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Exploring Data Center Migration: A Case Study

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ABSTRACT: A data center migration (DCM) refers to the physical and/or logical relocation of IT services from one physical and/or virtual location to another. The demand for and occurrences of DCMs have increased in recent years. In this case study, we examine a DCM completed by a governmental organization with approximately 80,000 users. We identify key success factors and measure the importance of specific DCM activities. Analyzing both quantitative and qualitative data to derive factors that contribute to DCM success, the following overarching conclusion emerged: *Key success factors in a data center migration include proper planning, consideration of procedures to minimize end-user impact including downtime, and effective communication among team members before and during the data center migration*. DCMs have practical implications for regulatory compliance and enterprise risk management efforts. Opportunities for future research include employing structure-mapping theory to test the predictive value of DCM success factors in other system implementation and migration contexts such as cloud migrations.

Keywords: case study; cloud migration; data center migration; risk management.

Data Availability: A complete copy of the questionnaire is available upon request.

I. INTRODUCTION

Organizations rely on information systems and the supporting information technology to capture and process data (COSO 2004). Organizations use facilities such as data centers to store and safeguard their information technology and hardware assets. According to a survey conducted by the AFCOM Data Center Institute in 2015, the modern data center will continue to play a pivotal role in today's companies. Most of all, the data center platform will be the driving force for the next generation of businesses. Cisco Systems, Inc. reports that global data center traffic is firmly in the zettabyte era and will triple from 2013 to reach 8.6 zettabytes annually by 2018 (AFCOM 2015, 1). By 2018, 65 percent of new data center infrastructure investments will be for systems of engagement, insight, and action rather than maintaining existing systems of record (Anderson et al. 2015). In the public sector, given the vast volume of data owned and managed by the federal government, the number of data centers run by the federal government has grown exponentially over the last decade from 423 in 1999 to over 3,000 in 2012 (AFCOM 2013).

In recent years, it has become almost inevitable for organizations to go through data center migrations (DCM) due to the growing demand of physical capacities (e.g., power and cooling), technology innovations, and corporate acquisitions requiring asset consolidation. The International Data Corporation (IDC) reported that at the end of 2013, 60 percent of large enterprise IT projects consisted of data migrations but only 60 percent of these projects were completed on time (IDC 2013).

Although DCM is a timely and important subject for academic and practitioner research, there has been little research that sheds light on the key success factors for executing an efficient and effective DCM. Gaining insight from IT personnel involved in a DCM provides a basis for understanding and studying DCMs. The objectives of our research are to identify data center migration success factors and to capture the importance of specific data center migration activities. Thus, in this research, we use a case study approach to examine a successful DCM. We captured data both pre- and post-DCM to support triangulation of

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key success factors and provide insight regarding the importance of specific migration activities. Using questionnaire data of IT personnel involved in the DCM, interview data from the DCM leadership team—including the chief technology officer charged with DCM planning, and content analysis of documents associated with the DCM, our study captures the experience of a large, governmental organization completing a DCM. The case study utilizes quantitative and qualitative data to identify and describe the factors that contribute to a successful DCM. In our analysis of the DCM case and in support of the first research objective aforementioned, we examine the following research question: What are the key success factors for a data center migration?

Our research examines a DCM, a unique and complex IT project that deals with data storage and IT asset management. The success factors identified in our study align with those uncovered in previous research on ERP implementation, and confirm applicability of systems implementation research in a new and unique context that has not previously been studied, that of a DCM. We submit that system implementations, migrations, and even disaster recovery preparedness may be viewed through the lens of structure-mapping theory by both researchers and practitioners and, therefore, our findings may extend to those contexts. Additionally, we inform research and practice by discussing the components of enterprise risk management (ERM) and the Sarbanes-Oxley Act (SOX) compliance requirements that DCMs may impact and by discussing the extension of DCM success factors to cloud migrations.

DCM, similar to system implementation projects, requires careful planning and change management efforts. Lessons learned from the field indicate that it is critical to manage IT personnel's expectations through clear communication and to utilize expertise and resources effectively in order to plan and implement a smooth migration. Although IT professionals bear the weight of responsibility in planning and executing a DCM, the risks presented by a DCM impact organizations' compliance and risk management efforts. DCM presents the challenge of assessing and responding to risks associated with a diverse set of potential impacts such as damage to hardware during the moving process, information systems and applications availability, and the potential for extended system downtime resulting in negative impacts on end-user productivity. Additionally, with the increasingly prevalent use of cloud computing, cloud migrations are well underway for many organizations.

Cloud migrations share similar purposes with those of a DCM, to lower capital and operating costs for data centers and improve application performance. As noted by AFCOM (2015), data center providers have stepped into the role of cloud computing providers as there has been an increase in demand to provide storage and support, but they have faced security concerns. Applying structure-mapping theory, results from our examination of DCM may be used to plan for and study cloud migrations. In the information systems context, structure-mapping theory suggests that consideration of the similarities between DCM and cloud migration may increase the likelihood of successful migrations by mapping knowledge about a familiar or base domain (e.g., DCM) to an unfamiliar or target domain (e.g., cloud migration). Because structure-mapping theory focuses on the human ability to acquire and apply knowledge, application of the theory provides insight into the human element that influences the success of the migration. As we will later report, technical expertise of the DCM team is identified by our participants as a key success factor for a successful DCM. We discuss our findings in light of their implications for research and practice in the areas of SOX compliance, ERM, and the use of structure-mapping theory to extend our DCM research results to a cloud migration context.

The rest of the paper proceeds as follows. In Section II, we provide background on DCMs. Section III describes the research method. In Section IV, we discuss data analysis and present the results. Finally, in Sections V and VI, we conclude with the research and practical implications, limitations, and opportunities for future research.

II. DATA CENTER MIGRATIONS

Data centers are facilities that house and run an organization's IT operations and equipment. Data centers store, process, and disseminate organizational data and usually include various backup supplies (e.g., power, data communications connections), environmental controls (e.g., temperature control, fire suppression), and security devices. A DCM is a broadly defined term that entails the physical and/or logical relocation of IT services from one physical and/or virtual location to another. A migration may consist of migrating existing applications, individual application layers, individual architectural components of applications (Andrikopoulos, Binz, Leymann, and Strauch 2013), relocating data exclusively, or transferring all information assets including moving all physical hardware to the new location.

