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IT Leadership and Cloud Computing Adoption in Western Canadian K-12 School Districts

by

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Abstract

Cloud computing IT infrastructure continues to grow in prevalence globally and across industries. This research sought to explore the extent of cloud computing adoption in Western Canadian K-12 districts, and to better understand the factors that influence its adoption (or nonadoption) within an educational context. This research answers the questions of how IT infrastructure decisions are made in K-12 districts, what is the IT infrastructure within these districts, and what are the influences/priorities that shape this infrastructure. The Frambach and Schillewaert (2002) conceptual framework for organizational innovation adoption was central to this research, identifying both the influences/priorities that affect districts' adoption of cloud computing, as well as districts' stages of adoption. This case study followed a data transformation model mixed-methods triangulation design, employing semistructured interviews, document analysis, and statistical correlation analysis. A finding of this study was that IT infrastructure decisions were most often made by leaders in either the instructional or financial branch of the district's superintendent's office, though who was responsible for IT decisions produced negligible differences concerning the IT infrastructure used. A major finding of this study is that cloud computing is ubiquitous in large Western Canadian K-12 school districts. In this study of all 75 districts in British Columbia, Alberta, and Saskatchewan, with 5,000 students or more, 100% of districts used cloud computing for at least one domain of their IT infrastructure. Non-cloud computing IT infrastructure was rare, and, when found, was typically used to complement cloud computing. The province in which a district was located had the greatest influence on its IT infrastructure. This was due to the influence of each province's unique legislation. Additional factors that influenced districts' IT infrastructure were a district's size and the other types of IT infrastructure used within that district. A recommendation of this study is that K-12 districts in Western Canada, and around the world, continue to shift their IT infrastructure towards cloud computing.

Preface

This thesis is original, unpublished, independent work by the author, P. Holowka. The data collected and reported in this document are covered by Ethics Certificate number REB13-1269, issued by the University of Calgary Conjoint Faculties Research Ethics Board for the project "Information Technology Leadership and Infrastructure in Large Western Canadian K-12 School Districts" on March 20, 2014.

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Additionally, the faculty, my academic peers, and the administrative staff of the Werklund School of Education have my deepest appreciation. Your support formed the enabling foundation beneath my scholarly and professional work.

Dedication

This research is dedicated to the information technology infrastructure teams and their leaders who play a critical role in contemporary education. A goal of this research is to raise the profile of the important work that these individuals do, as well as to empower them to have a more influential voice within their organizations. This dissertation would not have been possible without the support of many of these extraordinary people who participated in my study. You have my ongoing gratitude.

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CHAPTER 1: INTRODUCTION

Overview

In this research I examined information technology (IT) decision making at the district level of K-12 schools; specifically, the decision to adopt (or not adopt) cloud computing. I investigated the numerous factors, both human and nonhuman, that influence the decision of a large organization, such as a school district, to adopt a potentially transformative technology such as cloud computing. I focused exclusively on cloud computing adoption in Western Canadian K-12 school districts. First, I explored the decision-making process with regard to IT infrastructure at the superintendent's office/district level for district schools. Second, I created a snapshot of current cloud computing adoption practices and considerations. Third, I sought a better understanding of the complex interplay of the multitude of human (e.g., competitive pressures, supplier marketing efforts, etc.) and nonhuman factors (e.g., cost, complexity, etc.) that contribute to IT adoption decisions at the district level. This research will be of benefit to academics and practitioners who desire to understand and improve upon the IT decision-making process in school districts at the level of the superintendent's office. This understanding of IT-infrastructure decision making at the superintendent's office for a school district can ultimately positively affect teaching and learning practices at the school level.

Rationale

The complex interplay of a multitude of factors influences students' learning within formal K-12 education. Some of these factors are immediately visible, such as classroom teachers' instruction and facilitation; other factors, though less visible, are still of great importance. At the local school level some of these factors include the contributions of special-needs resource staff, teaching assistants, librarians, maintenance staff, educational-technology support staff, receptionists, accountants, the principal, and so on (Rakes, Fields, & Cox, 2006). At the district level the decisions of the superintendent's office, though even further removed from the teachers and students in classrooms, have a similar, and perhaps more profound impact. The decisions at this higher level have an even greater scope and affect all schools and students within a district (Hanks, 2010; Major, 2013; Mendoza-Jenkins, 2009).

As IT (defined in Appendix A) evolves in sophistication and becomes increasingly ubiquitous, it presents opportunities to enhance teaching and learning activities within formal K-12 education. Currently in many districts, the superintendent's office coordinates the planning and deployment of IT infrastructure for all schools (Collins, 2012; Stein, Ware, Laboy, & Schaffer, 2013). The IT decisions of the superintendent's office are of great importance because they have the potential to impact very directly how teaching and learning occur in classrooms and beyond.

