Running Head: IMPLEMENTING COMPUTER DATA SYSTEMS

Assumptions, Strategies, and Organization:

Central Office Implementation of Computer Data Systems

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Abstract

Despite the importance of computerization to data use, little is known about the work of central office when it comes to preparing for and implementing computer data systems. This study illuminates such work by drawing upon interviews and observations collected in three school districts over 11 months. We describe how central offices thought about, prepared for, and implemented computer data systems. We find that district efforts may be undermined by overly simplistic stances toward technology and planning. Accordingly, we discuss the ways in which central offices might rethink assumptions, strategies, and bureaucratic structures around data systems.

Keywords: Technology, data use, central office, implementation, rational systems, open systems

Introduction

District leaders face increased expectations around reporting data and supporting its use in schools. On one hand, test-based accountability policies have resulted in a host of pressures around demonstrating gains in student achievement (Booher-Jennings, 2005; Hamilton, 2003). On the other, the rapid pace of technological advancements has resulted in unprecedented capacities to gather, analyze, and distribute data about students (B. Tucker, 2010; Wayman, Cho, & Richards, 2010). Accordingly, it has made good sense for districts to see computerization as a lynchpin to supporting student achievement (Burch & Hayes, 2009; Hamilton et al., 2009; Shaw & Wayman, 2012).

Obtaining a data system is relatively easy. Districts have been quick to invest significant dollars in data systems (Burch & Hayes, 2009), and have hoped for equally significant use of these systems. Unfortunately, increased system acquisition among schools has not necessarily resulted in strong system use among educators (Means, Padilla, DeBarger, & Bakia, 2009; Wayman, Cho, & Shaw, 2009; Shaw & Wayman, 2012). Data systems can be rejected, used for unexpected purposes, or used for only a narrow subset of possible applications (Cho & Wayman, 2014).

Unfortunately, current research carries a number of blind spots when it comes to the research around effectively leading and managing technologies in education (McLeod & Richardson, 2011). This is especially so when it comes to the research on data use and data systems. Although scholarly attention around supporting data use has increased (Coburn & Turner, 2011; Daly, 2012; Spillane, Parise, & Sherer, 2011), it has not necessarily spilled over into attention to data systems. Further, those few studies that do directly attend to data systems have typically focused on work practices involving those systems (e.g., Brunner et al., 2005;

Halverson, Grigg, Pritchett, & Thomas, 2007; Wayman & Stringfield, 2006), and not necessarily their implementation. With the exception of our own work (Cho & Wayman, 2014), we are unaware of any studies that have directly addressed the implementation of data systems.

Such inattention may be especially troublesome, given how easy it is to oversimplify the relationships between technologies and work (Leonardi, 2009a; Orlikowski & Barley, 2001). For example, Brooks (2011) describes how district leaders can confuse investing in a new technology with actually improving teaching and learning. This same dynamic appears to be playing out specific to computer data systems, where districts seem to have invested more in the acquisition of data systems than the infusion of these systems into work (Cho & Wayman, 2014; Means et al., 2009; Wayman et al., 2009). Put another way, central offices are typically responsible for the acquisition of a data system (Burch & Hayes, 2009; Wayman et al., 2009), but district leaders are not necessarily prepared to ensure successful implementation.

What is missing in current scholarship is a clear understanding of the central office work leading to and during the implementation of computer data systems. Accordingly, the purpose of this comparative case study is to explore the work of central offices in implementing computer data systems. In particular, we apply an organizational perspective to technology implementation to shed light on how central offices in three disricts thought through these tasks. We were guided by three research questions.

1. What do central offices consider important about data systems?
2. How do central offices prepare for data system implementation?
3. How do central offices implement data systems?

Literature Review: Linking Technology to Organizational Theory

Historically, the study of technology and the study of organizations have represented distinct fields, neither leveraging insights from the other. For this reason, Orlikowski and Barley (2001) believed that scholars may need to investigate the ways in which technologies and organizations intersect. Educational scholars may also suffer from a similar need: McLeod and Richardson (2011) assess the literature around technology and educational leadership, finding that current scholarship has rarely and only narrowly addressed their intersection. In light of the demands that technologies can introduce to educational leaders' work (Anderson & Dexter, 2005; Halverson & Smith, 2009), such a gap in scholarship is troubling.

One step toward bridging the research on technology and the research on organizations is to examine how technology concepts may fit into broader paradigms around leading and managing organizations. From the technology research, a prevalent concept is technological determinism, which assumes that technologies have inevitable "effects" on work (Barley, 1990; Leonardi, 2009a; Orlikowski & Iacono, 2001). Technological determinism appears implicitly throughout descriptions of educators' experiences with data systems (Cho & Wayman, 2014; Means et al., 2009; Wayman et al., 2009) and thus is a good perspective from which to study data system implementation. From the organizational side, rational systems and open systems perspectives (Scott & Davis, 2007) are two contrasting paradigms that may help to illuminate the implications of technological determinism in district leadership. Below we describe: (a) technological determinism; (b) its potential relationship to rational systems perspectives; and (c) its potential relationship to open systems perspectives.

Technological determinism. The assumptions that one makes about the world shape what one sees (or fails to see). When it comes to the nature of technology, researchers and

practitioners alike have been prone to the assumption of technological determinism, despite the problems that this assumption may cause (Leonardi, 2009a; Orlikowski & Iacono, 2001). Technological determinism assumes that how to use a technology and what "effects" a technology might have are inevitable and predetermined. Thus, technologies are seen as simply tools, doing what their designers have intended (e.g., making work more efficient or less burdensome). Such contributions are assumed to be self-evident or imbued in the tool itself. As Barley (1990) observes, technologies are often seen as "implanting or removing skills much as a surgeon would insert a pacemaker or remove a gall bladder" (p. 67). For example, Brooks (2011) describes how district leaders and policy makers may assume that "progress" flows inevitably from acquiring the right technology, thus obscuring the need to actually support educators at the level of practice.

Technological determinism has been the subject of critique. As Leonardi (2012) points out, although the materials and design of a hammer can make it ideal for driving nails, this does not necessarily prevent some people from using it as a paperweight. Critics observe that technological determinism occludes the importance of human agency and sensemaking (Brooks, 2011; Jones & Karston, 2008). In this regard, how people experience a technology and what people think a technology is good for may hold sway over how (or if) the technology is used (Leonardi, 2009b; Pinch & Weibe, 1984). For example, Cho and Wayman (2014) describe how differing ideas about data use can influence how data systems are seen and understood.