Structure-mapping theory focuses on identifying similarities between familiar and unfamiliar phenomenon in order to better understand the unfamiliar phenomenon (Gentner 1983). Prior research has used structure-mapping theory to map conceptual similarities between phenomena in order to help individuals and organizations extend their knowledge from a familiar context to an unfamiliar context to support learning (Muniz and Oliver-Hoyo 2014; Reed 2015; Velentzas 2014; Woody and Himelblau 2013). In IS research, structure-mapping theory has been used in coding research as an approach to analyzing the similarities between unified modeling language diagrams used in structure-mapping engines (Park and Bae 2011). We extend the application of structure-mapping theory to identify situational contexts in IS with similarities and to apply the findings from one context to another. To do so, we consider the common aspects that DCMs share with other IS projects to

expound the application of our findings to other IS contexts. For example, similar to a system implementation, a DCM involves key steps such as planning, implementation, and testing. The ISACA's (2014a) *Insights from CIOs* thought leadership poses the question, "Is your IT infrastructure keeping pace with change?"

As organizations consider what their data center requirements will be in ten to 20 years, they have to decide whether they can transform their current data center or they need to move to a new data center location (Barwick 2013). An increase in the demand for cloud computing, in order to manage computational and energy costs, has also impacted companies' data center requirements (Ahmad et al. 2015) and may necessitate a change in data center infrastructure.

DCM, when carried out successfully, enables organizations to increase storage space, realize cost efficiencies, move to a newer facility, meet regulatory requirements, and improve the availability and recoverability of an organization's IT services (Brocade Communications Systems 2007). Organizations have struggled with DCM and experienced negative effects when the migration did not go well. The failure of the state of Oregon's data center consolidation in 2008 revealed many important issues and risk factors to consider and resolve in order to execute a successful DCM. The four-year effort, at an astounding cost to the state, produced disastrous results. Some of the contributing factors included poor planning, underestimation of requirements, and lack of experience.

In a survey reported by IBM (2007), greater than 75 percent of respondents engaged in data migration, which includes data center relocation, reported problems during the migration. Planning for a successful DCM can include consideration of the costs of the migration, the assessment of existing assets, applications and dependencies, consideration of cloud migration and of infrastructure (e.g., data center layout, power cabling design, space) requirements, assignment of a DCM team, and, possibly, contracting an outside DCM consulting team (Frenkel 2015). Even with careful planning, DCM efforts encounter challenges and obstacles; therefore, given the increasing demand and occurrences of data center relocations and consolidations, research in this area can advance our understanding and improve both the effectiveness and efficiency of DCM efforts, which include safeguarding physical and information assets during migration.

Organizations may use data centers to support the "services, infrastructure and applications" category of enablers articulated by COBIT 5 (ISACA 2014b). Data centers provide storage for electronic recordkeeping, which presents both advantages and disadvantages. Advantages of electronic recordkeeping practices include more efficient data searches, remote access to organizational information, and reduced physical storage space required as opposed to retaining hardcopies of records (Vera-Muñoz, Ho, and Chow 2006). COSO (2004) notes the widespread reliance of organizations on information systems, and these information systems are usually supported using data centers to house the information technology hardware. Because electronic recordkeeping and data centers have become commonplace, organizational stakeholders including management, the chief information officer (CIO), the chief technology officer (CTO), the board of directors, the audit committee, and the auditors must be cognizant of the risks to the organization's compliance efforts that this IT environment presents. Each of these stakeholders has a role in ensuring the appropriate use of information technology (IT) assets, such as data centers, in compliance and risk management efforts.

Study of DCMs will elucidate the efforts needed to complete a DCM in a successful manner to avoid common pitfalls and mitigate risk. Our review of existing literature did not reveal any research that captured the key success factors of a DCM by studying the experiences of those involved in a DCM. Therefore, we study an organization completing a DCM to address the following research question:

RQ: What are the key success factors for a data center migration?

III. RESEARCH METHOD

Case Study

Case studies are used to study a complex event, process, or organization in detail. Case studies produce descriptions and analysis that may take the form of qualitative or quantitative data and may be approached from an interpretivist, positivist, or critical research paradigm (Dubé and Paré 2003; Klein and Myers 1999; Yin 2011). Researchers completing a case study employ a variety of techniques to collect data about the phenomenon of interest. In case study research, data collection occurs over a period of time, and the strength of the method stems from the researchers collecting evidence from multiple sources to capture a complex process and multiple perspectives. Common techniques used to gather data in a case study include administering questionnaires, interviewing participants, and analyzing documents using content analysis (Dubé and Paré 2003; Rossman and Rallis 2003). Indeed, we collected both qualitative and quantitative data from multiple sources, using a range of data collection techniques; this approach is noted to "bring richness and flexibility to the overall research process" (Dubé and Paré 2003, 598). Positivist, descriptive case studies may be used when researchers seek to describe, in a straightforward and factual manner, the event under study (Dubé and Paré 2003).

We employed a positivist, descriptive case study approach to study a data center migration, which may be considered an event or a process that was completed by an organization with approximately 80,000 end-users. A case study is the appropriate research methodology in this instance because DCM has not been extensively researched. Foundational research in the IS field regarding qualitative methods notes that case study research is an appropriate approach to use when studying a phenomenon about which few prior studies exist (Benbasat, Goldstein, and Mead 1987). To support the credibility and rigor of our case study, we triangulated our findings by collecting data from multiple sources (e.g., the DCM leadership team and the DCM participants), at multiple points in time (e.g., both before and after the DCM), and using a variety of methods (e.g., questionnaire, interview, document analysis), and a variety of data forms (e.g., both quantitative and qualitative forms) (Anfara, Brown, and Mangione 2002; Rossman and Rallis 2003). Case studies are used to "extrapolate lessons learned" (Patton 2002, 500); therefore, we present our results in light of key factors to consider for a successful DCM.

Case Site and IT Governance Structure

A governmental organization that serves 80,000 end-users participated in our research. The organization is located in a large metropolitan area in the Mid-Atlantic region of the United States. Those charged with IT governance, led by the chief technology officer, determined that the organization needed to move its data center to a suburb of that metropolitan area to reduce the storage and rental costs associated with its data center, and to move to a newer facility with a more reliable cooling system. The DCM included the migration of 1,000 of the organization's 3,000 servers. The IT governance structure for the organization includes the Office of the Chief Technology Officer (CTO), which is directed by the CTO and reports directly to the director of the organization. Additionally, the Office of the Chief Technology Officer includes the CTO, an assistant to the CTO, a supervisor for information assurance and risk management/cybersafety program manager, and an IT systems security specialist, all of who report to the CTO and a data recovery/disaster recovery specialist, who reports to the supervisor for information assurance and risk management/cybersafety program manager.