District-Level IT Leadership for K-12 Schools

In large K-12 school districts of 10,000 students or more, the planning and implementation of IT infrastructure decisions often occur at the level of the superintendent's office (Maas, 2010). The majority of K-12 educational leadership research has been on schools and principals, but a relatively low percentage of educational leadership studies have focused on the superintendent's office (Hanks, 2010; Hentschke, Nayfack, & Wohlstetter, 2009). Even fewer researchers have examined how the superintendent's office makes IT decisions for the district's schools.

As technology has become more prevalent in society and in schools, many organizations, including school districts, have created formal IT leadership positions (Braganza & Franken, 2007; Sorenson, 2011). Though titles vary, ranging from chief information officer (CIO) to superintendent of technology to chief technology officer to director of technology and so forth, the mandate of these individuals is generally to handle the management and leadership of IT across a district (Consortium for School Networking [CoSN], 2012; Maas, 2010). The academic literature is now defining the role of the CIO (or similar IT leadership positions) within organizations, although literature specific to K-12 IT leadership remains rarer (Berry & Bravender, 2012; Mounir, 2010). Literature on the decision-making process for IT infrastructure, specifically the adoption of cloud computing by a school district's leadership, is particularly scarce (Stein et al., 2013).

This study makes an important distinction between the IT leadership of a school district and the users of IT within the school district. The IT leadership of a school district is defined as the personnel (individual or group of individuals) of the superintendent's office responsible for IT decisions on behalf of the school district (e.g., the CIO or an IT leadership team). The users of IT within the school district, on the other hand, include the teachers, students, principals and vice principals of district schools. The IT leadership of a school district makes IT adoption decisions on behalf of the users of IT in the school district. One of my subquestions in this study was how IT adoption decisions are made at the level of the superintendent's office on behalf of a school district. Answering this subquestion informs the human factors that affect the cloud computing adoption decision.

Cloud Computing

Definition of Cloud Computing and Related Terms

The definition of cloud computing according to the US Department of Commerce's National Institute of Standards and Technology ([NIST] 2011) is as follows:

> Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics [on-demand self-service, broad network access, resource pooling, and rapid elasticity], three service models [SaaS, PaaS, and IaaS], and four deployment models [private cloud, community cloud, public cloud, and hybrid cloud]. (p. 2)

NIST's definitions of supporting terms related to cloud computing are presented in Table 1.

Cloud Computing as a Disruptive Innovation

Cloud computing is an emerging disruptive IT phenomenon (Christensen, 1997) that offers an alternative to the conventional design and delivery of IT infrastructure and services (Ashurst, Freer, Ekdahl, & Gibbons, 2012; Sultan & van de Bunt-Kokhuis, 2012). As is the nature of disruptive innovations, cloud computing goes beyond optimizing/evolving existing approaches and presents a new means of providing access to IT-enabled resources (Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011). Compared to traditional IT infrastructure, cloud computing offers both new opportunities/advantages and concerns (Craig et al., 2009; Tsaravas & Themistocleous, 2011). In organizations, the IT leadership evaluates these reasons for and against, and decides whether to adopt cloud computing. Should the decision support adoption, the leadership makes subsequent decisions: Will cloud computing meet the need for supplementation, complementarity, or displacement? (Lin, 2011). Following adoption, the ongoing decision to continue or discontinue use remains (Rogers, 2003). Although I discuss these in greater detail in the following chapter, this section provides a brief, nontechnical

Table 1

Definitions of Cloud Computing from the U.S. Department of Commerce's National Institute of Standards and Technology (2011, pp. 2-3)

	Term	Definition
	CLOUD COMPUTING	Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models.
Essential Characteristics	On-demand self-service	A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.
	Broad network access	Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).
	Resource pooling	The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or data centre). Examples of resources include storage, processing, memory, and network bandwidth.
	Rapid elasticity	Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.
	Measured service	Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

(table continues)

	Term	Definition
Service Models	Software as a Service (SaaS)	The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based e-mail), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.
	Platform as a Service (PaaS)	The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.
	Infrastructure as a Service (IaaS)	The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of selected networking components (e.g., host firewalls).
Deployment Models	Private cloud	The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.
	Community cloud	The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises.
	Public cloud	The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.
	Hybrid cloud	The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

overview of one of the critical understandings/distinctions that underpin this research: how cloud computing differs from traditional IT infrastructure.

