the data architecture training—was postponed indefinitely. Soon all pretense of group learning and team development was abandoned and everyone was refocused

on one of the two “projects.” This move disclosed the startling fact that the organization had no idea just how to integrate DM team member activities with its existing IT project development lifecycle.

By applying associates individually to multiple efforts, the team managed to disguise its lack of cohesion. Since no one on the projects knew what a DM team member was supposed to do, none were accused of doing “the wrong thing.” Discussions were focused on not slowing down any existing IT projects. Only when team members compared notes across projects did discontinuities come to light.

5.3. Two Key Conversations

Two conversations very late in the second year (reproduced below) served as warning indicators that the entire process was veering further off track.

5.3.1. Attempting to Schedule the Data Architecture Training. The previously referenced data architecture course was developed to serve two audiences. The first audience was the DM team: The course would help them all to “get on the same page” with common vocabulary and concepts. Taking time to discuss the course contents, approaches, and vocabulary would coalesce team efficiently. The second audience was all BigCo IT associates. The EDE had secured agreement with BigCo’s IT management that all IT staff would be required to take the new (improved) course since the previous course had been deemed officially “data deficient.” The first conversation went as follows:

- DM team member: “We have decided to postpone the course. It turns out that we can’t agree what the words on the course outline mean. So we have decided to postpone the training for six months and have weekly meetings to resolve our internal differences.”
- Senior Consultant: “But walking through the course materials as a group is way more effective ...”
- DM team member: (interrupting) “... Yeah, we know that. But management won’t allow us to take time off the projects to schedule the training. So now that we have the time, we are going use it as I just described to you.”

Not having those weekly meetings would prevent a necessary first step to maturing as a DM team—establishing a common vocabulary and understanding of the specific challenges. At 2 years into the effort, the DM team was just now realizing that major prerequisite work still had to be accomplished. The weekly meetings were never scheduled.

5.3.2. Task Scoring. The second conversation occurred between the EDE, an SC, and a DM team member. The subject was a PILLAR assessment score. The DM team member’s perspective was, since some groups within the organization were accomplishing PILLAR-specific tasks, the PILLAR ought to receive a higher score. The Senior Consultant pointed to method guidance indicating that since the tasks were not managed BigCo-wide, it should receive the lower score, reflecting a weak organization-wide capability. The BigCo associate clearly expected that since SCs worked under their direction that that position would be reflected in the assessment.

The EDE was asked to comment and gave the following guidance:

- EDE: “Now (BigCo associate) you are responsible for ensuring that BigCo’s position is represented and (Senior Consultant) you are responsible for ensuring industry best practices are represented.”
- DM team member: “So which score should we use in the document?”
- Senior Consultant: “It does have strategic implications.”
- EDE: “Well you guys are really smart—you figure it out and tell me.”

That these roles were still this unclear at the end of Year Two clearly highlighted basic uncertainty around roles and project team members. In sum, that these conversations took place at all indicated big problems.

5.4. The EDE Was Reassigned Internally

Toward the end of Year Two, the EDE began spending more and more time addressing organizational issues other than data management program implementation. Soon, the group was left leaderless and informed of this change by observing a LinkedIn notice that BigCo was recruiting an EDE, this time from outside the organization. In private, BigCo management indicated that they now understood that it had been a mistake to attempt to run the group using someone with so little interest in DM and they were going to use their existing business network to recruit someone more suitable for the EDE.

5.5. Year Two Brief Recap

At the end of Year Two:

- the organizational culture was acknowledged to be playing an even more negative role than during Year One,
- the individual in charge (EDE) left suddenly for a “higher priority” project,
- there was still no training/team cohesion or even a common sense of purpose,
- one Senior Consultant’s departure reduced knowledge transfer possibilities,
- basic roles/responsibilities were confused, and
- lack of higher level IT management support and pressure to produce short-term results further hampered the effort.

All this resulted after a major effort to de-scope at the beginning of Year Two. Of equal if not greater importance, this de-scoping had moved BigCo further from its goal of treating data as less of an IT by-product and more of a strategic asset.

6. YOUR CHALLENGE: YEAR THREE—LESSONS LEARNED AND LAST CHANCE FOR A NEW START BY ACHIEVING DM PREREQUISITES

Two years is an eon in business. It is clear that BigCo’s attempts have not worked. Treating data as a strategic asset requires a substantively different approach to what has been attempted to date. Further, efficient correction of the major LOCATION data challenge (referenced in the Section 2.1) cannot occur effectively if BigCo continues to address these challenges using traditional, IT project-based approaches to systemic data challenges.

The answers to this case study are clear: Seven necessary but insufficient prerequisites (in combination) are required to attain tangible organizational data leverage. Importantly, these are programmatic as opposed to project-oriented activities. Further, these must be recognized and treated as “overhead” functions in order to determine appropriate return on investment. The reader’s task now becomes one of designing a means to make this happen.

Develop recommendations applicable to BigCo, advising it how to make progress in maturing its data management practices, especially in light of the relatively poor organizational performance characterized by the objective results. The challenge this experience article proposes is to create organizational conditions required to achieve the DM prerequisites and allow the DM effort to mature productively. These prerequisites are derived from the lessons learned during the first 2 years and are commonly applicable across organizations [Aiken et al. 2007; Aiken and Gorman 2013]. They include:

1. **Obtaining qualified leadership for data initiatives:** Someone knowledgeable must be in charge of organizational data assets. Because data are treated by our educational systems as a technical discipline, the knowledge base required to successfully leverage organizational data assets is currently unknown by IT management. Unlike the qualifications for a Chief Financial Officer (pass the CPA exam, earn a Masters in Accountancy, become a Certified Management Accountant, or obtain other recognized designations), CIO and data leadership qualifications have not been developed and, more importantly, the need for them has not been widely recognized. As a result, it is a case of not knowing that organizations *do not know what these qualifications are*, and therefore they *cannot* know who is qualified to head up such initiatives.⁶
2. **Understanding the underpinnings of data-centric thinking:** The lack of knowledge (from #1 above) unfortunately guarantees that business and IT alike are unaware of the architectural underpinnings required to implement organizational data assets. The set of ideas and motives that form the basis for data-centric thinking require a grounding in the disciplines of engineering and architecture that are not currently part of existing curricula. Just as you cannot build a multi-story house with a poor-quality foundation, good data management practices must precede effective and efficient organizational data leverage. It is key to develop standard procedures for handling data assets, just as there are standard ways of handling fiscal assets. Absent these, the workgroup-based processes existing in most organizations will continue to provide insufficient outcomes.
3. **Shared data must be developed separately from and externally to and precede individual IT projects:** The implementation method followed by traditional IT projects (especially Agile methods) cannot succeed in implementing organization-wide data assets capable of being leveraged unless a separate, external, and prerequisite effort is made to define and maintain them across individual IT projects. Attempting to determine data requirements concurrently with IT project requirements guarantees more disparate data. This fundamental, structural requirement is not reflected in existing IT project implementation methods. Further, organizations need to recognize that there are two distinctly different classes of data: master data and transactional data. This is an important distinction because the work DM professionals need to do relative to each class differs. There will also be different business rules, processes, and authorities for each data class
4. **Currently, asking EDEs to report into an IT project management-driven organization creates unresolvable conflict:** IT projects are just that—projects that have beginnings and ends. As outlined above, shared data (data that can be successfully leveraged) must be architected, engineered, and maintained at a level above IT projects. It is folly to ask the data team to report to an organization that (correctly) manages and implements IT change on a project-by-project basis. Instead, data asset management should report to the executive team at the same levels that other resource managers report to (i.e., managing organizational finances does not have a beginning or an end and cannot be implemented solely as a series of projects).
5. **Maintaining appropriate expectations/articulating success:** Achieving substantive changes in behaviors and tangible results can require progress to be measured in years [Aiken and Billings 2013]. The EDE must constantly explain why the data requires program-level investment and quantify the results. Only by understanding existing organizational strengths and weaknesses through a series

⁶The top data job concept has been embraced by Gartner, who predict that “90 percent of large organizations will have a chief data officer by 2019” [<http://www.gartner.com/newsroom/id/3190117>].

of iterative, shared attempts can any organization hope to achieve competency in this area, and this process can take years. It is critical for EDEs to set and maintain appropriate, reasonable expectations beyond the annual budget cycle. This requires a careful balancing between providing increased organizational data-leveraging capabilities and delivering operational results in terms of increased efficiencies and effectiveness. To much of one or the other will not support long-term objectives.

6. **Understanding how to successfully implement data-based strategies:** Porter first highlighted the need to make fundamental strategic choices between innovation and improved operations [Porter 1980]. Organizations need to understand that most DM teams cannot initially be good at both efficiency/effectiveness *and* innovation strategies. It is easier to practice the former and recognize tangible savings that can be used to fund the latter. This explains the reasons that most “big data” projects succeed at rates comparable to IT projects in general [Marr 2015] and why the recent expectations of investments in data science have produced less than stellar results [Harris and Murphy 2013].
7. **Implementing a successful organizational change management strategy:** “Culture eats strategy for breakfast” is a quote attributed to Peter Drucker [2006]. The changes required to implement successful management of data as a strategic asset require alterations at the most fundamental level in both IT and the business. It is critical to implement organization-wide change management strategies as part of the implementation or risk loss of executive sponsorship, organizational momentum, or vision.

Unfortunately, unless BigCo can figure out a way to get from where they are to where they want to be, they will continue to spend too much time and resources as they try unsuccessfully to leverage their data. And, perhaps more importantly, they are preparing to attempt to solve the previously mentioned “critical technology-driven challenge”—reengineering the LOCATION business object—without fully understanding how data management can play a key role in solution development. Are you able to help them out? It is hoped that this experience article will motivate your team to design solutions to the fundamental changes that must be made in order to achieve BigCo’s long-sought-after data leverage.

7. TEACHING NOTE

This teaching note includes information for those teaching the case. The material will be largely unfamiliar to most and so supplemental readings to the case are suggested in Section 7.8.

7.1. Teaching Themes and Lessons from the Case

Attempting to resolve the issue of poor data management practices using traditional means and managing it from the technically focused IT perspective cannot succeed. Research illustrates that approximately 10% have been successful to date [Aiken et al. 2007; Aiken et al. 2011] in spite of this being the era of “big” data. A different approach is called for, one heavily focused on leveraging the business value of organizational data. This thinking is new to most organizations.

The overall teaching theme of this case is that well-maintained data possess unique characteristics that qualify it as a strategic organizational asset. Historically, it has not been treated as such. This must be addressed in order to bring organizational data management practices up to par with IT project implementation.

- (1) **Lesson 1: Organizational data can and should be managed more effectively.** Most organizations think data management is being handled in a professional manner—it is not. The IT and the business sides each think the other is

responsible for managing data as an asset and, consequently, neither is doing a good job. This dichotomy is both pervasive and entrenched. It will require significant organizational commitment to redress properly. To begin to correct this hidden deficiency, data management must be reconceived from an informal workgroup-based practices to an integrated system of five integrated data management practice areas (of the DMM) described in the Appendix.

- (2) **Lesson 2: Strategic use of organizational data assets requires professional leadership.** Given the difficulties that organizations such as BigCo (and the vast majority of others) have experienced, it is clear that only strong executive support can begin to address this challenge. Having a single executive charged with this responsibility presents the best approach developed to date; perhaps participating students will improve upon these ideas.
- (3) **Lesson 3: All organizations can benefit from data-centric thinking.** Validation of an across-industry lack of success and sense of futility, illustrating that BigCo's experiences and lack of results are widely shared, and, thus, the lessons learned apply very broadly. Most organizations are like BigCo because of the largely technical focus on the part of the educational system. This technical focus must be supplemented with a formal curriculum (yet to be recognized, much less developed) before widespread adoption of this new thinking about data can become pervasive.

7.2. Case Descriptions/Synopsis of the Case

BigCo is successful and they think that their data is being managed in a professional manner. However, a newly hired organizational Chief Architect (CA) understands otherwise and sets about to develop capabilities that BigCo does not know that it does not possess. Challenges ensue as BigCo tries to implement this new way of thinking about data as a traditional IT project.