The relational mechanism in IT governance recognizes the importance of connecting the IT group and communicating the value of its initiatives to the business side of the organization (De Haes and Van Grembergen 2004). To support the relational mechanism between the IT group and the operations group of the organization, the DCM team also included a director of infrastructure and operations, who acted as a liaison between the IT group and the functional groups of the organization (i.e., the operations group) and who reported to the director of the organization. This individual not only had operational experience, but also had IT experience with the organization. There were six primary members of the DCM leadership team. They had an average of 7.4 years of experience with IT/IS at the organization (Table 1, Panel A).

Questionnaire Development

The objective of the questionnaire was to capture the perceptions about specific DCM activities of the personnel involved in the DCM both before and after the DCM and extrapolate possible DCM success factors. We developed a pre-DCM questionnaire and a post-DCM questionnaire. We kept the items in both questionnaires as consistent as possible in order to compare and contrast the pre- and post-DCM responses. We developed the questionnaire based on our review of existing practitioner publications, and the items were adopted from multiple sources (e.g., AFCOM 2013; Brocade Communications Systems 2007; IBM 2007; IDC 2013). To support inclusivity we asked the DCM team to review the instrument prior to launching it. We amended the instrument based on their feedback. The post-DCM questionnaire contained some additional questions regarding the participants' experiences during the DCM and assessments after the DCM. The questionnaires consisted of Likert scale questions, ranking questions, demographic questions, and open-ended questions:

1. Likert scale questions focused on the evaluations of the importance of data center migration activities (e.g., information security management, hardware mapping, and assessing power supply requirements).
2. Ranking questions related to the three most important contributing factors to the success of the data center migration.
3. Demographic questions captured the participants' experience levels with data center migration and IT in general.
4. Open-ended questions solicited free-text responses from participants regarding time and tasks involved in the data center migration, individual opinions about the planning and success of the data center migration, etc.

Participants and Data Collection Procedures

The questionnaire participants came from the organization undergoing the DCM. The organization's system supports over 80,000 users, and the organization receives government support. For both the pre- and post-DCM data collections, an email containing the link to the online questionnaire was sent to 71 employees identified as DCM participants by the Office of the Chief Technology Officer. The questionnaire was reviewed by the CTO and members of the DCM leadership team. During a

TABLE 1

Team Experience and Demographics

Panel A: Data Center Migration Team Experience

Data Center Migration Leadership Team Lead by the Office of the Chief Technology Officer

Position	Years in Current Position	Total Years of IT/IS Experience at Organization
Chief Technology Officer	5	11
Supervisor for Information Assurance and Risk Management/ CyberSafety Program Manager	10	10
Director of Infrastructure and Operations	5	5
Assistant to the Chief Technology Officer	1	1
IT Systems Security Specialist	6	6
Data Recovery/Disaster Recovery Analyst	5	4
Total years of Experience	32	37
Average Years	6.4	7.4

Panel B: Participant Demographics

	Pre-DCM Survey		Post-DCM Survey	
Participant Demographics	**Count**	**Percentage**	**Count**	**Percentage**
Have You Experienced a Data Center Migration Move Before?				
Yes	6	20%	6	26%
No	24	80%	17	74%
Have You Experienced a Data Center Disaster Recovery Event?				
Yes	18	58%	15	65%
No	13	42%	8	35%
Years of Experience in Current Position				
Less than 1 year	1	3%	2	9%
1 to 2 years	2	7%	5	22%
3 to 5 years	7	23%	3	13%
6 to 10 years	4	13%	0	0%
More than 10 years	16	54%	13	56%
Years of IT Experience				
Less than 1 year	7	23%	5	24%
1 to 2 years	2	7%	1	5%
3 to 5 years	15	48%	9	42%
6 to 10 years	6	19%	5	24%
More than 10 years	1	3%	1	5%
Education				
High School Diploma or GED	7	23%	5	24%
Associate's Degree	2	7%	1	5%
Bachelor's Degree	15	48%	9	42%
Master's Degree	6	19%	5	24%
Ph.D.	1	3%	1	5%

conference call, the CTO and the team members provided feedback on the questionnaire questions and added questions to the questionnaire instrument. The input from professionals in the field enhanced the external validity of the questionnaire.

Data for the pre-DCM questionnaire were collected a week prior to the DCM. In the pre-DCM questionnaire, we collected responses from 32 participants. Table 1, Panel B contains basic demographics of the questionnaire participants. The post-DCM questionnaire was open a week after DCM, and data were collected over a three-week time period. In the post-DCM questionnaire, we collected responses from 29 participants, but four responses were not useable; thus, the post-DCM results are

based on the useable responses from 25 participants. The response rates for the pre- and post-DCM questionnaires are 45 and 35 percent, respectively. Based on requests from the participating organization and requirements of the IRB approval process, the questionnaire participants were not forced or required to answer every question in the questionnaire. We matched the responses from pre- and post-DCM participants; therefore, some results are based on responses of fewer than 32 or 25 participants for the pre- and post-DCM results.

We also collected data through interviews with the DCM team both before and after the DCM, as well as a conference call with the DCM leadership team prior to the migration. Consistent with prior case study research in information systems (Gallagher, Worrell, and Mason 2012; Hardy 2014), we provide texture in data collection procedures by detailing the roles of the participants with whom interviews were conducted, the number of interviews conducted with each interviewee, and the duration of the interviews.[1] We conducted four interviews with the supervisor of information assurance and risk management/cybersafety program manager, who served as the point person for the participating organization for this research, totaling five hours, and three interviews with the data recovery/disaster recovery analyst totaling 3.5 hours. Further, we held an hour-long conference call with the CTO, the assistant to the CTO, the supervisor for information assurance and risk management/cybersafety program manager, an IT systems security specialist, a data recovery/disaster recovery specialist, and the director of infrastructure and operations. During the conference call, the supervisor for information assurance and risk management/cybersafety program manager projected the preliminary draft of the survey we had developed in Qualtrics for team review. The DCM leadership team suggested additional questions and provided feedback about the wording of the questions. Several questions were revised to include wording that specifically reflected the terms used by the organization under study.

Additionally, the organization provided copies of documents sent to the end-users and we used those documents in our content analysis to support our development of an overarching thematic conclusion. The documents included an email sent to end-users announcing the DCM and the timing of the DCM, emails between the DCM leadership team and a memorandum sent by the CTO and approved by the chief operating officer to all organization staff detailing the purpose, timing, applications and systems to be affected, and the expected timeline of accessibility of programs for end-users.