Traditional IT infrastructure design and service delivery. A personal computer, whether a laptop or a desktop computer, offers a basic, nontechnical framework for understanding traditional IT infrastructure for organizations, including school districts. This analogy will guide the comparison of traditional IT infrastructure and cloud computing. In the paragraphs below I do not present a brief history of computing; rather, I illustrate the progression of user needs that guide a corresponding response in IT infrastructure design.

When an individual edits a letter on a personal computer, the letter is stored on the local computer's hard drive. The individual edits the letter using a program (such as Microsoft Word) that runs on that computer's software and hardware (the operating system, such as Microsoft Windows or Mac OS, that allows programs to use the physical computer hardware). If the individual decides to send the letter to a printer directly connected to the computer (e.g., by USB cable), the individual prints from the program (e.g., Microsoft Word), and the program then communicates with the operating system (e.g., Microsoft Windows) by instructing the computer's hardware to pass the printing information to the connected printer.

The above describes a very personal, individualized use of computers. When the need for collaboration between individuals arose, personal computers were connected to each other and/or to a network. This allowed an individual to edit a document on another computer and to print it even when a printer was not physically connected to his or her computer (e.g., a central, heavy-duty shared office printer). Servers, more powerful versions of personal computers, were often added for document storage, connection between printers, and security/user management for the network. Servers allowed many individuals on a network to use the same program and/or files at the same time (located on the server), often to ensure file consistency (e.g., student records). Servers were also used when the computing power of a personal computer was not sufficient (e.g., to perform complex mathematical calculations).

The vignette above describes a local area network (LAN), which is a network that connects computers within a single office or building. A wide area network (WAN) interconnects multiple offices or buildings (sometimes in different cities). This allows the sharing of documents and IT resources among individuals across an organization, regardless of location.

Cloud computing infrastructure design and service delivery. Cloud computing uses the Internet to provide access to IT resources. Rather than documents being stored on a personal computer or server located in a central office connected by the company's network (LAN or WAN), they can be stored on a server connected to the Internet **(**Berry & Bravender, 2012; Craig et al., 2009; Tsaravas & Themistocleous, 2011). This server is accessed remotely through an Internet connection, enabling broader access to computing resources such as servers, storage, and applications (beyond what would be possible within a limited LAN or WAN). A powerful pool of servers connected to the Internet can also handle demanding computational tasks (e.g., video encoding).

One benefit of cloud computing is that it uncouples the program/application from the local computer. This resolves many compatibility issues between traditional software, operating systems, and hardware. For example, Software as a Service (SaaS) allows organizations to use Internet browser applications (e.g., Microsoft Word Web App or Google Drive/Docs) to edit documents without the need to own a word-processing program installed on a compatible computer with a compatible operating system (e.g., Microsoft Word). This uncoupling allows users to store, access, edit, and share files by using storage located on Internet servers. Similarly, less powerful devices (such as tablets, Smartphones, Netbooks, and older laptops) can access the computation power of Internet servers for tasks beyond the local device's capabilities (e.g., Google's YouTube video editor for editing high-definition video).

Although cloud computing offers many benefits previously unavailable with traditional IT infrastructure, it also raises new concerns. A key feature of cloud computing is the use of the Internet to provide broader access to computing resources. However, this presents new security concerns in that resources are no longer confined to a company's (or school district's) limited network. Another cloud computing concern is the shift in control from the organization to the cloud service provider. For example, changes in cloud services (e.g., Microsoft's change from Hotmail.com to Outlook.com or the discontinuation of Google Reader) can occur with little consultation or regard for impacted clients.

Research Problem

The Impact of IT Infrastructure on Teaching and Learning

As the role of technology increases in education, so too does the importance of the underlying IT infrastructure that enables that technology. Whether the underlying IT infrastructure is traditional, on-premises infrastructure, or one of the forms of cloud computing presented earlier, problems, outages, and/or limitations at the IT infrastructure level impact the technologies and users that depend upon them. This is of concern to many. This includes students and teachers, who are the most apparent users of educational technology. This also includes those who also have important though less obvious roles in facilitating K-12 education: IT support staff, superintendents, Ministry of Education personnel, school boards, policy authors, the university faculty that prepares future teachers, etc. For this latter group, this research is particularly relevant as they are in positions that shape the learning environments of those in the former group. The need for such research on the IT infrastructure that enables technology-enhanced teaching and learning is clear:

> … in a world that does not understand technology-enhanced learning design nearly well enough, we seem to be facing a new kind of leadership, policy & research challenge to help integrate learning design, instruction, leadership and regulation for learners who are increasingly dependent on Internet services. (Kowch, 2018, p. 132)

In developing an IT infrastructure to support teaching and learning, the leaders of K-12 school districts are often required to achieve pedagogical goals within constrained financial realities (Pew Center on the States, 2012). This problem also makes this research especially relevant to these leaders:

> “There’s nothing that can be done remotely in the Cloud that couldn’t be done better locally if you had unlimited resources.” Unlimited access to software, hardware, storage, networking capacity and, very importantly, technical support for each individual computer and server running—would render Cloud computing superfluous. But the funds for unlimited computational resources do not exist and nowhere is that more apparent than in the educational sector. Funding tied to state allocations for public education has been substantially reduced with the last several years’ economic recession. The Pew Center [of] the States (2012) estimated that in 2011–2012 thirty-seven states in the U.S. cut aid to local school districts (p. 9). At the same time, efforts toward integrating technology into pedagogy and curricula content have continued to become

> more sophisticated in facilitating learning. Reducing costs while protecting access to effective educational technology is the potential of the Cloud. (Stein et al., 2013, p. 235)

This research explores the adoption of cloud computing in Western Canada in large K-12 school districts, and goes beyond a mere description of the benefits and concerns associated with cloud computing. As will be discussed in the following chapter, descriptions of the potential benefits and concerns of cloud computing already exist in academic and practitioner literature. Instead, this research extends this literature, and explores the reasons behind a district's IT infrastructure (cloud computing or other). This explanatory research will benefit the leaders who shape IT infrastructure and policy for K-12 districts. These leaders are faced with the problem of balancing the teaching and learning needs of their students and teachers, the financial realities of their districts, as well as the regulatory compliance requirements governing their jurisdictions. This research will help these leaders to make informed decisions about how to best deliver technology-enhanced learning.

Shortcomings of Academic Literature on Cloud Computing and Organizational Adoption

Given the relative novelty of cloud computing as a viable alternative to traditional IT infrastructure for organizations, there has been little time for an extensive body of research to emerge on its organization-level adoption. The findings from the available studies on cloud computing adoption at the organizational leadership level are largely descriptive (Chebrolu, 2010; Hailu, 2012; Lee, Chae, & Cho, 2013; Ross, 2010). Although the researchers identified the factors for consideration in cloud computing adoption decision making, they rarely and/or minimally explored the interrelationships among these factors. The following abstract excerpt illustrates typical research at this time in the cloud computing field:

> This study provides an understanding of the reasons why IT (IT) leaders in developing countries adopt new technology by evaluating their perceptions of the security effectiveness, organizational need, reliability, and cost-effectiveness of cloud-computing technology. The study was conducted as a quantitative investigation with a validated survey instrument. The result indicates that perceptions of security effectiveness, need, reliability, and cost-effectiveness correlate positively with IT leaders in developing countries willingness to recommend cloud-computing technologies. (Hailu, 2012, p. ii)

Another limitation of the existing literature is that researchers have often conducted investigations of technology adoption from the perspective of the user rather than the organization's IT leadership (decisions of CIOs on behalf of users concerning the technology with which the users will work). Many researchers have identified the need for a better understanding of the decision-making process for technology adoption in organizations (Dynes, Brechbühl, & Johnson, 2005; Lease, 2005; Roberts & Pick, 2004). Yu and Tao (2009) spoke to this point:

> Literature on business-level technology adoption is scarce compared to general literature on examining individual-level technology adoption. . . . Enterprises allocate significant portions of their budget each year to procuring new IT/IS, and this trend has become more obvious following the advance of IT/IS and the diffusion and development of the e-life, e-society, and e-business. Hence, understanding business-level innovative technology adoption is just as important as understanding individual-level new technology adoption.
>
> Compared to the large body of individual-level TAM [technology acceptance model] literature, business-level . . . literature is relatively scarce. . . . This implies that

> the underlying technology adoption at the firm level has not been discussed and ascertained insufficient detail. (pp. 1-2)

Significance of the Research

Cloud computing is a relatively new, yet important phenomenon for the consideration of organizations and individuals. As cloud computing continues to evolve and gain greater acceptance, both globally and in Canada, new literature continues to emerge on the importance of an organization's and/or individual's adoption decision. Whereas cloud computing offers many benefits, it also involves privacy and security considerations. In the following subsections I explore the current literature on cloud computing, expose the limitations of the current knowledge, and underscore the significance of this research's contributions to both academics and leaders in education.

In the first subsection, on the descriptive nature of cloud computing literature, I present the limitations of what is currently known about the interplay of factors that influence cloud computing adoption in K-12 education. This subsection outlines how current cloud computing literature is primarily descriptive, and therefore limited in exploring the relationships between factors that influence its adoption. The limitations of what is currently known provides an opportunity for this research to contribute to the academic community new knowledge about the interplay of factors that influence the adoption of cloud computing. Moreover, as will be detailed in the later findings, analysis, and concluding chapters, this research will illustrate a limitation of existing frameworks, and will present a modification to assist future researchers to more accurately investigate organizational adoption. This expansion of the existing organizational adoption framework will benefit future research, both in the field of cloud computing adoption, as well as the broader field of organizational adoption of innovations.