7.3. Basic Issue(s)

Data management is perceived as a technology issue by most organizations. This perspective has been reinforced by educational programs that have mirrored this technical focus. The technology groups of most organizations treat data as a commodity (i.e., storage). A stereotypical response from IT is "If they can log onto the server then my task is complete." Most non-technical organizational associates (including executives) do not consider how their data are treated. After all, there is an officer whose title is Chief Information Officer (CIO); what more could be needed? Unfortunately, CIOs have been placed in charge of not just the organizational information assets but generally in charge of most of technology, ranging from email, disaster recover, application development, vendor management, and so on. There just has not been time to get more involved in data management and harm resulting from this lack of attention increases with data volume.

7.4. Potential Uses of the Case

Most organizations do not have formal, organization-wide data management programs. The programs that do exist are at a low level of maturity. This case can be used to introduce students to the challenges associated with implementing a formal organizational data management program in curricula ranging from business schools to computer science to library science.

7.5. Potential Audience of the Case

Both graduate and undergraduate students in science, technology, engineering, and mathematics (in particular, information systems, computer science/computer engineering, and science), indeed all knowledge-based disciplines, will benefit from a greater understanding of these challenges. The importance of data is such that groups

ranging from data journalism to political science have also found it useful, and use of this case should be considered for any situation involving knowledge workers—after all, that is the definition of a knowledge worker: one who works with data.

7.6. Teaching Objectives

Data are an organizational asset and IT has been treating data as a commodity. The resulting gap has resulted in a myriad of undiagnosed business and IT problems. This case highlights these two perspectives and provides students with an understanding that only a combined socio-technological solution supported by executive leadership can begin to resolve which has been a long-standing challenge for most organizations.

7.7. Suggested Teaching Approach/Plan

Ideally, the case should be presented as two 3-hour classes. It is designed to be introduced in a first class, and then development of an integrated case solution is discussed in a second class after a group assignment.

7.7.1. Class 1: Introduce the Case and the Seven Prerequisites. Assign the case and any supplemental materials to be read prior to class. Begin class by asking students what they think of when considering data and its use in solving organizational challenges. Lead them with a discussion to the conclusion that data are an organization's sole, non-depletable, non-degrading, durable strategic asset. Compare the characteristics of this organizational asset with other organizational assets, such as real estate, intellectual property, and human and fiscal capital. Introduce material from the Appendix while discussing the approach taken by BigCo, highlighting why, after 2 years, the effort was failing.

Conclude class by dividing students into seven teams. Assign the seven student teams each a single prerequisite (see the Appendix, Section A.1.6), and ask each team to design a solution to achieve it. Each group should prepare a plan to refocus BigCo's efforts towards the resolution of each prerequisite.

7.7.2. Possible Discussion Questions For Class 1.

What are the characteristics of organizational assets that are considered strategic in nature?

Emphasize that data are the only durable, strategic asset that do not degrade over time and cannot be used up.

How did this situation come about?

Explore the various data-related backgrounds of class participants; what have they learned about data's role as an asset from their various programs?

What needs to happen from the technology side?

Realize that having no one in charge of data on the technology side leaves a vacuum in the organization. In a world of IT projects, how does one advance the idea that cross-project resources (data) need to be considered at a higher level of abstraction that occurs outside the traditional implementation method.

What needs to happen from the business side?

The business side does not realize that (1) data have the unique asset property of being the organization's sole, non-depleting, non-degrading strategic asset, and (2) no one is in charge of it. This leaves another harmful vacuum in the organization. Contrast this with how organizational fiscal assets are managed.

Faced with this all this as context, where does one acquire the knowledge, skills, and abilities to manage data as an organizational asset?

7.7.3. Class 2 Developing An Integrated Solution. During class 2, having read the proposed solutions as completed assignments, get the student teams to present them to the class and use these to help the entire class to understand the need for a combined/integrated solution. Specific questions are delineated in Sections A.2.1 through A.2.7 in the Appendix; be certain groups have addressed at least these foci when presenting their individual prerequisite solutions. When combined as part of a class discussion, the composite solution will provide the entire class with broader insights as each aspect is revealed to solve portions of the entire challenge. Class discussion can be focused on integrating each partial solution into something that BigCo can implement as a holistic solution. This will highlight various interdependencies between prerequisites (see Appendix Figure 5) and reinforce the complex structural nature of the challenge. Save at least the last half-hour to discuss ways of combining the various approaches into a holistic solution. Conclude the second class by emphasizing the teaching theme and three lessons from Section 7.1.

7.8. Suggested Additional Readings

The following can be assigned as supplemental reading to provide more background and context for the assignment.

- (1) P. H. Aiken and M. Gorman. 2013. *The Case for the Chief Data Officer: Recasting the C-Suite to Leverage Your Most Valuable Asset*. Morgan Kaufmann, San Francisco.
- (2) Peter Haynes Aiken, M. David Allen, Burt Parker, and Angela Mattia. 2007. Measuring data management practice maturity: A community's self-assessment. *IEEE Comput.* 40(4) (2007), 8.
- (3) Peter Haynes Aiken, Mark Gillenson, X. Zhang, and David Raffner. 2011. Data management and data administration: Assessing 25 years of practice. *J. Database Manag.* 22(3) (2011), 20.

7.9. Multimedia Support

A number of Keynote slides⁷ (including all figures in this experience article) are posted on the JDIQ website for use as teaching supplements. These can also be obtained directly from the author.

A. APPENDIX: CHALLENGES IMPLEMENTING MATURE ORGANIZATION-WIDE DATA MANAGEMENT PROCESSES AND PRACTICES

Organizations hampered by disadvantageous data management practices face three specific disadvantages. To quote from the IBM research:

Knowledge is power—but only if it can be extracted quickly and efficiently from an ever-growing data mass. Business and other organizations now see their information stocks snowballing beyond their ability to manage them and beginning to work against the health of the enterprise by damaging efficiency and bottom lines. The stock answer to the data pile-up is more cheap storage and lots of it. But reflexively pumping everything and anything into an apparently limitless reservoir hurts the organization in three ways:

1. It becomes harder and harder to retrieve information promptly
2. More people are needed to manage increasingly chaotic data dumps
3. Networks and application performance are slowed by excess traffic

as users search and search again for the material they need. (IBM 2006)

⁷Keynote is the Apple Macintosh and cloud-based version of PowerPoint—these can be usually converted into Power-Point format. In addition, the author participates in the ACM and IEEE distinguished speaker/visitor programs and can present this case in person or via Skype with sufficient advance notice (see http://dsp.acm.org/view_lecturer.cfm?lecturer_id=2345).