Rational systems perspectives. Rational systems perspectives have played a central role in how scholars and practitioners have thought about the nature of organizations (Scott & Davis, 2007). Rational systems perspectives originate from interests in the late 19th and early 20th centuries around industrial efficiency and bureaucracy. Rational systems perspectives emphasize

formal structures, aligning procedures to goals, and articulating the division of labor. In other words, they assume that people in organizations act rationally—that when people know the "right" thing to do, they will do it (March, 1991). Accordingly, rational systems perspectives tend to harbor technologically deterministic assumptions. If organizations are seen as big machines (Morgan, 1986), then other machines might be assumed to seamlessly plug into or replace activities in those organizations (Barley, 1990). Thus, district leaders might assume that data system implementation work is simply about giving educators access to what they have decided are the "right tools" for the job.

Rational systems perspectives, however, also have limitations. For example, although rational systems perspectives can be insightful about work in environments with predictable challenges (e.g., production lines), they do not account well for situations where workers frequently apply professional judgment (Davenport & Prusak, 1998; Weick, 1976). Right answers are not always obvious, and decision makers may be influenced differently by factors such as training, personal experience, and politics (Brown & Duguid, 1991; Carlile, 2002; Eisenhardt & Zbaracki, 1992). Further, it may be a mistake to assume that effective plans can be made in the abstract, away from real-world events. Events and conditions can change over time, making decision makers' information sometimes imperfect or incomplete (Eisenhardt, 1990; Rivkin & Siggelkow, 2002).

Thus, the things that might seem clear to district leaders before system acquisition might not be the real issues to address during system launch. For example, district leaders might be enthusiastic about a data system and mistakenly assume that teachers will automatically follow suit in those enthusiasms. Left unchecked, such assumptions might lead to an overly optimistic and overly simplistic reading of the implementation work ahead. Further, rational systems

perspectives can fail to account for how technological changes can unexpectedly "spill over" into issues such as work capacity or social status (Barley, 1990; Orlikowski, 1996). For example, rather than making all work quicker and easier, district leaders might find that some system users may be overburdened with tasks such as data entry, information requests, or troubleshooting. Similarly, differences in levels of access or functionality might have unintended consequences in power dynamics among central office departments.

Open systems perspectives. Open systems perspectives provide an alternative paradigm for understanding organizational behavior and decision making (Scott & Davis, 2007). These perspectives view organizations as composed of people that are continuously interacting with, processing information about, and adjusting to their environments (McDaniel & Driebe, 2001). Thus, whereas rational systems perspectives value the forethought of a decision-making center, open systems perspectives view the "cognition" of an organization as the product of interactions among organization members (Pfeffer, 1997). In other words, open systems perspectives recognize that from one individual to another, understandings about phenomena might be different and somewhat limited. It is through addressing information silos and connecting perspectives that a more complete picture of phenomena emerges (Brown & Duguid, 1991; Carlile, 2002; Rivkin & Siggelkow, 2002).

Open systems perspectives offer an alternative view on formal planning. They acknowledge that individual understandings about the how and why of work could be incomplete or imperfect (Brown & Duguid, 1991; Weick, 1993). Thus, they emphasize shared understandings and sensemaking. Open systems perspectives also recognize that working in the real world means adjusting to new circumstances as they arise (Eisenhardt, 1990; Nonaka,

Umemoto, & Sasaki, 1998). Thus, they recognize the value of prototyping plans and of tailoring work according to feedback.

These views on planning may help to address the shortcomings of technological determinism. For example, open systems perspectives recognize that even the same technology could mean different things to different people (Pinch & Weibe, 1984; Leonardi, 2009a). They would not assume that the "right tool" exists apart from place and time. In this way, technology implementation does not end at the moment of acquisition, but rather continues into extended periods of social adjustment (Cho & Wayman, 2014; Davidson & Chismar, 2007; Leonardi, 2009a; Orlikowski, 1996). Thus, if a "rollout" of a data system or other technological tool concludes with training sessions on the system, it may fall short of helping educators implement the system into their routines.

Research Perspective

This literature base suggests that perspectives taken by central office – both implicitly and explicitly – will affect data system implementation. Rather than elevate either the rational or open systems perspectives as "better" than the other, our intent is to explore such issues. Although rational systems perspectives would seem to offer structures beneficial to data initiatives (Datnow, Park, & Wohlstetter, 2007; Wayman, Jimerson, & Cho, 2012; Wayman & Stringfield, 2006), they would also seem subject to technological determinism. They would seem more susceptible to assuming that what a technology "is" or what it is "good for" is imbued within the technology itself, rather than the sense that people make of the technology. Although open systems perspectives would seem to resist technological determinism by accounting for local context and sensemaking, it is yet unclear how such perspectives translate into the everyday work of central office.

We thus approached this study recognizing that the burdens of data system implementation might not fall solely to the technology itself. Accordingly, we focused our attention on central office approaches to planning, structure, and context.

Method

Below, we first provide background about the study districts. Subsequently, we describe our methods for data collection, data analysis, and study limitations.

The Study Districts[1]

This comparative case study (Merriam, 2009; Yin, 2009) draws upon data from a larger study of three Texas school districts. The districts were selected in order to help uncover patterns around districts and their efforts around data use. The districts were not known or selected for their success at using data. Cho and Wayman (2014) review how educators (i.e., central office members, campus administrators, teachers) in each district conceptualized about data and its use. The districts varied according to contextual factors such as size, demographics, and academic achievement. We describe the district contexts below.

Boyer School District served approximately 8,000 students. Most students were classified as non-Latino White,[2] and less than five percent were classified as economically disadvantaged. Because most students in Boyer easily met minimum state standards, many teachers believed "data use" to be inapplicable to their context. In a typical year, the percent of students meeting standards on the state exam was consistently greater than 95% in Boyer; the overall state rate was typically about 82%.

[1] Pseudonyms are used for each district.
[2] 80% non-Latino White, 10% Latino.

Gibson School District served approximately 25,000 students of various ethnic backgrounds,[3] half of whom were economically disadvantaged. State test performance was important in Gibson, but educators at every district level spoke of these tests as only one of many student achievement indicators. Much of "data use" in Gibson surrounded a set of locally-developed benchmark exams tied to the curriculum. In a typical year, the percent of Gibson students meeting standards on the state exam was approximately 75%.

Musial School District served approximately 45,000 students of various ethnic backgrounds,[4] a third of whom were economically disadvantaged. State test performance was a strong focus throughout Musial. Musial employed district-wide benchmark tests that were intended to align to curriculum and to predict TAKS outcomes. In a typical year, the percent of Musial students meeting standards on the state exam was approximately 85%.