In the second subsection, on the importance of the cloud computing adoption decision, I present the significance of this research to IT leaders, educational leaders, and policy authors. This subsection presents a call by multiple government bodies in Canada for a deeper understanding of cloud computing in order to help school authority leaders to make informed decisions about the adoption and use of cloud computing. The following chapters will equip these leaders with information and recommendations to address their timely challenges. The findings chapter will provide these leaders with insights concerning current IT practices in Western Canada, both in terms of IT infrastructure and the organization of IT responsibility within K-12 districts. The analysis chapter will provide these leaders with an understanding of the correlates and influences that shape IT infrastructure/cloud computing adoption in Western Canada. Lastly, the concluding chapter will provide these leaders with recommendations, based upon the study's findings and analysis, to best balance the value and risks of cloud computing use.

The Descriptive Nature of Cloud Computing Literature

Cloud computing began to mature into its current form in the late 2000s (Brian et al., 2008; Chao, 2012). It represents a new paradigm in IT infrastructure design (Ashurst et al., 2012; Sultan & van de Bunt-Kokhuis, 2012). Consequently, academic and IT-industry research has focused on the nature of cloud computing. Vaquero, Rodero-Merino, Caceres, and Lindner (2008) identified at least 22 definitions of cloud computing. By 2011 the understanding of cloud computing matured, and NIST (2011) presented a widely accepted definition of cloud computing that clarified the characteristics of cloud computing, its delivery, and deployment models (refer to Table 1).

Cloud computing research, because of its nature as a facilitation/infrastructure technology, spans a variety of industries (Gartner Inc., 2013; International Business Machines, 2012). Within the field of education, cloud computing research has focused on instruction, learning, and research in a cloud computing environment; policies and legal issues; technical considerations/foundations; and technology leadership and planning (Chao, 2012; Papa, 2011; Picciano, 2011). This literature also discusses cloud computing’s benefits and challenges/ concerns (compared to more traditional IT infrastructure and/or pedagogical practices). Academic and practitioner research on cloud computing, particularly in education, is typically descriptive, and identifies current and emerging practices with cloud computing (Chebrolu, 2010; Hailu, 2012). This literature informed the analysis (political, economic, social, and technological) of the current context of cloud computing adoption and use (Appendix Table B1). However, a gap exists in the understanding of the interplay among the known benefits and challenges of an adoption decision, particularly within the contemporary context of K-12 education in Western Canada.

The Importance of the Cloud Computing Adoption Decision

Despite being a relatively recent phenomenon, cloud computing has been the focus of considerable attention from government bodies. The Office of the Privacy Commissioner of Canada (OPC), the Office of the Information and Privacy Commissioner of Alberta, and the Office of the Information and Privacy Commissioner of British Columbia, in a joint document, wrote, “Organizations must take care to fully assess the benefits, risks, and implications for privacy when considering a cloud computing solution” (OPC, 2012, Make an Informed Decision section, para. 1). The importance of a careful analysis of the factors that affect the decision to adopt or not adopt cloud computing is echoed nationally, across multiple industries (Shared

Services Canada, 2013; Treasury Board of Canada Secretariat, 2011). Alberta Education (2013), for instance, issued a technology briefing on cloud computing to aid in such an important infrastructure decision. The document presents the advantages and disadvantages of cloud computing (compared to more traditional forms of IT infrastructure) and draws attention to the numerous factors that IT leaders must consider in their far-reaching decision:

> While cloud computing has many benefits, it also involves risks, and has privacy and security implications. School authority leaders have an important role to play in making decisions about cloud-based services and in developing guidelines for use. School authority leaders, educators, IT leaders, legal counsel and FOIP coordinators should work together to balance value and risks. (para. 2)

Research Questions

The central, guiding question of this study is, "What factors influence district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for district schools?" The answers to this question will contribute to new knowledge in the three areas, namely IT leadership structures and processes at the district level, the current level of cloud computing adoption in large Western Canadian K 12 school districts, and the interplay of human and nonhuman factors that influence infrastructure decisions. These questions and subquestions are presented in Table 2.