While the above description focuses attention on harmful effects caused by immature data management, it misses what many consider to be the most harmful effect—the drag on the productivity of the organization’s individual knowledge workers. As work becomes increasingly knowledge based, organizations continue to search for ways to increase worker productivity, and improving organizational data management practices represents one of the most promising.

This Appendix describes seven necessary prerequisites to mature, organization-wide data management practices that have already profoundly helped many organizations achieve significant increases in knowledge worker productivity across the board [Aiken and Billings 2013]. These prerequisites are necessary but insufficient to ensure that value is achieved from investments in organizational data management. BigCo cannot hope to reach their desired strategic data leverage without first maturing their data management practices to achieve these prerequisites. Before examining the prerequisites in detail, a bit of explanation is in order.

A.1. Formalized Data Management Practices and Processes Exist at a Relatively Low Level of Maturity

This section describes data management practices and their importance. Data management practices, while relatively immature, are starting to be defined and researched. All of this is unknown to BigCo. As long as BigCo remains unaware of these practices—staying thoroughly distracted by the silver-bullet IT “project” mentality enforced by its heroics-based culture—it will have an insufficient foundation on which to build business practices capable of leveraging the enormous wealth of data that it possesses.

A.1.1. Data Management as a Formal Business Discipline. Data management has existed formally as a discipline since World War I [Andrew 2009] and has been more broadly recognized since the 1970s. In research dating to the 1980s, it has been defined as:

Understanding the current and future data needs of an enterprise and making that data effective and efficient in supporting business activities [Aiken et al. 2007].

Data management is, thus, a “young” business discipline when compared to the mature subject of accounting, whose professional practices are acknowledged to date back more than 7,000 years [Hayes 2002]. It is also demonstrably less mature when compared to software engineering, whose practitioners are able to incorporate objective measures, such as function points and effort, using standard measures such as complexity [McCabe 1976]. No such standards have been proposed for data.⁸ Beyond a gross measure of size, these (and other important) concepts are missing when discussing data, datasets, and data engineering concepts/challenges. In fact, using the 2012 ACM Computing Classification System (the most recent), data management shows up in only the most general way. For example, this experience article is most accurately classified under *database management and design*.⁹

Two important references exist defining data management: The *DAMA International Data Management Guide to the Body of Knowledge*, also known as the *DM BoK* [DAMA International 2009], describes DM practice areas, and the CMMI Institute’s *Data Management Maturity Model*, or DMM for short [Mecca 2014], formalizes DM processes. Iconic representations of both products are shown as Figures 3 and 4 (respectively). Each is described briefly below. Combined, they represent the current shared

⁸Hence, the impossibility of ever defining the abstract concept, “big data”; note, however, that “big data techniques” can be objectively defined.

⁹Data and related topics constitute less than 6% of this classification system, perhaps indicative of the lesser focus that has been placed on the discipline to date: see <http://www.acm.org/about/class/2012?pageIndex=1> for more details.

Fig. 3. The DAMA-DM BoKSM "Wheel" iconically delineating 10 DM Practice Areas.

understanding data management. It is important to note that these DM practices and processes remain academic concepts with relatively few organizations attempting to improve their DM BoK-based practice areas using DMM processes.

A.1.2. Data Management Body of Knowledge (DM BoK) Describes the Previously Informal Data Management Practice Areas. Published in 2009 by DAMA International and widely accepted as a standard, the *DM BoK* represents a first attempt to codify DM practices. We¹⁰ used an approach similar to how the Project Management Institute formalized the discipline of project management. Project management is now an accepted standard and has been codified as the well-respected Project Management Institute Body of Knowledge (PMBOK). The *DM BoK* describes data management as 10 specific practices: nine plus DATA GOVERNANCE as a central discipline.¹¹ The *DM BoK* has been

¹⁰The author served as President of DAMA International from 2009 to 2013 during the development and release of both the *DM BoK* and the DMM.

¹¹*DM BoK Version 1* contains no notions of optionality or dependency, two concepts key to data management. Thus, many incorrectly read the *DM BoK* wheel as stating that organizations must employ data warehousing

Fig. 4. The CMMI Institute's DMM Model's Processes.

widely adopted, with more than 20,000 references appearing in a Google search and five Wikipedia articles referencing it in early 2016.

A.1.3. CMMI/Data Management Maturity (DMM) Model Prescribes Process-Area-Based Improvements to Successive Levels of Data Management Maturity. Research sponsored partially by the author, when he was the U.S. DoD Reverse Engineering Program Manager, resulted in the development of Carnegie Mellon University's (CMU) SEI CMMI, arguably the most successful process improvement framework to date [Corporate_Executive_Board 2006]. CMU released the data management maturity model (DMM) in 2014 as a CMMI instantiation for data management; other CMMI products have seen widespread adoption for the following:

- establish, manage, and deliver services;
- product development/software engineering;
- Acquire and integrate products/supply chain;
- Workforce development and management; and
- data management (as of 2014).

The DMM is an integrated system of five process areas that were originally described in Parker et al. [1995]. Each area is briefly described below and is focused on the

or that metadata management can be introduced at various times when, in fact, it typically must *precede* individual practice related efforts. These and other improvements are slated to be incorporated into the forthcoming *DM BoK Version 2*.

following questions: *How are we doing?* and *What should we do next to improve our outcomes?*

Data ...	Process Focus
... <i>Management Strategy</i>	Create, communicate, justify, and fund a unifying vision for data management
... <i>Governance</i>	Active organization-wide participation in key initiatives and critical decisions essential for the data assets
... <i>Quality</i>	A business-driven strategy and approach to assess quality, detect defects, and cleanse data
... <i>Operations</i>	Systematic approach to address business drivers and processes, building knowledge for maximizing data assets
... <i>Platform & Architecture</i>	A collaborative approach to architecting the target state with appropriate standards, controls, and toolsets

Each *DM BoK* practice area can be self-assessed against the widely understood CMMI scale ranging from (lowest) PERFORMED to MANAGED to DEFINED to MEASURED to OPTIMIZED (highest) and receiving 1 to 5 points, correspondingly. Thus, each *DM BoK* practice can be objectively characterized as being performed as a process at a specific CMMI level within an organization. DMM-based guidance exists to help organizations reach the next performance level. For example, data warehousing can be performed at level 2 where specific practices are MANAGED but lack the requisite standardization to achieve the DEFINED level (3) where these data management practices would be implemented consistently across the organization.