Data Collection

Data were collected over 11 months (March 2010 to January 2011). Data sources included interviews (e.g. individual interviews and focus groups) and observations. Data collection was aimed at capturing a variety of issues involving data systems, including how district leaders (e.g., superintendents, assistant superintendents, department directors) saw and approached data system implementation. Below we describe our procedures for collecting interview and observational data.

Interviews. Interviews and focus group interviews followed semi-structured protocols (e.g., Merriam, 2009; Miles & Huberman, 1994; Weiss, 1994) addressing districts' efforts around data use and computer data systems. In order to be responsive to differences in audience, accommodations were made to the order in which questions were asked. Cho and Wayman

[3] 40% Latino, 30% non-Latino White, 20% African American.
[4] 50% non-Latino White, 25% Latino, 10% African American.

(2014) report the full protocols used for this study. In total, 82 central office members, campus administrators, and teachers participated in individual interviews or focus group interviews. The sample of central office members began with a start list that then expanded based upon other participants' recommendations. Central office members participated in interviews individually, resulting in 17 interviews total. Per district, interviews broke down thusly: five in Boyer, six in Gibson, and six in Musial.

In order to better triangulate the nature of central office initiatives, campus administrators and teachers were also included for data collection. Three schools were selected at random per district: one elementary, middle, and high school. This resulted in nine schools total. At each school, one focus group for administrators and one for teachers was conducted (18 focus groups total). Administrative teams were composed of principals and those they designated as team members (e.g., deans, assistant principals, program coordinators). Teachers were selected at random, with checks to ensure a variety of grade levels or content areas. Focus group size ranged from three to six people. In all, 19 campus administrators and 46 teachers participated in focus groups.

Observations. Observational data helped to provide a first-hand glimpse into how districts were managing data systems. Events observed followed central office members' work around implementing data systems. These included trainings for computer data systems, leadership events (e.g., principals' meetings), and meetings among central office administrators. In total, 15 observation sessions were conducted; each lasted from one hour to several hours. Per district, observations broke down into three sessions in Boyer, three in Gibson, and nine in Musial. As will be explained in the results, Musial's work around data systems was more concerted. This afforded more opportunities for observation.

All observational data were collected by the first author. Following the recommendations of Emerson, Fretz, and Shaw (1995), field experiences were first recorded as jottings (i.e. quotes or paraphrases, abbreviations, and symbols), then converted into lengthier prose within 24 hours. Time of day was recorded every three to five minutes, helping to provide a sense for the overall pace and sequence of events.

Data Analysis

As data were being collected, they were also being analyzed. This helped to sharpen data collection and analysis jointly (Bosk, 2003; Merriam, 2009). Informally, data analysis was supported through the use of a research journal. Formal analysis of transcripts and field notes began with coding and culminated in cross-case comparisons. These procedures are described below.

Research journaling. In February 2010, the first author began a research journal for key events, decisions, and musings related to the study. As data collection progressed, a concerted effort was made to follow each interview or observation with an entry that pushed data analysis forward. This supported the reliability of research findings by providing a way to review how insights were developed (Erlandson, Harris, Skipper, & Allen, 1993; Yin, 2009).

Codes and cross-case comparisons. All data were coded using the Atlas.ti software. Observational data were analyzed in the same manner as the interview and focus group data. The aim behind the observations was to enrich and help triangulate information from our interviews (Yin, 2009), but not necessarily to afford generalizations about the districts on their own. `

Coding began with a start list of codes that were refined as the study progressed (Eisenhardt, 1989; Miles & Huberman, 1994). As described earlier, the research perspective for this study is that rational and open systems thinking will define data system implementation, and

that each may serve to enable or mitigate technological determinism. Accordingly, codes were chosen that enabled us to interpret the data in terms of history, context, and assumptions about the nature of data systems. These codes reflected our research questions. Our first research question related to the perceived importance of data systems. The code *data system intents and purposes* addressed this question. Our second and third research questions both related to implementation and were addressed using the same three codes. These codes were: *efforts to support data use, efforts to support data system use,* and *central office information sharing.* Because the second and third research questions differ according to time period of interest, output from these three codes were further separated according to whether they occurred in preparation for or during implementation.

Using these codes, we developed within-case portraits of each district. Subsequently, we applied a "replication logic" (Yin, 2009) to examine patterns across the three districts. By focusing in on the circumstances under which patterns held (or failed to hold) (Eisenhardt, 1989; Miles & Huberman, 1994), we were better able to generalize about issues facing districts.

Study Limitations

Issues such as teachers' perspectives about data and data systems fell outside the scope of the present study, but are reported in prior work (Cho & Wayman, 2014). Rather, the present study is about the work of people at central office and relies heavily upon self-reported interview data. Two main strategies helped to support the trustworthiness of our findings. First, the use of campus-level and observational data helped to provide checks on the self-reports of central office members. Second, we employed peer debriefing (Erlandson et al., 1993; Merriam, 2009). This involved conferring weekly with other members of our research team. These colleagues were

studying other phenomena but in the same study districts. Peer debriefing served as a way to examine hunches, challenge assumptions, and evaluate alternative viewpoints.

Findings

We drew upon data collected from three school districts to address our research questions. First, we describe what central offices considered important about their data systems. Second, we describe how central offices prepared for implementation. Third, we describe central office work during implementation.

What Central Offices Considered Important About Data Systems

Our first research question relates to what central offices consider important about their data systems. In order to address our research question, we compared how central offices saw the importance of their computer data systems. In general, we found that how central office leaders viewed the power or potential of their data systems was relative. Importance was generally embedded in local histories and contexts, except for when a sudden funding opportunity took precedence. In general, we found that how a central office viewed the importance of its new data systems was tied to prior challenges, successes, or conditions in the district. This pattern even held true in the Boyer district, even though Boyer eventually chose to abandon efforts to pursue data system implementation. The one exception to this pattern was in the Gibson district, which attempted to launch two systems at once. Although the first system was seen as strongly connected to local history and context, the second had been spurred by unforeseen policy events (i.e., federal stimulus funding). Having leapt at the opportunity of funding, Gibson leaders were later unclear about the importance of the second system.

Musial's history and context. The centerpiece to Musial's efforts around data use was the Front End[5] system. Local history and context helped to frame the importance Musial leaders associated with this system. Throughout our interviews and observations, Musial central office members were adamant that state testing was the vehicle by which the district would accomplish its mission of serving "all students." This drive around testing pervaded how Musial central office members saw their everyday work. As one district leader explained, "until a campus understands that [state test achievement is] what's expected… then there are going to be all kinds of people in there trying to help them, and to fix them, and to make them do things." Such activities included direct involvement at schools around hiring and firing, as well as classroom observation and supervision. Within this social context, district leaders felt that Front End was a perfect fit. As one central office member put it, "[Front End] gives folks an opportunity to really be aware of who their students are, relative to the ways that the accountability system looks at students and student performance."