IV. DATA ANALYSIS AND RESULTS

We implemented a two-tiered approach to data analysis. First, we analyzed participants' responses that were captured using quantitative measures. Second, we analyzed participants' responses captured using qualitative measures. Because case studies include a variety of data collection techniques, our data took a variety of forms.

Quantitative Measures

We performed descriptive analyses to measure the participants' rating of the importance of DCM activities. Responses were captured using a seven-point Likert scale with the following points: 1 = Not Relevant; 2, 3, 4 = Helpful; 5, 6, 7 = Critical. See Table 2 for a summary of pre- and post-DCM response means.

We asked participants to rank five factors that contributed to the success of the DCM both pre- and post-DCM. We present the pre- and post-DCM responses in Table 3, Panel A and Panel B, respectively. Overall, technical expertise was ranked as the top factor contributing to DCM success, while choice of DCM strategy was ranked as the least important out of the five factors. The rankings for these two factors are consistent both pre- and post-DCM. The remaining three success factors experienced slight changes between pre- and post-DCM rankings.

Further, 89 percent of the participants in the pre-DCM questionnaire and 91 percent in the post-DCM questionnaire thought the planning was adequate for a successful migration. In the pre-DCM questionnaire, all participants thought the planning activities contributed to the success of the DCM, and 95 percent of the participants in the post-DCM questionnaire agreed. In the post-DCM questionnaire, 79 percent stated that the DCM experience was what they expected it to be and rated their impression of the DCM experience as 6 out of 7 (7 being the most positive). Therefore, overall, the questionnaire participants agreed that the DCM project was successful. This partially explains the consistency in the pre- and post-DCM answers to the items in Table 2.

To statistically test whether individuals' perceptions of the importance of DCM activities changed between pre- and post-DCM, we ran a paired sample t-test to compare the two sample means for the items in Table 2. A paired sample t-test is often used in "before "and "after" studies when the samples are matched pairs. By using the paired sample t-test, we can statistically conclude whether the perceptions changed on the importance of implementation activities. The results indicate that out of 42

[1] Consistent with Heck (2006, 380), we employed an open-ended interview approach to encourage "informal conversation" and to allow the participants to express their full range of reactions with the methodological intent to capture diverse participant experiences about a relatively understudied phenomenon (i.e., DCM).

TABLE 2

Rating of Importance of Data Center Migration Activities

Data Center Migration Activities	Pre-DCM Mean	Pre-DCM Std. Dev.	Post-DCM Mean	Post-DCM Std. Dev.
Information security management	5.81	1.45	5.28	1.81
Data center migration budgeting	5.44	1.33	5.44	1.72
Data center migration planning	6.69	0.69	6.25	1.54
Minimizing end-user downtime	5.72	1.11	5.52	1.61
Hardware map of current data center location	5.81	1.40	5.33	1.81
Hardware map of new location (i.e., diagram of hardware in its planned location)	6.28	1.20	6.16	1.43
Orchestration with other organization processes (i.e., timing of migration based on organizations' business cycles)	5.91	1.09	5.76	1.59
Data backup prior to migration	6.61	1.15	6.00	1.64
Assessing power supply requirements	6.53	0.84	6.32	1.41
Assessing Ethernet and cable connection requirements	6.34	1.18	6.21	1.50
Testing the hardware following migration	6.44	1.08	6.16	1.52
Testing of application services (i.e., Are the paths to the applications working properly? Are the data reachable?)	6.47	1.05	6.08	1.50
Tracking hardware by inventory number prior to transport	5.53	1.05	5.42	1.79
Tracking hardware by inventory number following transport	5.47	1.02	5.33	1.76
Migration scheduling (i.e., developing a specific timeline of events)	6.09	0.93	5.67	1.46
Conducting a relocation site walk-through before the migration	5.78	1.21	5.91	1.53
Conducting a relocation site walk-through after the migration	5.48	1.43	5.67	1.52
Conducting a successful test failover of the core environment to the disaster recovery site	5.26	1.91	5.21	2.08
Performing tests of server connections	6.09	1.33	6.13	1.45
Conducting data center performance tests on each server	4.97	1.91	5.25	1.94
Destination fully prepared with new racks prior to relocation	5.10	1.99	5.22	2.11
Device labeled with rack number or location identifier	5.94	1.46	5.92	1.56
Device labeled with number of cables to be installed	5.74	1.65	5.35	1.92
Labeling each rack with the specific hardware devices to be placed on it	5.87	1.57	5.39	1.80
Connecting the new environment (i.e., Wide Area Network [WAN], Local Area Network [LAN], and applications)	6.39	1.28	6.17	1.46
Testing the power to the new environment	6.38	1.07	6.04	1.49
Testing network infrastructure (i.e., Is the hardware connected in the new environment? Can it communicate with other hardware?)	6.41	0.80	6.17	1.61
Testing of the routers (in support of WAN infrastructure)	6.53	0.72	6.13	1.54
Testing of the switches (in support of WAN infrastructure)	6.16	1.19	5.96	1.57
Testing LAN (i.e., testing the servers to ensure connection between hardware)	6.26	1.09	6.08	1.61
Restore operating systems	5.31	2.11	5.18	2.24
Restore backup tapes	5.24	1.94	4.95	2.16
Restoring data center to full operational status	6.47	1.04	6.09	1.53
Performing a walk-through of the day-of-move plan	5.19	1.56	4.96	1.83
Day-of-move plan is adjustable/flexible	5.77	1.43	5.74	1.66
Assessment of the HVAC requirements (i.e., the ability of the air conditioning unit to adequately cool the equipment)	6.16	1.27	6.00	1.73
Computational fluid dynamic analysis (i.e., analysis of the airflow at the new facility)	5.80	1.27	5.95	1.59
Fire suppression requirements (i.e., appropriate location of sprinklers or chemical fire suppressants)	5.84	1.42	5.82	1.56
Assignment of roles and duties of data center migration personnel	6.06	1.09	5.96	1.37
Pre-DCM communication plan (i.e., communication plan between the individuals involved in the DCM)	6.23	1.09	5.96	1.40
During-DCM communication plan (i.e., communication plan between the individuals involved in the DCM)	6.10	1.14	6.17	0.98
Post-DCM communication plan (i.e., communication plan between the individuals involved in the DCM)	5.52	1.50	5.88	1.48

TABLE 3

Pre- and Post-DCM Success Factor Ranking

Panel A: Pre-DCM Success Factor Ranking

Rank	Success Factor
1	Technical Expertise
2	Knowledge of DCM Plan
3	Hardware Mapping
4	Knowledge of Hardware Configuration
5	Choice of Strategy

Panel B: Post-DCM Success Factor Ranking

Rank	Success Factor
1	Technical Expertise
2	Hardware Mapping
3	Knowledge of Hardware Configuration
4	Knowledge of DCM Plan
5	Choice of Strategy

DCM activity items, the means for two activities (information security management and data backup prior to DCM) were statistically significantly different. Interestingly, information security management and data backup are the only two activities in the list that are not DCM specific. While the participants agreed on the importance of the DCM-specific activities both pre- and post-DCM, it is plausible that the importance of these two activities decreased in the post-DCM evaluation because they were not directly related to DCM.