The DMM processes are interrelated. Figure 5 illustrates how the ORGANIZATIONAL STRATEGY guides other DM processes. Two of these, DATA MANAGEMENT STRATEGY and DATA GOVERNANCE, provide direction to the implementation processes: DATA OPERATIONS and DATA QUALITY. The PLATFORM/ARCHITECTURE process straddles the line between direction and implementation. All processes exchange feedback designed to improve and fine-tune overall data management practices.

A.1.4. Combined, the DM BoK and DMM Provide Foundational Capabilities on Which to Build Advanced Data Management Practices. Currently, by combining the *DM BoK* and the DMM, organizations are able to assess their approach to *DM BoK* practices and use the DMM processes to assess currently performance and guide next steps. A stated goal on the part of CMMI and DAMA-I is to more formally integrate the two frameworks but, as of this writing, this task will have to be classified as future research.

Lacking knowledge of these advances in data management capability development, organizations have relied on vendor-driven, technology-based approaches (often referred to as “silver bullets” or “shiny objects” such as Master Data Management (MDM), Service Oriented Architecture (SOA), and big data to name just three). When discussing data at the C-level of organizations, talk always revolves around these advanced data practices (shown in the so-called golden triangle of data management in Figure 6). The fundamental problem with this technology-first approach is that the low level of data management maturity existing in most organizations makes this exercise analogous to handing the keys (well, a fob, really) to a Tesla to an inexperienced driver. Good technology in the hands of an inexperienced user rarely produces positive results.

This construct is analogous to Maslow’s Needs Hierarchy [Maslow 1943], with the foundational data management practices serving the same function as the lower levels of the hierarchy: Food, clothing, and shelter prerequisites (not to mention driving lessons and experience) functioning as prerequisites to self-actualization. We do not expect great writing to be produced if the writer’s survival is threatened. The basic data

Fig. 5. Interrelationships among DMM processes.

management practices and process form the foundational capabilities on which advanced technologies can be introduced. The basic data management practices are now understood as necessary but insufficient prerequisites to advanced data management practices. Successful integration of these is required in order to establish a sound foundation to efficiently and effectively leverage data using advanced data management technologies such as cloud, MDM, SOA, and so on.

A.1.5. Foundational Data Management Practices Are Held Together by a Weakest-Link-in-the-Chain Architecture. Of almost equal importance is knowledge that the five foundational data management practices are only as strong as their weakest link. This is obvious only if Figures 5 and 6 are well understood. For example, if BigCo develops strong data GOVERNANCE, QUALITY, STRATEGY, and OPERATIONS practices but neglects its data PLATFORM/ARCHITECTURE processes, then BigCo will not benefit from the more mature practices and overall it will perform only as well as the least mature practice. Understanding this is important because in order for BigCo to meet its objectives, it must simultaneously mature all five foundational practices, advancing through CMMI levels as an organization. Unbalanced investments will not produce the desired results.

A.1.6. The State of Data Management in Organizations. One widely repeated definition of insanity is: “doing the same things over and over and expecting different results.” In general, the same misperception exists with respect to data management practices in general. The business side assumes data management practices to be guided and managed by IT because, after all, what else would the chief information officers do? However, the search for evidence of good DM practices has come up short!

The only studies to date report generally low levels of practice maturity. Figure 7 indicates very low averages, with the typical organization unable to repeat basic data management practices. Not being able to repeat processes effectively blocks any self-correction or improvement potential. Since being published initially in 2007, the

Fig. 6. Data Management Practices Hierarchy.

Fig. 7. An update of “evidence of widespread immature data management practices” from Aiken et al. [2011].

1981	2007
74% reported to the CIO or 1 level down	43% reported to the CIO or 1 level down
26% reported at least 3 levels down	57% reported at least 3 levels down

Fig. 8. Statistics reproduced from Aiken et al. [2011].

general scores have barely improved (not statistically significant) and only two organizations (of 500 total observations) have scored any 4-point scores at all. This, in spite of an estimate that organizations spent more than \$4 billion on data management services/tool industry wide in Bernstein and Haas [2008].

The mess faced by the BigCo is not uncommon. Research has indicated a common root cause for organizational data confusion. In the academic world, the vast majority of students taking computer science/information systems/computer engineering undergraduates take a single course focused on data. That class teaches how to build a new database to hold information for some business need. Students learn virtually nothing of data as an asset or data management’s importance. Smart students, learning what they are taught, learn that the answer to data problems is to build more databases and that this discipline belongs to IT. Worse, this paradigm reinforces the notion that the only circumstances requiring data knowledge is the development of new databases. This means that organizations “wrongly” believe that:

- If we are migrating databases, then we are not creating new databases and we do not need organizational data management knowledge, skills, and abilities (KSAs).
- If we are implementing a new software package, then we are not creating a new database and therefore we do not need data management KSAs.
- If we are installing an enterprise resource package (ERP), then we are not creating a new database and therefore we do not need data management KSAs.

Our DAMA International studies indicate that most IT professionals spend 10 years in IT before coming to the understanding of the power of data leveraging [Perez 2006]. So if the business does not know that data are a resource and IT thinks that the answer to data questions is a database, is there someone we can look toward to help us out of this downward spiral?

You might hope that an organizational officer with the title Chief Information Officer (CIO) would have this as a primary focus. This was truer in the past than it is at present. Our studies have shown that since the early 1990s the EDE has moved down the CIO’s chain of command. Figure 8 reproduces (statistically) significant findings.