Front End also fit well with the district's history and context specific to technology. District leaders were enthusiastic about Front End, because it did something long overdue: Front End provided teachers with direct access to a student's data. Prior to this, site licensing issues had prevented direct, across-the-board access to data. In fact, the "data systems" before Front End were email and Excel spreadsheets. Teachers had had to rely on other staff to generate reports from various district systems; these reports then arrived periodically as email attachments. Reports were not tailored to teacher interests or needs. Each contained a deluge of students and data points in the school. Moving forward, Musial leaders wanted to ensure that teachers had access to the "right data" in timely, user-friendly, and interpretable ways.

[5] Pseudonyms are used for any systems mentioned in this study. Cho and Wayman (2014) provide additional details regarding the designs of these systems and teachers' perspectives.

Specifically, Musial leaders considered it important that Front End provided access to attendance/tardy data, discipline records, state test scores, and district benchmark scores.

Gibson's history and context. The Gibson district attempted to implement two data systems at once: Flightpath and Dashboard Central. Whereas Flightpath was relatively familiar with most educators, Dashboard Central represented a sea change in how educators might think about data.

Flightpath. For Gibson district leaders, Flightpath had a clear sense of history and trajectory around it. An older system was being retired, and educators in Gibson clearly saw Flightpath as its successor. Educators at every level of the district commonly described Flightpath as being like the old one, except more user-friendly (see Cho & Wayman, 2014). In fact, Flightpath was being funded with monies originally spent on its predecessor.

Further, the Flightpath interface was not new to the district. Flightpath had previously been used for the purposes of teacher appraisal, and only the functions relating to student assessment data were new. Thus, Gibson leaders felt that Flightpath matched their district's emphasis on using data around student expectations (SEs). Specifically, they especially liked that Flightpath reported SE data for individual students and classrooms, as well as recommendations about how to group students for additional support or tutoring according to SEs.

Dashboard Central. In contrast, Dashboard Central was an entirely new kind of technology. In spring 2010, the district experienced a windfall due to economic stimulus funding from the federal government. Accordingly, Gibson leaders worked quickly that semester to select a system that might be purchased with those funds. The result was the purchase of Dashboard Central. At a basic level, most central office members felt that the power of Dashboard Central rested in its promise of integrating disparate computer systems. Those systems included not only

Flightpath, but also other assessment systems, student information systems, and human resources systems (i.e. data about teachers). Such expansive integration, however, broke with local norms around data and data systems, which had traditionally centered on SEs.

Lack of ties to history and context, however, resulted in some ambiguity among district leaders regarding around what Dashboard Central was "good for." As one district leader put it, "I haven't been able to get an answer [about Dashboard Central's purpose]." Looking back at the initial selection process, one central office member admitted, "We had a vague idea that we needed something that would answer some questions, but we didn't know what the questions were."

This ambiguity was also evident in disagreements around how or why integration might be important. Although one central office member described integration as a way to increase the "safety net" for serving the "whole child," others were more excited about Dashboard Central's novelty than its connection to extant practices. For example, one Gibson leader mused that the district might be able to "correlate" teacher professional development attendance with student achievement. Another central office leader imagined how Dashboard Central might affect teacher supervision. He envisioned principals logging into data about teachers (e.g., attendance) and students (e.g., test scores) in the midst of teaching observations.

Boyer's history and context. Although the Boyer central office was initially interested in obtaining a new data system, those intents were later abandoned. Nonetheless, we still found that local history and context helped to frame district leaders' thoughts about data systems.

"Exemplary" levels of student achievement. State accountability policies played a role in Boyer's initial interest in obtaining a new data system. Throughout the Boyer central office, people took pride in their students' overall high levels of achievement. Boyer and its schools

regularly held the highest state accountability ranking ("exemplary"). One central office member reported that the very bottom quarter of students in Boyer still placed in the 50th percentile on nationally norm-referenced tests. As another central office member summed, the majority of Boyer students were "literally off the charts smart."

As a result of recent changes to state accountability policies, Boyer would need to pay special attention to achievement disparities among demographic subgroups in order to maintain its "exemplary" rating. Notably, the disparity in Boyer was not about sheer passing rates. Rather, approximately 20 students classified as "economically disadvantaged" needed to make the jump up to the "commended" level (the highest tier) on the state test. In one district leader's words, "Now we have to take a closer look at our lower socioeconomic students. We have to have 25 percent of them reach the commended level in order for a campus or the district to be considered exemplary." At the time, however, Boyer lacked an integrated data system capable of instantly reporting and assembling disparate data about particular students.

Lack of system integration. In general, Boyer leaders were content with what they were getting from their data systems, and dissatisfied only with their systems' lack of integration. Boyer had several data systems, and the Boyer central office liked that individual systems could play to each other's strengths and weaknesses.

For example, two systems in Boyer were Flightpath and PM Plus. Boyer district leaders saw Flightpath as the go-to place for periodic, standardized test data. As one Boyer district leader explained, Flightpath was "very good for [state test] data and for the benchmarks we give." Balancing this, PM Plus was an assessment system offering short, biweekly "learning probes" to monitor student performance. Accordingly, central office members described this system as offering a "really good, comprehensive look at the child." Another described how PM plus was

good for "exactly identifying" students' weaknesses in specific areas (e.g., phonics, reading fluency, math computation, math applications). For example, one central office member explained:

> You can see patterns in yearly trends. You can look back at a timeframe and intervention, then see in a trend line if it really worked. There are lots of pieces of information and quality data for support teams to plan around.

An added bonus to PM Plus was its reporting of data in relationship to national norms. One central office member reported that teachers found this data "reassuring and interesting," because these data showed many Boyer students to be exceptional.

Central office members' complaints about data systems stemmed from lack of integration. One central office member called Boyer's systems a "hodge podge, where there is data, but there is nothing that really consolidates it or that correlates that information." Another district leader stated, "What's missing is a complete picture of the kid in one place... They must pull, pull, pull." In this, several central office members admitted that it could be hard to pull data, because it was hard to remember how to log in or use so many systems at once. Thus, they hoped for a future data system that could resolve the burdens of integration.