The paired sample t-test demonstrates that most of the survey participants did not change their perceptions on the importance of DCM activities and that their beliefs remained mostly consistent before and after the DCM. Moreover, because the majority of the participants concurred on the importance of planning and deemed the planning of this DCM successful, we would expect consistency in the responses. The lack of significantly different responses further confirms the success of the DCM overall and triangulates the importance of the DCM activities.

Further, Tables 4 and 5 contain the top ten most important activities in DCM considered by the questionnaire participants for pre- and post-DCM perceptions, respectively. Out of the ten most important DCM activities, six overlap between pre- and post-DCM questionnaires. This again lends support to the importance of planning and the consistency in perceptions when DCM is a success.

TABLE 4

Top Ten Most Important DCM Activities (Pre-DCM Questionnaire)

Pre-DCM Rank	Top Ten Most Important DCM Activities (Pre-DCM Questionnaire)	Corresponding Post-DCM Rank
1	Data center migration planning	2
2	Data backup prior to migration	
3	Assessing power supply requirements	1
4	Testing of the routers (in support of WAN infrastructure)	9
5	Testing of application services (i.e., Are the paths to the applications working properly? Are the data reachable?)	
6	Restoring data center to full operational status	
7	Testing the hardware following migration	7
8	Testing network infrastructure (i.e., Is the hardware connected in the new environment? Can it communicate with other hardware?)	5
9	Connecting the new environment (i.e., Wide Area Network [WAN], Local Area Network [LAN], and applications)	6
10	Testing the power to the new environment	

TABLE 5

Top Ten Most Important DCM Activities (Post-DCM Questionnaire)

Post-DCM Rank	Top Ten Most Important DCM Activities (Post-DCM Questionnaire)	Corresponding Pre-DCM Rank
1	Assessing power supply requirements	3
2	Data center migration planning	1
3	Assessing Ethernet and cable connection requirements	
4	During-DCM communication plan (i.e., communication plan between the individuals involved in the DCM)	
5	Testing network infrastructure (i.e., Is the hardware connected in the new environment? Can it communicate with other hardware?)	8
6	Connecting the new environment (i.e., Wide Area Network [WAN], Local Area Network [LAN], and applications)	9
7	Testing the hardware following migration	7
8	Hardware map of new location (i.e., diagram of hardware in its planned location)	
9	Testing of the routers (in support of WAN infrastructure)	4
10	Performing tests of server connections	

As can be seen from Tables 4 and 5, planning and power requirement assessments are highly ranked by the questionnaire participants both pre- and post-DCM. This is consistent with literature in the field (Bullock 2008). In addition, assessing Ethernet and cable connection requirements ranked third, and communication plan ranked fourth in the post-DCM questionnaire. In fact, several participants reinforced the importance of assessing connection and power requirements with one participant stating, "Take your time to get new data center ready (cabling, power, network cables, fiber, AC, HVAC, UPS, generators, etc.)." Further, as seen in Table 5, participants ranked "assessing power supply requirements" as the most important activity in the post-DCM questionnaire. The importance of this task is reflected in the following participant quote: "Doing an inventory of all servers/racks, including heat output and power requirements . . . planning to know how many ACs we should have . . . how to arrange the aisles for hot/cold, what type of electrical cabling system to use, what electrical cords to purchase, etc." In the pre-DCM questionnaire, participants considered data backup and data center restoration as more important activities.

Qualitative Measures

We analyzed the qualitative data collected from the open-ended questions, interviews, and documents to identify patterns, themes, and categories of responses. The analysis of the qualitative responses provides insight into our research question: "What are the key success factors for a data center migration?"

The qualitative analysis is presented in an exhibit based on the presentation of qualitative data suggested by Anfara et al. (2002). Please see Exhibit 1 for the qualitative data results.

Exhibit 1 should be interpreted from the bottom-up in the following manner:

1. The First Iteration represents individual responses that the researchers grouped together because they shared a common issue.
2. The Second Iteration is presented based on pattern variables identified in the individual responses represented in the First Iteration.
3. The Third Iteration summarizes the pattern variables and groups them into themes to be used in the formation of the Overarching Thematic Conclusion.
4. The Overarching Thematic Conclusion uses the themes to summarize in one sentence the key success factors for a DCM.

In the First Iteration, we jointly coded the data based on similarities. Coding is a process used to find evidence in the data of an underlying concept (Rossman and Rallis 2003). We jointly coded the data in sessions that encouraged discourse between the researchers about the patterns that emerged from the data.[2] Participants' responses were grouped based on emerging patterns. The pattern variables that emerged based on participants' responses were planning activities such as mapping the new

[2] We recognize that independently coding the data enhances credibility and dependability in qualitative research; however, we found the process of jointly coding the data to enhance the pattern identification process. Because of this approach, we used triangulation to support both the credibility and dependability of our research (Anfara et al. 2002).

EXHIBIT 1
Mapping of Data Center Migration Key Success Factors[a]

Research Question

What are the key success factors for a data center migration?

Overarching Thematic Conclusion

Key success factors in a data center migration include proper planning, consideration of procedures to minimize end-user impact including downtime, and effective communication among team members before and during the data center migration.