CIOs distance (conceptually and organizationally) from the DM function have caused them to loose touch with the details/progress/concerns/importance of organizational data management; simply put, it is not seen as a concern by CIO or by those who advise CIOs. This leads to one of three logical conclusions:

1. CIOs think data management is being adequately accomplished in their organizations;
2. CIOs are unaware of the strategic nature of data; or
3. CIOs are not concerned about how data management is accomplished in their organizations.

While this may seem puzzling at first, it becomes clearer when examining the “advice” given to CIOs. Using multiple, annual CIO surveys (Figure 9), it is possible to create a map (Figure 10) showing the priorities that have been established for the collective

	2005	2006	2007	2008	2009	2010	2011	
Grant Thornton-State CIO Survey								6
Ameritech ITAA Annual CIO survey								6
CIO Magazine-State of the CIO								5
UK CIO Survey								1
Gartner Annual Priorities								7
Informationweek Global CIO top 10 issues								3
Accenture CIO Survey								1
KPMG & Harvey Nash								6
NASCIO Survey								7
Robert Half Technology								6
	3	6	9	7	8	8	7	48

Fig. 9. Source Surveys CIO Concerns 2005–2011.

Fig. 10. Evolution of top five CIO priorities 2005–2011.

CIO community. A variety of sources fell into two categories: surveys of what CIOs report as their top priorities and surveys of industry experts advising CIOs (including but not limited to Gartner, Forrester, Deloitte, Grant-Thornton, IBM, Accenture). The resulting ranks were inverted (i.e., the top ranked concern was given 5 points, the next ranked concern was given 4 points, etc.) and grouped by year. Since different years contained different numbers of “concern areas,” each year’s concerns were equalized by dividing by the total number of observations across all years.

Figure 10 summarizes the analysis showing that the topic of IT/Information Security/Privacy has consistently been a top-five concern. What is striking is the absolute absence of any and all data management topics in these lists. The closest concern was “information sharing,” and it only ranked in the top five during the year 2011. Missing entirely is any focus on data quality, metadata, architecture, and other data

Fig. 11. Does DM organization feel that it has been successful?

management foundational (basic DM practice) topics. The results demonstrate that little attention is paid to data management as a CIO priority. It only registers obliquely as an unstated underpinning to several of the initiatives, most obviously BI/Analytics but also to IT Security/Governance and Standardization.

Many conversations with current and past CIOs confirm that data management has not been on their respective radars. In fact, this only seems natural given the breadth of skills required to address these collective concerns. CIOs are talented busy individuals with a lot on their collective plates. Managing data as a top quality asset for the organization is clearly not one of them.

The results seem also to reflect these alternative foci. Figure 11 reports self-assessment of data management programs in 1981 and again in 2007. The percentage of DM organizations labeled “successful” fell from 43% to 15%, while the number labeled “partially successful” grew from 10% to 39%, and the number labeled “unsuccessful” increased from 5% to 21%. These differences are also statistically significant as reported originally in Aiken et al. [2011].

Either way, CIOs have been surprised when reminded of or alerted to data management’s foundational role in other organizational technology initiatives. Collectively, they either do not know how about DM is performed or they do not believe that their improving their organizational data management performance is important to their success as CIOs. That last statement remains true only while the overall industry-wide data management performance remains uniformly low. If one competitor begins to out-perform the rest using better application of data management, then the game quickly changes.

To summarize the objective data about organizational data management performance:

1. Those closest to the process (data managers) rate their own levels of success as low; organizations are widely unable to repeat processes and there is very little evidence of excellence in practice.

2. As the distance between the Data Manager and the CIO increased since the mid-1990s, the level of understanding of data issues by CIOs has dropped.
3. The specific data responsibility gap between IT and the business has not been addressed: Both sides are sure the other is addressing the problem.

A.2. Seven Prerequisites to Mature Organizational Data Management Are Largely Unknown by Practitioners and Organizations

These prerequisites are common across organizations and include:

1. Obtaining qualified leadership for data initiatives,
2. Understanding the underpinnings of data-centric thinking,
3. Shared data must be developed separately from, externally to, and precede-individual IT projects,
4. Currently, asking EDEs to report into a IT project management-driven organization creates unresolvable conflict,
5. Maintaining appropriate expectations/articulating success,
6. Understanding how to successfully implement data-based strategies, and
7. Implementing a successful organizational change management strategy.

Each is discussed below.

A.2.1. Obtaining Qualified Leadership for Data Initiatives.

To replace the initial EDE, what qualities will be required in order to succeed?

As noted above, very little of what is done in data management is guided by valid scientific, research, architectural, or engineering principles. Organized knowledge of this subject has been hard to come by and does not currently exist in most organizations. Since there are virtually no higher-education-based offerings focused on data management, organizations cannot look to higher education to provide data management knowledge, skills, and abilities. Instead, they rely on professional organizations to fill this gap.¹² Finding individuals possessing both the requisite data management knowledge/experience and the intellectual/corporate fortitude required to gain management support continues to be a non-trivial task. Unless and until BigCo realizes that leveraging data requires the singular focus of a qualified and responsible individual, it will not be able to change the current thinking.

A useful comparison can be drawn with the Chief Financial Officer role. For most organizations, this individual possesses the knowledge, skills, and abilities to manage the fiscal assets of an organization. Singularly, focused, they typically occupy their positions for more than a decade according to WEBCPA_Staff [2010]. This is closer to how data assets should be managed.

A.2.2. Understanding the Underpinnings of Data-Centric Thinking.

How can we ensure all participants (not just the DM team) understand the fundamental principles of data-centric, architecture-based development?

Because of the lack of qualified data leadership, the remainder of the organization is also not data knowledgeable—lacking the underpinnings of data-centric thinking. Most importantly, at the organizational level, all organizational data management work is architectural in nature, as opposed to software development that *can* be organizationally architectural in nature. Data management depends so much on abstraction that

¹²A new designation, the Certified Data Management Professional (CDMP), offered in conjunction with the ICCP, is providing some solid first steps with more than 1,700 individuals certified as of the start of 2016. For more see <http://www.dama.org/content/certification>.

Fig. 12. Designing for evolution differs from creating new systems.

there is just no point in doing it if it is not done from an architectural perspective. It is the only way to leverage data organizationally. As with all architectural constructs, if the foundation is not able to support the higher levels, the entire effort will be fatally crippled—just as you cannot build a multi-story house with a foundation of marshmallow. Good data management practices must precede innovative organizational data use, much less basic data leveraging.