How Central Offices Prepared for Data System Implementation

Our second research question related to how central offices prepare for system implementation. This question asks about the nature of the central office work before system launch. Theories on organizing offer alternative ways for understanding such work. For example, central offices working from rational systems perspectives would emphasize bureaucratic structures, the alignment of procedures to goals, and how labor is to be divided. In contrast,

central offices working from open systems perspectives would emphasize adaptation, especially the importance of sensemaking and information sharing in influencing how jobs get done.

In general, central offices approached preparatory work by focusing on the bureaucratic and rational, but with some variations. For example, the Musial district focused on its bureaucratic structures, but in order to flex and adapt them to new demands. Concerned about information silos, Musial took measures to address their bureaucratic structures before launching Front End. In contrast, the Gibson district kept extant bureaucratic structures intact, despite their misfit to the work at hand. Finally, the Boyer district attended to its priorities by deciding *against* acquiring a data system. It made bureaucratic changes around instructional coaches instead.

Musial's bridging of department boundaries. Several changes took place in the Musial central office before implementing Front End. The district had a multi-faceted plan for supporting overall data use, and Front End was only one facet of that plan. Musial's data initiatives had been sparked by out-of-district tours that had taken place prior to this study. The purpose of these tours had been to gather knowledge from other districts in the state regarding about how to better support student achievement. Among other things, these visits brought home the importance of supporting data use. In the words of one central office leader, "You know, I think that was one of the first events where all of a sudden we had a driving force… to say ok, well, this data is important."

Further, district leaders learned that fragmentation among central office departments was undesirable. Describing the value of bureaucratic structures, one district leader said, "Bureaucracy done properly can help you think, offer control points, and do post mortems." Another district leader described how this became especially clear during the district tours. He said, "We heard other people saying, 'You can't have a riff between what the campuses are

actually asking for and what curriculum is saying they need.' They have to be in agreement with one another."

Rethinking its bureaucracy, Musial created a new job position: associate director for data use. Housed in the school improvement office, this position was aimed at student achievement throughout the district. Musial advertised for someone with expertise in three areas: instruction, data use, and computer data systems. One central office leader described the new job as "straddling the assessment, accountability, and information processing aspects of district work." Previously, technology work and expertise had been housed within the technology department.

By all accounts, Susan[6], the new associate director for data use, exceeded expectations. Central office and campus-level administrators commonly described her as the "go-to person" when it came to data use. Moreover, Susan was considered a skilled intermediary, both among departments and up the chain of command. One district leader explained:

> Most of the data processing and assessment or accountability folks in this district are not educators. There's a schism between what principals might think they want, but not be able to do, and how a person [elsewhere] might envision that report or electronic platform to look like. So we tried to get a job that would be able to interface between those two different, unrelated divisions. That was really the goal.

In her own words, Susan described the importance of boundary spanning:

> You need to understand clearly the connection between instruction, assessment, and how data drives instruction. You need to be able to work well with teachers and principals... You need to be able to talk to the technical people and be able to say this is what our teachers need.

[6] A pseudonym.

Accordingly, members of the technology department commonly appreciated how Susan was skilled at "lending a face" to their work.

Gibson's unchanged bureaucratic structures. Unlike the Musial district, Gibson's preparatory work did not involve changing bureaucratic structures. Instead, the Gibson central office worked within pre-existing lines of authority and divisions of labor. The curriculum and instruction department had overseen Flightpath's predecessor; it now took over Flightpath. Meanwhile, the technology department was charged with handling Dashboard Central because of the technical work of interfacing with systems from throughout the district (e.g., human resources). Both departments reported to the deputy superintendent. This arrangement was a misfit in two ways.

First, this arrangement was inflexible to Gibson's practical circumstances. For example, not long after the decision to choose Dashboard Central, Gibson's technology department director left the district. One person, Edith[7], now held two sets of duties when it came to Dashboard Central: the overarching project management work, as well as the nuts and bolts technical work. Compounding matters, Gibson leaders put forth a tight, inflexible timeline for Dashboard Central's launch. In order to get the most out of their federal stimulus dollars, teachers would need to be using the system at the opening of the subsequent school year (fall 2010). As one district leader put it, "If you don't start something at the beginning of the school year, it's hard for it to get traction."

Edith now reported to the deputy superintendent directly instead of via a director. Although this made rational sense, it failed to account for informal aspects to the technology director job. Edith lamented not having had someone with a "little bigger club" in central office.

[7] A pseudonym.

Recalling her inability to sway the deputy superintendent on his deadline for Dashboard Central training, she said that once the "expectation was expressed... it was set." Further, managing ties to the Dashboard Central vendor also fell through the cracks. Edith recalled:

> My boss was trying to keep so many balls bouncing, it was a difficult time. If somebody had been in place, I could have probably gone to them and said, "I need you to deal with the vendor. They are not being responsive. We're not meeting this deadline, et cetera."

In line with open systems perspectives, some of the challenges around central office were not simply structural, but also social.

Second, Gibson's plan for oversight failed to remedy divisions among departments. The result was that important information sharing about Dashboard Central was stymied. At a practical level, this meant that the technology department lacked expertise around how to fit the system to district instructional goals. As one technology member stated, "I'm not a teacher. I think Dashboard Central is important. It's cool, but it might not be anything that anybody really needs." At an organizational level, this also meant tensions around authority and oversight. Some central office members lamented lack of input into Dashboard Central decisions, because the technology department had the "keys to the kingdom." As one Gibson leader asked, "Don't you find it odd that [curriculum and instruction people] don't know a lot about Dashboard Central?"

Boyer's decision against technology implementation. The Boyer district decided not to adopt a new computer data system. Although Boyer leaders had initially been interested in acquiring an integrated data system, such interest dissipated when they learned about the financial costs of the system. At a meeting with the Boyer superintendent, one district leader recounted how he had talked to a single vendor about pricing. The quote he received was "unbelievably expensive." Hearing the price tag, a second district leader exclaimed, "Damn!" A

third district leader followed up by explaining that having an integrated data system was an "absolutely great idea, but horribly expensive... we don't have the money to do that." Thus, leaders framed the decision not to fund a data system on rational, economic terms.

Instead, Boyer leaders employed a different strategy for supporting data use: instructional coaches. Instructional coaches were in their second year in the district, and Boyer leaders decided that their roles should now include integrating data. It might be recalled that accountability pressures in Boyer centered only a select handful of students. The Boyer district saw instructional coaches as a sort of data system. As one Boyer leader explained:

> If we eliminated [instructional coaches] and used that money to pay for just a single data system, they may be able to get data, but we have no idea if they're using it—or even what they are using it for. So we've erred on the side of "let's go with a human resource solution to solving the problem." In a perfect world, we would have both [coaches and a data system.]