Third Iteration: Themes

1A.	Planning	1B.	Minimizing/managing end-user impact	1C.	Effective communication

Second Iteration: Pattern Variables

1A.	Planning physical placement of data center assets	1B.	Minimizing user downtime	1C.	Good communication between groups and throughout stages of the DCM
2A.	Planning tasks	2B.	Minimizing the DCM timeframe	2C.	Use tools that increase the clarity of information
3A.	Planning for challenges (e.g. risk assessment and risk response activities)	3B.	Manage end-user expectations regarding impact of DCM activities	3C.	Utilize good communication to tap into employee expertise

First Iteration: Initial Codes/Surface Content Analysis

1A.	Proper labeling of hardware before migrations	1B.	Minimizing downtime	1C.	Coordinating various groups
1A.	Mapping of new data center including hardware placement, and network and power cable placement	1B.	Supporting students and staff when school resumes	1C.	Good communication throughout (planning, executing, coordinating, reporting, closing)
2A.	Planning/coordinating the move	2B.	Bring all hardware online within scheduled timeframe	2C.	Using white board to visually depict plan
2A.	Planning the assembly/disassembly tasks	2B.	Timeline considerations	2C.	Labeling hardware
3A.	Planning well ahead of the move	3B.	Communicate the impact of the DCM to end-users	3C.	Communicate with all team members involved
3A.	Assess risks and plan for potential challenges	3B.	Scheduling the DCM during a week where users were least affected	3C.	Tap into team members' expertise to address challenges

[a] Coding table based on Anfara et al. (2002).

data center and labeling equipment, minimizing the impact on end-users by managing the migration timeframe, and communication among migration team members.

Using a categorizing strategy to identify similarities in the data (Rossman and Rallis 2003), we grouped the pattern variables into themes that included planning, minimizing/managing end-user impact, and effective communication. We developed the following overarching conclusion building upon the themes: "Key success factors in a data center migration include proper planning, consideration of procedures to minimize end-user impact including downtime, and effective communication among team members before and during the data center migration."

Overall, the open-ended responses, interview data, and content analysis converged around three themes during the three iterations of data analysis. For example, the questionnaire participants listed the detailed planning activities needed in order to ensure a smooth migration, such as risk assessments, task planning, mapping, and proper labeling. One participant stated, "Good diagrams of the new data center and planning how to best, most quickly restore services," while another stated, "Do lots of planning and make sure you have an adequate window of down time." The planning patterns then emerged from the initial codes and content, which then supported planning as one of the most important success factors in DCM. This result triangulates the quantitative analysis where the majority of the questionnaire participants agreed on the importance of planning.

Further, participants were cognizant of the importance of minimizing end-user impact, with one participant recognizing the impact of "scheduling the DCM during a week where users were least affected" as a success factor for DCM. Another participant recognized the importance of end-users by stating, "Get end user buy in and do your best to exceed their expectations." One participant explicitly linked end-users and planning by stating, "When you start the project, plan for success, not damage control and pay attention to the internal staff (i.e., end-users), leaving them out IS the best way to fail."

Finally, we identified effective communication as another key success factor, with several participants simply replying "Communication" when asked about what contributed to the success of the DCM. One participant linked both the planning and communication factors by stating, "Be realistic in your time estimates even if that realism causes some push back from management." Additionally, one participant specifically stated, "I provided status communication to the Chief Technology Officer as needed." Communication was further supported as a theme in our content analysis of communication documents sent to all organization personnel (in this case, the end-users). Content analysis entails a systematic approach to examining communication and identifying patterns (Rossman and Rallis 2003). In a memorandum to all members of the organization, the CTO clearly explained to the end-users the DCM including the change in the location of the data center, the expected downtime of the information system, and the limited functionality of critical system components that would be maintained throughout the DCM. Therefore, the three key success factors we identified (planning, minimizing end-user impact, and effective communication) were supported by the participant response data to the open-ended questions, interviews with the DCM team, and content analysis of documents.

Bracketing

In qualitative research the researcher is "the instrument of the study" (Rossman and Rallis 2003); therefore, we acknowledge that all bias may not be removed from our perception of the data. Qualitative researchers use bracketing to disclose their experiences that may impact the way in which they make meaning of the qualitative data (Creswell 2003). Therefore, we disclose the background of our research team. Our research team was comprised of two individuals with differing professional backgrounds and perspectives with regard to the research topic. Bracketing revealed that Researcher 1 does not have experience with data center migrations, and her professional experience consists of auditing government organizations. Her viewpoint is sensitive to the risks that the organization faced while conducting the DCM. Additionally, because the participating organization received government support, her professional experience as a government auditor is important to disclose. Researcher 2 has experience in financial system implementations and has conducted research on information systems such as knowledge management systems (KMS), which is one aspect of the IS that DCM impacts. Her expertise in IS supports her interpretation of the process and evaluation of its success.

V. DISCUSSION

Our study contributes to the understanding of DCMs by identifying key success factors and measuring the importance of DCM activities. Several key success factors emerged from the participants' responses. First, proper planning was identified as a key factor for a successful DCM. Both the quantitative and qualitative data results supported the identification of planning as a key factor. Poor planning has consistently been one of the top reasons for the failure of IT-related projects cited by IT managers. In our case study, the DCM participants focused on minimizing user downtime and minimizing the impact of the DCM on the organization's end-users. Advanced preparation enabled the DCM to be implemented as planned and caused little disruption to employees' work routines.

Effective communication throughout the DCM team also contributed to the success of the DCM. Similar to a system implementation project, establishing strong communication plans among all functions involved and articulating action plans both vertically and horizontally within the organization is important for its success (Al-Mashari, Al-Mudimigh, and Zairi 2003; Sarker and Lee 2003).

Additionally, technical expertise was ranked as the top key success factor for DCM. This supports prior research that identifies effective utilization of personnel experience and expertise as a key success factor (Bullock 2008). The importance of technical expertise is further supported in the qualitative data, which reveal effective communication is a key success factor for a DCM so that DCM team members' expertise may be properly utilized. The participants' positive impression of the DCM process lends support for the conclusion that the participating organization was able to appropriately utilize the technical expertise of their personnel to minimize unexpected circumstances. The users must have a firm understanding of the implementation plan, and a critical mass of the technical knowledge required, for the tasks assigned for the project to carry out as planned (E. Umble, Haft, and M. Umble 2003).

Among the ten most important activities from our data analysis, five out of ten relate to various testing activities (e.g., testing hardware, network infrastructure, power supplies). Consistent with the system implementation life cycle, testing is a critical phase in a DCM. Thorough testing procedures are essential to make sure the system is reliable and running as expected (Gargeya and Brady 2005). Inadequate testing efforts have been a key element in past ERP implementation failures. For example, in implementing SAP, Whirlpool Corporation attempted to meet a project deadline by reducing testing programs, which caused many inventory and delivery problems at go-live, resulting in long-term financial loss for the company (Collett 1999).