BigCo cannot implement its goal of leveraging data as a strategic asset without becoming more educated in the knowledge, skills, and abilities required to transform the organization from IT project centric to data centric. It is not possible to accomplish this with a week of classroom training. Just like the implementation of an organizational project management discipline, expectations of progress must be measured in terms of years and, in some cases, decades.

A.2.3. Shared Data Must Be Developed Separately from and Externally to and Precede Individual IT Projects.

How can we develop data shared across projects using IT project thinking?

One of the major misconceptions about the evolution of data is its relationship with that of individual IT projects [Madnick et al. 2009]. DM team members are constantly asked to describe how they fit into IT projects. Figure 12 demonstrates why this is the wrong question to ask. It illustrates a key difference between IT projects and the development of an organization's shared data. The focus of IT projects is to create something where nothing existed prior and to do it in a repeatable standardized manner to obtain low production cost.

The question is not "Where do data fit into IT projects?" but "Where do IT projects fit into data evolution activities?" The purpose of any IT project is to create something from nothing by implementing capabilities where they did not previously exist. Data

persist across IT projects and, as such, it evolves at a different pace/cadence/gait than do IT projects. All organizations have shared data (represented as an organizational data architecture); the question is whether they are able to use their data architecture to support organizational strategy. As such, data architecture efforts are focused on improving whatever is presently in existence. Implementing IT projects is a vastly different activity and contains important motivational distinctions that work in opposition to the development of shared organizational data assets. It does not fit their paradigm because it must precede individual IT projects. That is, the development of an organization's data assets must occur prior to implementation of individual IT projects. It can take many years to evolve current practices from the present state to their desired state. Understanding both is the only way for organizations to determine an appropriate balance/working relationship for their organization.

BigCo's common organizational data needs will be evolved to new versions in response to (1) changing organizational data requirements and (2) improved understanding of existing organizational data requirements. Put simply, in order to obtain proper leverage of organizational data assets (leverage where BigCo gets more out the data than it costs to produce), BigCo's common organizational data needs must be properly understood. Absent this, it is impossible to accurately specify the data requirements for any IT project. BigCo's shared data must be developed separately from and externally to and precede BigCo's individual IT projects.

A.2.4. Currently, asking EDEs to Report to an IT Project Management-Driven Organization Creates Unresolvable Conflict.

How can we accomplish the required organizational realignment required to succeed as the chief official in charge of applying strategy supporting data assets?

When searching for a root cause of generally poor data, it becomes apparent that there is a fundamental misperception about whose problem data really are. When asked, survey after survey of business professionals indicate that they think that this function is performed by IT, who think that data is a function managed by the business, see, for example, Eckerson [2001]. The natural tendency and the belief of many senior executives is that data are an IT problem and that the CIO takes care of data.

But, as demonstrated, a singular focus on the data is not part of the recent past or present focus of CIOs. Consistent with reported results showing that approximately 10% of all organizations achieve a positive return on their investments in data management and 30% achieve any substantive results at all [Aiken et al. 2011]. It appears much of this effort has been to no avail. Clearly, the responsibility for this critical business function is not a primary concern for CIOs and it has fallen into the crack between business and IT well articulated by Clarence W. Hempfield [2011].

So, hopefully, now it is clear that organizations should be managing their data assets in a manner that dramatically differs from current practice by creating a new position within the business, the true home of the EDE. Similarly, asking the DM team (including the EDE) to report to an organization that is still attempting to learn how to implement IT projects successfully creates unresolvable conflict. Again, everything in an IT project is engineering focused while everything for the DM team is architecturally focused. This engineering project focus differs different from the evolutionary processes associated with the development of shared organizational data. The approach is literally foreign (in strategy and execution) when presented to IT professionals.

As shown in Figure 13, once understood, common organizational data needs can be maintained to provide well-defined data and data requirements to individual IT projects. Over time, the number of requests to data architecture-based metadata increase as developers mature their understanding of available methods/resources and

Fig. 13. Individual IT projects make increasing use of an organization's shared data.

how to work these into their development plans. Similarly, as the data architecture increases in complexity, volume and scope, the amount and utility of the metadata provided to project teams increases. And, as a result of this new approach, each subsequent system development activity also contributes an increasing amount of metadata describing the newly developed systems.

BigCo must revise its understanding of data leverage from that of a project to a program (see the sidebar in the case). Asking the person in charge about the effort to conform the program to a series of projects will never yield the desired results. IT project-oriented deliverables cannot yield deliverables that are useful across multiple projects absent higher-level coordination. Currently, asking EDEs to report to an IT project management-driven organization creates unresolvable conflict with the DM function being unable to “fit” work products (representing shared data) into IT project-driven schedules.

Unfortunately, what is required here is a rethinking of organizational data management roles. The EDE is really a business function so the EDE should be charged with managing data as a corporate resource (to be used to support implementation of organizational strategy). The EDE, as properly implemented, should no more report to a project-based organization than should the individual responsible for financial resources.

One unaddressed task for BigCo is to eliminate the conflict between the two data groups highlighted in Figure 1. The difficulties experienced by BigCo attempting to manage their logical and physical data groups separately more than outweigh any positive potential benefits. One thing is quite clear: The competing groups would be better served reporting to a single coordinator instead of each group reporting to the CIO through different management chains. This would eliminate the coordination required to define the handoffs, workflows, and responsibilities—essentially the governance

Fig. 14. BigCo's reorganization of the data group required in order to maximize use of its shared data.

encompassing the two disparate groups. BigCo has invested heavily in the existing structure and does not understand that it is currently dysfunctional.

BigCo needs to recruit a qualified EDE and have that individual report to the C-suite at the same level as other resource managers: HR, Finance, IP, and so on. In addition, the two data teams (reporting to distinct VPs) need to be combined and report to a single EDE who reports outside of the CIO. Figure 14 illustrates that the majority of *DM BoK* practice areas would report to the EDE and thus outside of anyone responsible for implementing IT projects. The light gray areas of METADATA MANAGEMENT and DATA SECURITY MANAGEMENT would be shared with IT and the darker gray areas of DATA DEVELOPMENT and DATABASE OPERATIONS management should continue to report to IT as they are largely IT project focused.