How Central Offices Implemented Data Systems

In the present section, we address our third research question, which related to central office work around implementation.[8] Like the preceding section, the present section explores the degrees to which central offices worked in accord with rational or with open systems perspectives. The difference in this section is one of timing and stage of work. Rational systems perspectives views were found to hold sway at central office during preparatory work, but what about districts' later endeavors?

In line with open systems perspectives, we found that central offices benefited from the ability to be responsive to real world demands. The Musial district provided one example for

[8] Teachers' uses of and attitudes regarding these data systems are reported in Cho and Wayman (2014).

how a central office could make formal steps to gather feedback and engage with users positively around data systems. In contrast, the Gibson district provided one example for how lack of adaptation to demands can stunt system implementation. Finally, the Boyer district provided an example for how it may be possible to adapt to real world needs by *not* computerizing data use.

Musial implementation work. Although Musial's early work around Front End had primarily been bureaucratic, Musial's work during implementation provided some evidence that central offices could find value in working from open systems perspectives. First, the Musial district demonstrated that it is possible for district planners to manage initiatives using real world feedback, and not simply central office preconceptions. Second, the Musial district demonstrated that it is possible for central offices to work on not only the technical side to data systems, but also the subjective, sensemaking side to data systems.

An adaptive plan. The Musial district approach to implementation allowed for the adaptation of plans during roll out. This approach was facilitated by the timely collection of feedback. Some of this feedback was formal, such as Front End usage rate data. Other feedback came informally, such from piloting Front End before rolling out districtwide. Adaptation and feedback was perhaps best exemplified in the creation of a Front End user group. This group was composed of teachers and administrators from across the district. It convened throughout Front End's design and during roll out. At such meetings, attendees were reminded that their goal was to help define or refine Front End's service to the "most critical" aspects of their work.

Because Front End was designed collaboratively between the Musial technology and accountability departments, representatives from both these departments participated in these meetings. Technology department members attributed the success of these meetings, however, to Susan's ability to "translate" among worldviews. They described how she was able to help the

technology department interpret feedback, as well as how she was able to explain problems to teachers about their requests. In the end, the Musial central office was unanimously satisfied with Front End's design. One central office saw Front End as capturing "teachers' desires." In the words of central office member, "we hit it on the money."

Attention to sensemaking around Front End. Musial introduced teachers to Front End in two ways. The first approach did not provide strong evidence of support for user's sensemaking. In this approach, all teachers were provided access to an "online training module" (i.e. Powerpoint). In line with rational systems perspectives, this strategy assumed that people will use tools the "right way," if they are told what the "right way" is.

Musial's second approach, however, did address users' sensemaking about Front End. In line with open systems perspectives, this strategy engaged with individuals and their attitudes about Front End. Specifically, we observed Susan's direct, interpersonal work at Front End trainings. Attendees at these trainings were teachers designated as "go-to people" for help with Front End at each campus. Teachers' reactions at trainings were remarkably positive. Although fewer teachers came into direct contact with these trainings, we report these findings because they open the door to understanding the potential for central offices to address sensemaking about data systems.

In observing these trainings, we observed that they followed a similar agenda. Trainings were co-led by Susan and technology department members. Susan began trainings by reviewing elements of Musial's strategic plan (e.g., "closing achievement gaps") and recent surveys about campus needs (e.g., "assessment reporting"). Although the technology department explained how to access certain functions, it was Susan who chimed in with connections about how Front End might help close an achievement gap or improve access to assessments. Susan would also

interject about the role of the user group in helping to design particular features. We saw these tactics as attempts to foster Front End's importance and legitimacy among teachers.

We also observed Susan's efforts to stoke excitement around Front End. For example, she made it explicit "laughing and learning" were included in her goals for training. As the technology department explained certain functions, Susan would interject with calls for teacher applause or a "thumbs up." When trainings entered lulls, Susan would suggest that the technology department demonstrate a feature that "really gets those oohs and ahhs" and the "Price is Right effect." Such features did indeed win wows, murmurs, and nods from teachers. One teacher was so enthusiastic that she interrupted with, "Shut up! You just saved me hours of cumulative folder digging!" Similar comments pervaded trainings and were reiterated by Susan when she overheard them. Commenting on Susan's success at shaping sensemaking, one technology department member described its differences with technical work:

> It's coordinating, packaging, and putting out a unified message. The [technology department] is not the one to be doing that. We're the data jocks. We should be listening to our users' needs, but the coordination and roll out of Front End has been served by our school improvement office.

Gibson implementation work. Although the Gibson district experienced few problems with implementing Flightpath, such was not the case with Dashboard Central. Gibson leaders were caught off guard by many of the challenges associated with Dashboard Central's implementation. Although the technology department's authority over Dashboard Central had seemed rational at first, social and organizational tensions around this arrangement became evident. In other words, as technical problems with Dashboard Central emerged, so did the people problems. The end result of these problems was that after a summer and fall semester of

attempting to launch the system, district leaders realized that they might need to "re-start" their launch of Dashboard Central in the spring. Below we describe the work and troubles encountered by the district prior to this realization.

Unreliable data. The technical work associated with Dashboard Central was more difficult than expected. Although Gibson leaders had envisioned all technical work to be completed within the summer of 2010, much was still undone or unreliable even into the fall. For example, although some student data was beginning to find its way into Dashboard Central, other data (e.g., human resources, teacher-made assessments) had yet to be touched.

One major technical challenge was data validation. It was difficult to ensure that Dashboard Central had the "right data." One district leader attributed this problem to Gibson's lack of shared procedures around recording data—the district had not prepared bureaucratically for the system. He provided an example using student discipline data. Previously, decisions about how to code and maintain student discipline data were made at the campus level. This meant that the district lacked uniform number codes across all schools (e.g., all schools recording "assault" via "4493"). Accordingly, it was difficult to ensure that discipline data in Dashboard Central were intelligible when integrated. The problem of data validation was multiplied by the many assortments of data that could be entered into Dashboard Central.

Problems with the vendor. The problems with Dashboard Central were several. In a previous section, Edith lamented not having a technology department director to stay on the vendor's case when problems emerged. In fact, this issue became more troublesome as Dashboard Central began to take on more clients. Gibson leaders felt that their Dashboard Central contact person dealt with so many districts that Gibson fell to the "back burner." They

reported how phone calls were not returned and how their contact person would miss meetings. In effect, the Gibson central office lacked any effective bridge between district and vendor.