The first research question offers insight into the IT leadership structures, influences, and processes of K-12 districts, with a focus on the human-adoption factors. The decision to adopt cloud computing or not is a major decision that relates to infrastructure planning, privacy, cost,

Table 2

Central Research Question, Subquestions, and Domains of Contribution

	CENTRAL QUESTION: "What factors influence district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for district schools?"	
QUESTION 1	Q1. "What are the IT leadership structures and processes at the district level for large Western Canadian K-12 school districts?"	
	Subquestions	Supporting framework
	Q1A. Who is responsible for IT infrastructure decisions in the K-12 district? Is it an individual or group? Q1B. How are IT infrastructure decisions made? What is the process? Q1C. Do cloud computing IT infrastructure decisions follow this process or are they handled differently? If so, how?	Contingency decision-making framework (Daft, 2013)
QUESTION 2	Q2. "What is the current level of cloud computing adoption in large K-12 school districts in Western Canada?"	
	Subquestions	Supporting frameworks
	Q2A. What is the extent of cloud computing adoption in large Western Canadian K-12 school districts? Q2B. Do the following technologies use traditional IT infrastructure or cloud computing?: o Student Information Systems? o Learning Management Systems? o Library Services? o Security and authentication? o E-mail? Q2C. What are the future plants of Western Canadian K-12 school districts concerning their IT infrastructure? Adoption? Continued use? Etc.	Frambach and Schillewaert (2002) framework; PEST
QUESTION 3	Q3. "What is the interplay of human and nonhuman factors that influence infrastructure decisions by district-level IT leadership in K-12?"	
	Subquestions	Supporting frameworks
	Q3A. What human or nonhuman factors have the greatest influence over the decision to adopt cloud computing? Q3B. What is the influence of human and nonhuman factors (absolute and relative)?	Frambach and Schillewaert (2002) framework; PEST; contingency decision-making framework (Daft, 2013)

availability, and so on; it has a broad potential impact on numerous stakeholders. This study fosters a better understanding of the people involved in IT planning decisions for school districts and the means by which they reach district-level IT decisions. This includes an examination of the IT decision-making relationships within the superintendent's office and an exploration of possible external relationships, such as the influence of IT vendors. I use frameworks from the fields of leadership and organizational studies to interpret the research findings and produce a clearer picture of the K-12 district-level IT decision-making process.

The second research question creates a snapshot of current cloud computing adoption in large K-12 districts in Western Canada. The answer to this question offers insight into the diffusion of cloud computing and an understanding of the existing IT infrastructure (cloud computing or not) in the districts that I studied. This snapshot, informed by frameworks from the field of organizational innovation adoption, also captures the intentions of districts to continue or discontinue the use of their current IT infrastructure. This second research question makes possible a better understanding of the factors that result in a certain level of cloud computing adoption.

The third research question examines the interplay among the human and nonhuman factors that influence district-level IT leadership's infrastructure decisions in K-12. For instance, do human factors, such as who is responsible for IT infrastructure in a K-12 district, have a correlation with a district's decision to adopt cloud computing (or not adopt cloud computing)? Do the needs of a K-12 district's users dominate security/privacy concerns, or is the opposite true? Does a single factor trump all other considerations? and so on. Whereas the first two research questions identify the human and nonhuman factors that influence IT infrastructure, this third research question aims to produce an understanding of the relationships that shape a district's IT infrastructure. This third question is therefore critical in providing both an understanding of the current state of IT infrastructure in K-12 school districts, and insights into how to further optimize IT infrastructure.

Research Goals

An organization’s cloud computing adoption decision is of great importance. Governments at the federal and provincial levels have called for a careful examination of the benefits and challenges/concerns as organizations plan their future IT infrastructure. Academic literature on the nature of cloud computing, its benefits, and its challenges is available to inform organizations’ adoption decision. However, little is known about the interplay of factors, human and nonhuman, that result in an organization’s decision to adopt or not adopt technology (Brailsford et al., 2011; Tarcan, Varol, & Toker, 2008; Yu & Tao, 2009). Although researchers have used Frambach and Schillewaert’s (2002) framework or a derivative in the past to explore organizations’ innovation adoption, a study of cloud computing adoption in Western Canadian school districts has never been done. In this study I used an integrated framework, which I explain in the following chapter, to achieve this important and timely end.

Beyond a purely academic contribution of new knowledge on the cloud computing adoption and decision making of senior IT leadership in Western Canadian K-12 school districts, in this research I aimed to benefit the practices of current and future IT leaders—both within the education sector and beyond. “Research evidence is clear that neither classic learning technologist nor classic leader roles prepare new leaders best to lead technology involved schools in the information age. . . . Leaders require new capabilities and paradigms for ‘seeing ahead’ to do good work” (Kowch, 2009, pp. 43-44). Table 2 presents the three research questions of this study. These three questions, in support of the central question, connect otherwise separate areas of study (K-12 IT leadership structures and processes, infrastructure decision influences, and cloud computing) with the aim of shaping IT leaders’ knowledge and eventual practice. The answers to the central question of this study provide deep and broad insights into the complex nature of IT leadership. These insights deepen current IT leaders' understanding of their own work, enhance the preparation of future IT leaders, and, ultimately, benefit the technology environments (and thereby the end users within these technology environments) that the decisions of current and future IT leaders shape.