A.2.5. Maintaining Appropriate Expectations/Articulating Success.

How do we manage the expectations gap? How do we obtain the alignment that is prerequisite to benefiting from organizational alignment synergies and how do we make concrete what it means to successfully manage data assets in support of strategy?

It can be challenging to demonstrate how data supports strategy, but it is equally challenging to manage expectations for a new DM initiative. Data as a resource to be employed by the organization in support of strategy has a binary characteristic. Either data are employed successfully in support of strategy or data are an impediment to successful strategy implementation. There is no neutral position. An organizational transformation is required to achieve this reorientation and it appears, occurs, and is caused by different factors in each organization. If it is unclear, it will be difficult to “sell” conceptually.

BigCo’s leadership needs to accept that what has been attempted has not worked and acknowledge at least a multiyear commitment. It needs a new EDE to clearly articulate and deliver an agenda that is balanced between developing objectively identifiable organizational capabilities and specific, tangible efficiencies that permit others to value the initiative. In an IT project-driven development culture, BigCo’s EDE will constantly have to explain why the Data Architect function requires the time and of what value are the results. Crawl-walk-run is the realization that as much as the organization wants to achieve world-class competence using advanced techniques such as big data and Analytics, it must first *get good at the basics*. The only way to accomplish this is for the group to practice together as a team and, as their knowledge, skills, and abilities mature, capture this organizational knowledge to guide those that follow. Like the old adage: “How does one get to Carnegie Hall?” (answer: “Practice, practice, practice”), organizations cannot purchase ready-made data management packages, personnel, or processes. Only by understanding existing organizational strengths and weaknesses through a series of iterative, shared project attempts can any organization hope to achieve competency in this area and this process can take years.

A.2.6. Understanding How to Successfully Implement Data-Based Strategies.

How can we derive a more robust data strategy, focused on organizational strategic objectives?

Organizational data management practices and maturity generally follow a progression through the four quadrants shown in Figure 15. That is, for organizations at V1, data management is not seen as strategically important to the organizational strategy and little is attempted in with data management that transcends individual work group levels, beyond “keeping the doors open.” Data are not seen or managed as a strategic asset but instead minimal efforts are expended towards maintenance of basic data required to sustain operations (i.e., a focus on reporting cash balances instead of developing cash-forecasting abilities).

Organizational needs in V2 dictate a data strategy focused on increasing organizational effectiveness and/or efficiencies. These might be applicable supporting a lean-supply chain management or low cost provider model. V3 organizations have achieved the ability to use data to invent or dramatically reimagine various business models. Capital One is an often-cited example of such an innovator—innovating around the idea of providing products for underserved credit populations [Lattin and Rierison 2007]. However, organizations mastering V3 without mastering V2 (more than half of all V3 organizations) do so with greatly inflated costs and thus poorer return on investments in, for example, data science. V4 organizations have gotten good at both V2 and V3 practices; for examples, see [Chan et al. 1997a, 1997b].

BigCo requires a complete reset with respect to this objective. Its new EDE must use the newly formulated data strategy to secure and make concrete the nature of the long-term investment required to achieve its desired goals including specific capital investments in training, education, and then and only then selected technologies.

Fig. 15. The focus of organizational data strategy should be sequenced.

A.2.7. Implementing a Successful Organizational Change Management Strategy.

How can we determine the easiest and most effective means of implementing this needed discipline?

Finally, the technical abilities require to implement information/data leverage require a much more mature and experienced development and change management practices than most organizations currently possess. It is critical to implement these using organization-wide change management strategies. Luckily, this discipline is widely studied and best practices are well understood [Keen 1981]. Organizations can embrace this task with relatively low levels of risk by incorporating accumulated knowledge supporting this practice. It is a matter of becoming aware of this needed refocusing.

BigCo must embrace this using its best efforts to implement organization-wide change management techniques. Failure to do so will result in this being considered “just another management initiative of the month” and the desired changes being given nothing more than lip service, something that has happened to virtually all TQM initiatives in previous decades.

A.3. Visions of Data-Centric Support for Strategy Are Largely Unrecognized

To further place this material into context, the final section of this Appendix contrasts data-centric thinking with traditional IT project development practices. This is done to illustrate the context in which DM professionals find themselves. Coincidentally, this is what is singularly missing from the vast majority of organizations: *knowledge and implementation of data-centric thinking leading to more effective development practices.*

Fig. 16. Traditional IT project development practices are application-centric.

Fig. 17. Data-centric thinking/development practices.¹³

Figure 16 illustrates traditional IT project development practices, as implemented by the vast majority of organizations. From the top:

- In support of strategy, the organization drives specific combinations of IT projects,
- Data and information are typically considered after the other specifications have been articulated.

Challenges that have been identified with this approach include:

- Processes and data are tightly formed around applications making it awkward to maintain and change either,
- Very little data reuse is possible with an IT project-specific focus, and
- Data requirements are focused on around the application and not on organizational data requirements.

Figure 17 illustrates the fundamental shift in thinking required to adopt data-centric development practices. The first step remains determining the organizational strategy. Next, however, DM team must specify the data required to achieve measured goals and objectives—with an eye to organization-wide usage and derived from a shared, useful data architecture. As a result, IT projects can now be specified and delivered using the smallest possible footprint and simplest design, focused on previously articulated business goals expressed in terms of an organizational data model.

Advantages of the data-centric approach include the following:

- Data assets can be developed from an organization-wide perspective,
- Individual IT projects can support organization-wide data needs and compliment organizational process flows,
- Data reuse/sharing is maximized,
- Situation brittleness is eliminated by separating process and data with the development of a data architecture, and
- It enhances data shareability and maintainability, particularly in cases where data are shared across functional areas.

¹³I am indebted to Doug Bagley (dougbagley73@gmail.com) for the original version of this highly effective conceptualization.

As a result, it is abundantly clear that successfully implementing a data-centric approach can produce:

- Fewer, less complex, better-quality, easier-to-maintain software/systems,
- More productive knowledge workers,
- Better integration with evolving business processes/practices,
- More reuse from leveraged data/metadata, and
- Higher-quality business and technical requirements.

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