At the same time, Gibson leaders found that they were having trouble getting the system to do the things they thought it did. For example, Dashboard Central came pre-loaded with over 250 unique reporting functions, but the vendor left it to the district to decide how to assign those functions to users. This task, however, was nearly impossible: Dashboard Central had no guide explaining what functions even were – let alone how they might be used in practice. In the words of one district leader, there was no "valid reason" explaining the how and why of these reports. When the vendor was asked for explanations, the district was told, "Well, that's what it is."

Further, some Gibson leaders realized that reporting functions they'd found most attractive at product demonstrations were not prefabricated components of the Dashboard Central system. Rather, they had to be custom built. Gibson leaders had never planned for such technical work. Indeed, one reason they had chosen Dashboard Central was because they had thought such work wouldn't be needed. As one central office member lamented:

> The [competing vendors] were like okay, we're going to sit down with you and talk about what your data looks like. And then we're going to build the cubes. It would have taken a lot longer—probably. But looking back, maybe not. Hindsight is always 20/20.

Training. Trainings for Dashboard Central were a particular sore spot among campus administrators. To some extent, some of the missteps around training for the system can be traced to the social and bureaucratic forces in Gibson.

For example, because the technology department was an auxiliary to campuses and other offices, it was unprepared to mandate who should attend training or how concepts from training should be applied in practice. Confusion ensued amongst the campus administrators. At one

school, administrators turned the table on the interviewer, asking whether they were supposed to be using the system, as well as whether they were now trainers in a "train-the-trainer" model. Similarly, one principal was frustrated that he had been mandated to attend a different event on the same day as Dashboard Central training. He knew neither where to turn for missing knowledge, nor the consequences for missing the training. Contrary to the central office belief that late summer was a good time for training, he felt that he was already too busy preparing for the school year.

Further, there was the problem of vendor-led trainings. Although Dashboard Central was to have led some training, it canceled at the last minute. Nonetheless, Gibson drove on. As one district leader explained, "the train had left the station and there was no stopping it." Training was thus narrowed down to logging in and to personalizing home screens. Campus-level educators lamented the lack of support for data use. Teachers called this the "here it is, now go" and the "walk away" approach to training. Wishing for support, one administrator confided that she was forgetting how to use Dashboard Central and wished she had never gone.

Boyer's instructional coach work. As reported above, the Boyer district decided against acquiring a computerized system, deciding to fund instructional coaches instead. Boyer leaders described how coaches helped tailor one data use training to the needs of particular students' teachers. This training was geared toward helping teachers see the "whole student" by examining several printouts of data for individual students. In the absence of an integrated data system, coaches helped support this training by logging in to systems, isolating students relevant to the teachers, querying the system for particular reports, and then repeating the process for additional systems. Central office leaders and coaches then had conversations with teachers about serving

those individual students. Boyer leaders saw this approach as supporting their abilities to adapt to the needs of teachers and students. One Boyer leader explained:

> We make it a point to say it isn't one piece of data that will tell you a child needs help or needs [intervention]. The whole point was to dig deeper and look at the whole picture of how they're doing in the classroom. Not to just look at [test scores].

In general, coaches were seen as knowledge resources benefiting teacher- and school-level data use. Educators throughout the district were positive about their coaches' support of data use. In the words of one principal, "We don't know what we'd do without them." Further, one principal reported that because coaches could now work directly with teachers, she was now freed to examine data at the teacher and school levels. Similarly, another principal trumpeted the expertise that instructional coaches brought to her teachers:

> I can't be the expert in every single thing, there is no way. I would be kidding myself and I would be kidding the staff. I mean, I know enough about each one to—to be dangerous so to speak—to be in the loop. But I can't be everywhere. I can't know everything.

Discussion

The findings from the present study described varied approaches to data system implementation. Findings indicated that the Gibson and Boyer districts both took technologically deterministic approaches to data system implementation, but with different results. Gibson personnel relied heavily on the promises of their data systems and encountered problems when those promises were not realized. On the other hand, Boyer eschewed acquisition of a data system, assuming that data systems promised little that people could not do themselves. Findings also indicated Musial personnel seemed to avoid at least some of pitfalls of technological

determinism.[9] Musial sought input from other districts and from educators within their own district in planning for a system, then maintained contact with a group of users during implementation.

In the following sections, we offer our interpretation of these data, in light of the research perspective described earlier. In order to remain open to the range of possibilities in central office work, we sought to avoid normative assertions about either rational or open systems perspectives being "better" than another. Three discussion points are especially salient in this regard. First, technologically deterministic stances may be inadequate to the real work of technology implementation. Second, there may be value in balancing rational and open systems thinking throughout implementation. Third, data "champions" and bottlenecks affect implementation in ways that are illuminated by the present study. In the following three sections, we engage these points in more detail.

It's Harder than They Think: The Problem of Technological Determinism

At its heart, technological determinism is a form of reductionism. Technologies become little more than tools; their "effects" are thought of as predictable, inevitable, and universal (Brooks, 2011; Orlikowski & Barley, 2001). Researchers of technology would assert that such thinking obscures the unintended consequences of introducing new technologies. For example, good technologies can be rejected (Leonardi, 2009), and other technologies can lead to unexpected "spill over" into how people go about their jobs (Barley, 1990; Davidson & Chismar, 2007; Orlikowski, 1996). Our study illustrates how technological determinism may bring leaders to oversimplify implementation. In this sense, the "technology" implemented might just as well be a new curriculum, counseling program, or 1:1 mobile device initiative.

[9] Caveats around Musial's work apart from data system work are described in Cho and Wayman (2014).

The study districts helped to demonstrate the problem of oversimplification. For example, the Gibson district was caught off guard by the challenges of implementing Dashboard Central. Taking the system at face value, there had been relatively little preparation before system acquisition and inadequate routines for handling unexpected challenges. On the flip side, the Boyer district's decision against system implementation could also be understood as technologically deterministic. Boyer leaders saw data systems as being simply about technology integration. Data systems, however, offer more than just integration (Means et al., 2009; B. Tucker, 2010; Wayman et al., 2010). Today's systems offer a range of features, ranging from complex diagnostics to instant, proactive support in retailoring instruction. Equally important, increased access to data provides new opportunities for collaborative problem solving (Wayman & Stringfield, 2006; Wohlstetter, Datnow, & Park, 2008). Overly simplistic about the potential benefits of data systems, Boyer leaders were mistaken in assuming that that people (i.e. coaches) can do the work of computers with the same efficiency as computers.

In short, it may be hard to know a priori the exact challenges and work that might come up during implementation. Examples of strategies for addressing this problem might be had by considering how districts might balance their reliance on rational and open systems perspectives.