CHAPTER 2: LITERATURE REVIEW

Overview

Answering the central question of this study requires an understanding of three key domains: (a) cloud computing, (b) the organizational adoption of technology, and (c) organizational decision making. This literature review chapter establishes the foundation and frameworks which I will use to examine large K-12 districts in this study. In the first section I discuss a Political, Economic, Social, and Technological (PEST) framework analysis based upon the work of Fahey and Narayanan (1986). I use the PEST analysis to present what we currently know about cloud computing adoption considerations. In the second section, Frambach and Schillewaert's (2002) adoption framework, I identify the numerous factors, human and nonhuman, that influence an organization's adoption decision. In the third section, the Daft (2013) contingency decision-making framework, I foster an understanding of how an organization's leadership makes decisions on behalf of that organization. Fourth, I present how I used these three separate frameworks to describe and interpret the study's findings to answer the central research question.

At the end of this chapter I also present a review of literature pertaining to the implications and recommendations of this study. This literature illustrates contemporary challenges affecting educational technology, and serves as a foundation for the recommendations that stem from the conclusions of this research.

Cloud Computing Adoption Considerations: A PEST Analysis

In this section I discuss cloud computing's characteristics, service models, and deployment models with reference to the PEST framework (Fahey & Narayanan, 1986; Senior & Swailes, 2010). This framework shows the emergence of cloud computing as a solution to business challenges, and I discuss the strengths of cloud computing in a contemporary context. Last, I address cloud computing concerns, with a focus on issues that are particularly relevant to this study's Canadian context.

The Background of the PEST Analysis Framework

Fahey and Narayanan developed the PEST analysis in 1986 to conduct an environmental analysis in a business context. This framework can also be applied to the analysis of an educational context. The PEST framework facilitates the examination of markets and business environments through the lenses of political, economic, social, and technological considerations (Lee et al., 2013; Senior & Swailes, 2010; Thompson & Martin, 2010). Political considerations include government legislation, international law, human rights, local regulations, taxation policies, union activities, and so on. Economic considerations include wage rates, employment rates, global market conditions, competitor activities, supplier activities, exchange rates, and so on. Sociocultural considerations include demographic trends (global and regional), lifestyle changes, population attitudes, equality issues, ethical and cultural norms, attitudes towards worker mobility, and so on. Technological considerations include the automation of processes (e.g., factory manufacturing or agricultural harvesting), a population's use of personal electronics, levels of Internet connectivity at work and at home, the availability of mobile Internet access via Smartphones and telecommunication providers, and so on.

Following the initial development of the PEST analysis framework, additional extensions have emerged. These include PEST + Environmental + Legal (PESTEL), PESTEL + Industry analysis (PESTELI), PEST + Ethical (STEEP), PEST + Legal (SLEPT), PESTEL + Ethical (STEEPLE), STEEPLE + Demographic (STEEPLED), and PESTLE + International +

Demographic ([PESTILED] David, 2009; Johnson, Scholes, & Whittington, 2008; Rothaermel, 2012; Thompson & Martin, 2010).

The expansions/adaptations of the original PEST analysis framework (e.g., PESTEL) better serve situations in which specific considerations such as legal and environmental conditions are both pertinent and distinct. The specific aspects of each of the framework's considerations that must be analyzed are not well defined in the literature (Hair, Bush, & Ortinau, 2004; Senior & Swailes, 2010; Verdu, Gomez-Gras, & Volberda, 2006). Rather, the specific situation to which the PEST framework or its extensions is applied shapes the aspects that must be analyzed (Žvirblis, Krutkienė, & Vitkunas, 2009).

In this study I used the original PEST analysis framework, both to situate this research within a more established body of literature than is available on the other PEST derivatives and to avoid overlapping issues between categories (Lao & Jiang, 2009; Lee et al., 2013; Xiang-Jun, 2010; Yingfa & Hong, 2010).