The most common challenge mentioned by participants was the DCM timeline. Participants noted that the DCM took longer than planned. Other organizations may learn from this experience and build in additional DCM time to address this challenge. Additionally, several participants identified an issue with network and power cables. Organizations may consider having additional cables on hand during DCM efforts.

The participating DCM team in our study addressed the challenges by using clear communication including the use of a white board to map out participant responsibilities and tasks to address the challenges. Participants also noted that they used persistence and hard work to push through challenges that arose. Setting realistic expectations, such as preparing DCM team members to expect a challenge at some point during the DCM process, may have positively impacted the participants' responses to the challenging situations as they arose.

Overall, the DCM was successful and experienced few, minor setbacks during the process. Participants had two primary pieces of advice for other organizations experiencing a DCM. First, "do lots of planning" taking into consideration "the needs/requirements of time, staff, hardware, software, and all partners." Second, incorporate additional system downtime into the DCM plan for unexpected challenges. Utilizing technical expertise and the experience of others who have helped with a DCM or disaster recovery event may help ensure the smooth execution of the DCM. Our overarching conclusion, presented in Section IV, may be used as a guide by other organizations that are completing a DCM.

Contributions to Research and Practical Implications

We extend the literature by presenting a case study about a relatively new and understudied IS event, a data center migration. Dubé and Paré (2003, 598) note that by "having access to and reporting on real-life IT experiences, case researchers allow both academia and practice to keep up with the rapid changes occurring in the IT world as well as in organizations." Our research is one of the first case studies to examine a DCM and we note that by using a case study approach, we are able to provide a descriptive analysis of an IT phenomenon that is occurring more frequently in the field. Additionally, we submit that structure-mapping theory supports the application of the key success factors in DCMs identified in this research to predictive success factors of other migrations, such as cloud migrations, that may be considered in future research. Because our findings are akin to those of systems implementation research, we tender support for the transferability of success factors between system implementation and migration contexts. Therefore, applying structure-mapping theory suggests that explicit consideration of similarities between IS projects, such as implementation and migration projects, may allow researchers to predict success factors and experience commonalities among participants and practitioners to better utilize technical expertise in order to apply the base expertise of the migration team to a target domain.

The overarching conclusion from this case study has implications for research and practice and provides insight for management and others charged with governance responsibilities. By studying a DCM, we introduce a new context in which structure-mapping theory and systems implementation literature may be tested. A DCM is an internal event that introduces a unique and uncommon risk to an organization. Although many organizations are planning DCMs in the near future, most organizations only go through a DCM once in a while. Therefore, it is imperative that organizations learn from other

organizations' DCM experiences in order to manage the risk of DCM failure when they complete their own. Our study identifies planning, minimizing user-impact, and effective communication as key success factors for a successful DCM.

SOX Compliance, ERM, and Organizational Change Efforts

Management, audit committee members, and board members may not have expertise in DCMs; nonetheless, they are charged with SOX compliance and ERM efforts. Those charged with governance may not be aware of the implications that a DCM has on compliance and risk management. Our overarching conclusion may guide their DCM efforts and minimize the risk of an unsuccessful DCM. Prior research identified Sections 404 and 409 of the Sarbanes-Oxley Act of 2002 (SOX) as key intersections for IT and regulatory compliance efforts (Brown and Nasuti 2002; Garcia 2004; Wallace, Lin, and Cefaratti 2011; Weidenmier and Ramamoorti 2006).[3] SOX Section 404 requires corporate officers to assess the effectiveness of internal controls over financial reporting. Considering the Committee of Sponsoring Organizations of the Treadway Commission's *Internal Control–Integrated Framework* (COSO 1992, 2013) and *Enterprise Risk Management Framework* (COSO 2004), we note that DCMs are particularly salient to two components of internal controls and four components of ERM. The two components of internal control that are impacted by a DCM are Entity Risk Assessment Processes and Information and Communication. Meanwhile, we submit that the four components of ERM impacted by a DCM are as follows: Event Identification, Risk Assessment, Control Activities, and Information and Communication.[4]

First, a DCM represents an internal event that affects an entity's achievement of its objectives, and therefore DCMs should be evaluated as part of Event Identification processes for ERM. Companies that depend on proprietary systems and data are particularly at risk for business process interruption from a DCM.

Second, a planned DCM impacts entity Risk Assessment procedures because it represents a change in the entity's technology used to support its information systems. Although a DCM typically includes moving existing IT hardware from one location to another, the supporting infrastructure of the new data center (e.g., such as the cabling in place and the cooling system used to keep servers from overheating) should be considered as part of an entity's assessment of new technology.

Third, management must consider the impact of a DCM on the organization's Control Activities. A DCM impacts an organization's general controls by affecting its information processing controls and technology infrastructure (e.g., the mainframe, the client/server, and the desktop computing environments). Further, a DCM impacts physical controls such as the physical security of assets and use of secured facilities. Therefore, a DCM presents a two-tiered risk to control activities.

Finally, because two-thirds of organizations deploying new IT capabilities fall behind schedule (ISACA 2014c), DCMs present the risk of interruption to the Information and Communication component of ERM, which requires the entity to capture and communicate relevant information on a timely basis (COSO 2004). Access to electronic data used in business processes and in risk management efforts is vital for ERM (Brown and Nasuti 2002). Interruption to information access impacts compliance with SOX Section 409, which requires issuers of financial statements to disclose in a timely manner any material changes in the financial condition or operations of the issuer (U.S. House of Representatives 2002). Further, some businesses' competitive advantage is housed within the systems that they use. To move their hardware without a backup system in place, which is very costly to have in place during a DCM, presents a risk to the very nature of their business operations.

Organizations face the challenge of considering changes to IT and information systems from SOX compliance and ERM perspectives. The IT Governance Institute (ITGI 2006) notes that boards of directors and other enterprise leaders are responsible for effective IT governance, which necessitates managing IT-related risks. Modifications to the IT environment include both software and hardware changes, and the risk associated with changes to the IT environment in which the hardware is stored may be overlooked or not considered as part of the ERM process. We have noted two sections of SOX and four components of the ERM framework that are directly impacted by changes to the physical environment of an organization's information systems. Therefore, DCMs should be evaluated for their impact on SOX compliance and ERM efforts, as compliance efforts may be viewed as organizational change efforts to the extent the organizations improve and revise their compliance and risk management processes.