Adjusting Attitudes and Approaches toward Implementation

Although there are many ways in which central offices might approach their work, our findings suggest that central offices may gravitate toward rational systems perspectives. After all, such perspectives provide a convenient way to think about management. Although formal structures, aligned procedures, and divisions in labor can indeed have value (Datnow et al., 2007; Bolman & Deal, 2008; Wayman et al., 2012), our findings also demonstrate how a narrow reliance on such tactics could result in missed opportunities.

The problem is not that district leaders try to think things through. Rather, it is that they might fail to recognize fallibility in their decisions and estimations about the future (Allen, Strathern, & Baldwin, 2005; Eisenhardt & Zbaracki, 1992; March, 1991). Open systems perspectives recognize the limits of decision-making centers (Pfeffer, 1997; Scott & Davis, 2007), emphasizing issues such as information flow and adaptation to circumstances as they arise (McDaniel & Driebe, 2001; Rivkin & Siggelkow, 2002).

The study districts help to set such issues into relief. For example, Musial planners began not with Front End, but with searching outside the district for insight about improvement. Musial engaged in a variety of strategies to collect feedback about Front End and to adapt their work, such as by piloting the system and collecting data about its use. Further, Musial leaders resisted technological determinism by not assuming that their own ideas about Front End were the only ones possible. Rather, Musial worked continuously with a district user group around system design, then attempted to stoke enthusiasm for the system during trainings.

In contrast, the Gibson district helped to show how lack of information flow and adaptation may take their toll. For example, both the technology and curriculum and instruction departments made data system decisions based upon their own ideas about what might be important, but without necessarily by consulting end users or one another. This came with mixed results. Although Flightpath implementation went without complaint, Dashboard Central implementation suffered from a host of problems. In particular, Dashboard Central's technical problems seemed exacerbated by unadjusted bureaucratic structures, divisions within central office, and troubles in managing ties with the vendor.

Thus, open systems concepts may afford district planners what Pfeffer and Sutton (2006) call an "attitude of wisdom." Although leaders should try to do what they think is right, they

should also organize for possibility that their decisions could also be wrong. For example, district leaders might take steps to improve their information gathering and feedback. If information is a resource flowing among people, then relationships with others can be important conduits for ideas and feedback (Burt, 2004; Daly, 2012). On this note, Honig and Venkateswaran (2012) theorize about how central offices might better engage with schools around data use. Similarly, Cho and Wayman (2014) describe how central offices might address teachers' needs for sensemaking by treating implementation as an extended period of adjustment.

Further, district leaders might also be served by being mindful of the "depth" to which they engage with evidence from the outside word (Farley-Ripple & Cho, in press). For example, leaders might work to benefit from outside knowledge by bridging boundaries with other organizations (Daly, 2012; Honig, 2006; Leana, 2011). One might muse about what might have happened had Gibson better vetted if, how, and where Dashboard Central had been previously implemented. Similarly, one might question Boyer's reliance on a single price quote in its abandonment of plans to obtain a system. The issue for Boyer is not whether it was right to fund instructional coaches, but rather whether their limited search process adequately explored their options for serving students.

Finally, an attitude of wisdom is not simply about leaders gathering information. Rather, it is also about all organizational members being candid with each other, even if the truth is bad news. Although one might say that Gibson's technology department should have spoken up to district leaders and with the vendor, the flip side is that district leaders needed to lay the groundwork for such advocacy. Effective organizations treat failures as opportunities for improvement (Pfeffer & Sutton, 2006; A. L. Tucker & Edmondson, 2003), and leaders may need

to institutionalize protocols for handling difficult conversations (McDonald, Mohr, Dichter, & McDonald, 2007; Wayman & Stringfield, 2006).

Champions, Bottlenecks, and Bureaucracy

Whereas cautions have been raised at the school level about relying too much on a single champion for data use (Copland, 2003; Lachat & Smith, 2005; Wayman & Cho, 2008), our study raises this conversation to the realm of central office. The burdens of being the single champion can prove overwhelming, thus creating a bottleneck of work. What's more, significant amount of expertise would be lost should that person ever exit the system. For example, Boyer instructional coaches were valued precisely because they performed burdensome work and had expertise that principals had previously been unable to provide.

The examples of Musial and Gibson demonstrate some of the advantages and disadvantages of having the single champion at central office. Both Susan and Edith engaged in a significant amount of work that no one else could do. Susan was lauded for her abilities to bridge the worlds of technology, instruction, and data use. Although her direct influence on educators was primarily limited to those who participated in trainings, she was able to indirectly influence educators throughout the district via Front End's successful implementation. Meanwhile, Edith lamented her relative isolation when managing Dashboard Central's implementation, especially her lack of preparation and authority for making decisions that might impact instruction. Not only did she see herself as a "technology person," but district bureaucratic structures upheld the ways in which she was siloed.

Although the Musial district formally bridged department boundaries by creating Susan's job position, this solution may be difficult to replicate or make sustainable. Evaluating the relative skill levels of current staff and the potential to hire new staff might be only a first step.

Our hunch is that at there are more Ediths in the world than Susans. The technology expertise required for managing districtwide data systems is probably rare among educators, and district leaders might find it easier to fill technology positions with technology people. In other words, it may be hard to avoid having a large share of responsibility falling onto one set of shoulders.

If so, then district leaders might be served by addressing barriers among central office departments (Wayman et al., 2012). Both the Gibson technology department and the curriculum and instruction department felt that their formal division hindered Dashboard Central implementation. Bringing together divergent perspectives might have fostered creative frictions and new insights (Brown & Duguid, 1991; Carlile, 2002; Nonaka et al., 1998). Sounding boards can improve the quality and speed with which knowledge is brought to bear on decisions (Daly, 2012; Eisenhardt, 1990; Weick, 1993), and even "water cooler conversations" can contribute to productivity (Davenport & Prusak, 1998). Accordingly, district leaders attend to when, how, and with whom central office members get explore and share ideas.

Conclusion

Although some districts can face troubles ensuring that data systems are leveraged (Means et al., 2009; Wayman et al., 2009; Shaw & Wayman, 2012), we are optimistic about their potential to improving schooling. As the present study demonstrates, however, districts can and should do more in order to realize such potential. In particular, open systems perspectives may support district planning by resisting technological determinism, and in turn, supporting how districts leverage feedback or adapt to circumstances. An analogy might be drawn from the world of gardening: Good gardeners do not select plants based simply on their beauty. Rather, they consider a host of environmental conditions and long-term needs. They experiment, reassess, and adjust their activities over time. Thus, we suggest that districts should avoid taking

data systems at face value. Districts should evaluate carefully whether systems “fit” their contexts, as well as whether they have prepared adequately for system use to flourish.

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