Although many factors contribute to the success of organizational change efforts, research has increasingly pointed to the important role of the "human factors" (Fugate, Kinicki, and Prussia 2008). How an organization implements change will determine the impact (Burke 2002) and the overall success of the change. While we captured data from the implementation

[3] We note that several other sections of SOX, including Section 302, have been identified in prior research as critical junctures for IT and SOX compliance. We focus our discussion on Sections 404 and 409, as we believe our research is most informative to compliance efforts focused on these sections.

[4] We acknowledge that a valid argument may be made for data center migrations impacting additional components of ERM, as COSO (2004, 4) noted that the ERM process "is a multidirectional, iterative process in which almost any component can and does influence another."

team, future researchers may employ measures of success traditionally used in systems implementation literature to capture the impact that a DCM has on end-users and to test the reverse relationship by considering the impact that end-users' perceptions and attitudes have on the success of a DCM. For example, future research may measure systems satisfaction from the end-user's perspective (Delone and McLean 2003) to capture the individual or micro-level perspective, or measure job satisfaction (Morris and Venkatesh 2010) and job performance (Sykes, Venkatesh, and Johnson 2014) to capture the impact of a DCM from an organizational or macro-level perspective (Sykes 2015).

Moreover, given the micro and macro levels at which system implementation success may be measured, future research may consider the impact of DCMs on compliance and risk management efforts through a multilevel lens. Our research provides a starting point for the consideration of DCMs as a multilevel phenomenon under which the organizations', the data center migration teams', and the end-users' experiences may be studied as discrete units of analysis. The combination of macro- and micro-level phenomenon present in DCMs presents an opportunity for future researchers to consider the impact that a DCM has on each unit of analysis and the aggregate effect the DCM has on the organization.

Cloud Migrations

In recent years cloud computing has had a critical impact on data centers. According to the AFCOM Data Center Institute, cloud traffic will nearly quadruple over the next three years and represent more than three-fourths of all data center traffic by 2018 (AFCOM 2015). The findings from our research have implications for cloud migration and can provide insight for organizations considering cloud migration. Applying structure-mapping theory to the findings presented in this research, we may consider the DCM success factors identified to be predictive of success in cloud migrations. Structure-mapping theory focuses on viewing phenomenon through similarities or analogies in order to map knowledge about a base domain to a target domain (Gentner 1983). Information systems developed structure-mapping engines, based on the application of structure-mapping theory to algorithms that produce matches predicated on relation, attribute, and/or function (Guan, X. Wang, and Q. Wang 2008); however, the impact of structure-mapping theory itself has not been considered in light of organizational information systems initiatives such as DCMs, cloud migrations, and systems implementation. Structure-mapping theory, as opposed to structure-mapping engines, provides a means by which the human impact may be considered on the success of information systems implementation efforts. For example, implementation team members who have experience with one type of migration may be able to use that base knowledge of the success factors from prior implementations to inform the planning and execution of subsequent migrations.

KPMG's *2014 Cloud Survey Report,* which surveyed nearly 800 global executives, found that about half of organizations use cloud technology to lower costs (KPMG 2015). Because cloud data storage is relatively affordable, organizations can store and analyze a vast volume of data, and the cloud enables greater levels of data access and easier data sharing between systems (KPMG 2015). Similar to DCM, organizations migrating to the cloud are also facing challenges such as project planning, security, and legacy equipment and systems. For example, migration planning in a cloud migration context is equally important as in a DCM, as organizations may neglect to perform thorough research on cloud technology or the provider. Just as in a DCM, it is important to carefully assess the IT infrastructure, needs, and usage to best determine what cloud service is the best fit. It is imperative to document expectations to discuss with potential providers, and explore what new possibilities a cloud-based system provides.

Our results indicate the importance of experience and expertise in a successful DCM. Similarly, an organization needs technical expertise in cloud computing to ensure that its cloud platform provides sufficient computing power. The application of structure-mapping theory to information systems migration research suggests that analysis of the similarities between migration projects may yield further support for the key success factors we identified in this research and that individuals with one form of migration experience may be able to map their prior experiences (i.e., base domain knowledge) with future migrations (e.g., cloud migrations) to avoid pitfalls.

Finally, our results indicate the importance and necessity of sufficient and thorough testing to ensure a smooth transition. In a cloud migration, when organizations migrate their most essential applications to the cloud, it is important to ensure those applications will perform smoothly in their new environment and to fine-tune the applications for optimal performance in the cloud. DCM and cloud migration may both be viewed under the umbrella of systems implementation literature, but the specificity of each context warrants further examination and confirmation of implementation success factors. Potential future research linking structure-mapping theory with the findings from this research may include testing the predictive value of the success factors identified in DCM to success in cloud migrations and other systems implementation undertakings, testing the success of migrations when the individuals on the migration team have prior experience with migrations or systems implementation, and examining the extension of success factors to disaster recovery efforts after mapping similarities between migrations and recovery processes.

Limitations

The results of this study should be interpreted in light of the limitations. First, we utilized a case study approach that included IT personnel involved in a single DCM. Because case studies focus on a specific case, the results are context dependent (Rossman and Rallis 2003). Although no two cases are identical, readers may consider the application of the lessons learned from the case we present to other cases by employing "reasoning by analogy," which considers the similarities between sets of circumstances and "allows the application of lessons learned in one case to another population or set of circumstances" that is similar to the case presented (Rossman and Rallis 2003, 105; Kennedy 1979). Additional case studies of DCMs may produce the data needed to complete a cross-case analysis of the key factors for a successful DCM. Second, our results are descriptive as opposed to predictive. Future research may use our results as a baseline to develop testable hypotheses. Third, because we coded the qualitative data during the coding process, our conclusions are subject to researcher bias, a common limitation in qualitative research. To address this issue, we bracketed and reported our experience and perspectives that may have impacted our interpretation of the data. Reporting researcher influence, including bracketing, is a means of increasing the trustworthiness of the research and the findings (Toma 2006).

VI. CONCLUSION

Data center migrations may improve the infrastructure supporting organizations' information systems, and the number of organizations completing a DCM is expected to increase. Properly assessing the risks associated with DCMs and safeguarding information assets during the DCM help minimize end-user impact and decrease the likelihood of a poorly executed DCM. The results of this case study research provide key success factors learned from an organization that successfully executed a DCM. Future research may focus on specific aspects of the DCM, such as planning or system testing post-DCM, or apply structure-mapping theory to consider the role of individuals' prior knowledge or experiences on completing a DCM. IT professionals may work with those charged with corporate governance that have an extensive understanding of ERM to plan for and minimize risks before undergoing a DCM, and organizations considering cloud migration may find the key success factors revealed in this study to be applicable to their migration project.

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