PEST Analysis Applied to the Contemporary Cloud Computing Environment

The PEST analysis framework is a means of examining the political, economic, social, and technological factors that influence the environment on a macro level. Appendix Table B1 displays a PEST analysis of considerations specifically related to cloud computing adoption in Western Canadian K-12 school districts. This analysis of both facilitating and inhibiting conditions for cloud computing adoption creates a context that helps to more fully understand the participants' responses, particularly in Frambach and Schillewaert's (2002) framework's categories of environmental influences (e.g., political and economic considerations), perceived innovation characteristics (e.g., technological considerations), and adopter characteristics (e.g., social considerations). In framing my review of the existing literature, this PEST analysis identifies new information from the participants that might exist outside of what we currently know affects cloud computing adoption in large Western Canadian K-12 school districts.

Organizational Innovation Adoption

At the core of this study's investigation of cloud computing adoption by K-12 district IT leadership for district schools is Frambach and Schillewaert's (2002) conceptual framework for organizational innovation adoption. This framework consists of two parts: the adoption of an innovation at the organizational level (Figure 1) and the adoption of the innovation by individuals within the organization (Figure 2). In this section I discuss the framework's appropriateness to this research.

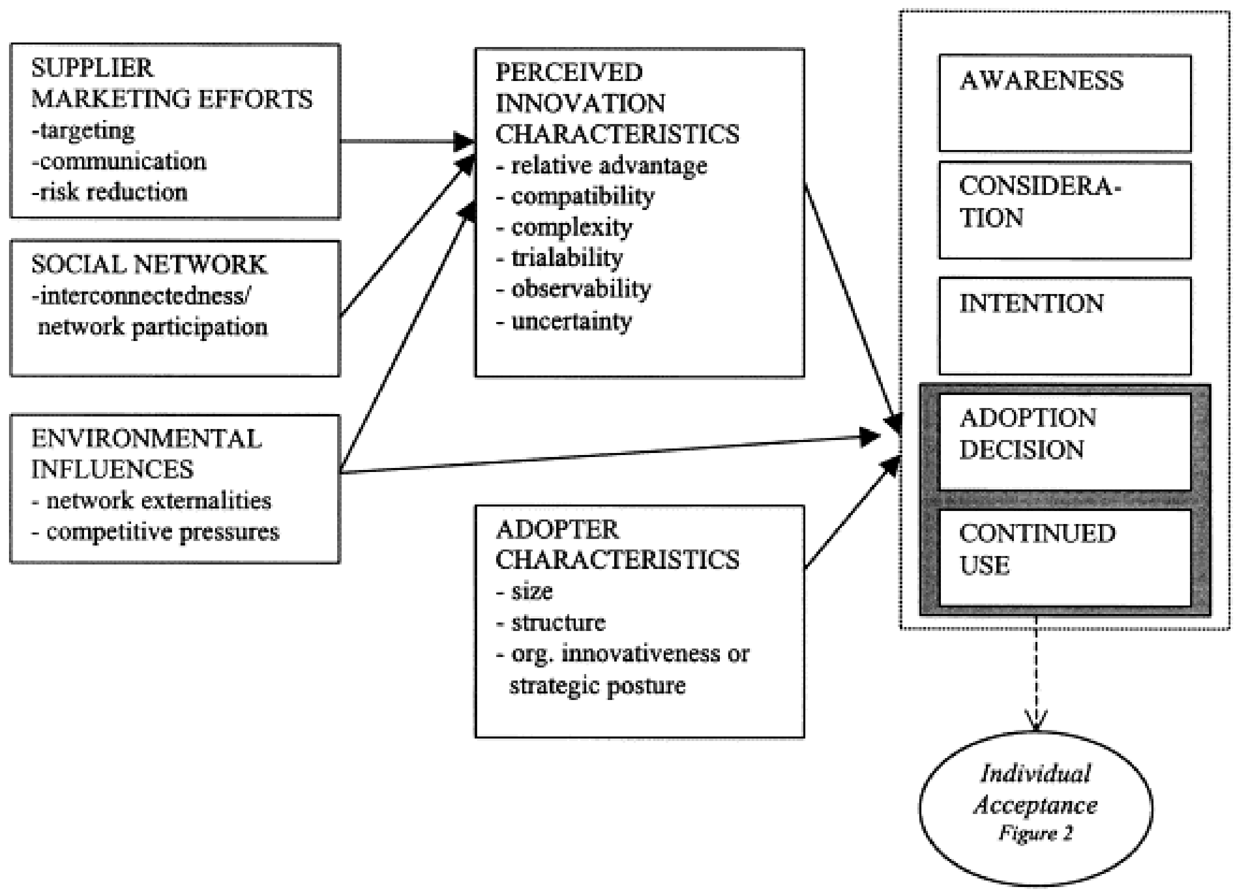


Figure 1. A conceptual framework of organizational innovation adoption (Frambach & Schillewaert, 2002, p. 165)

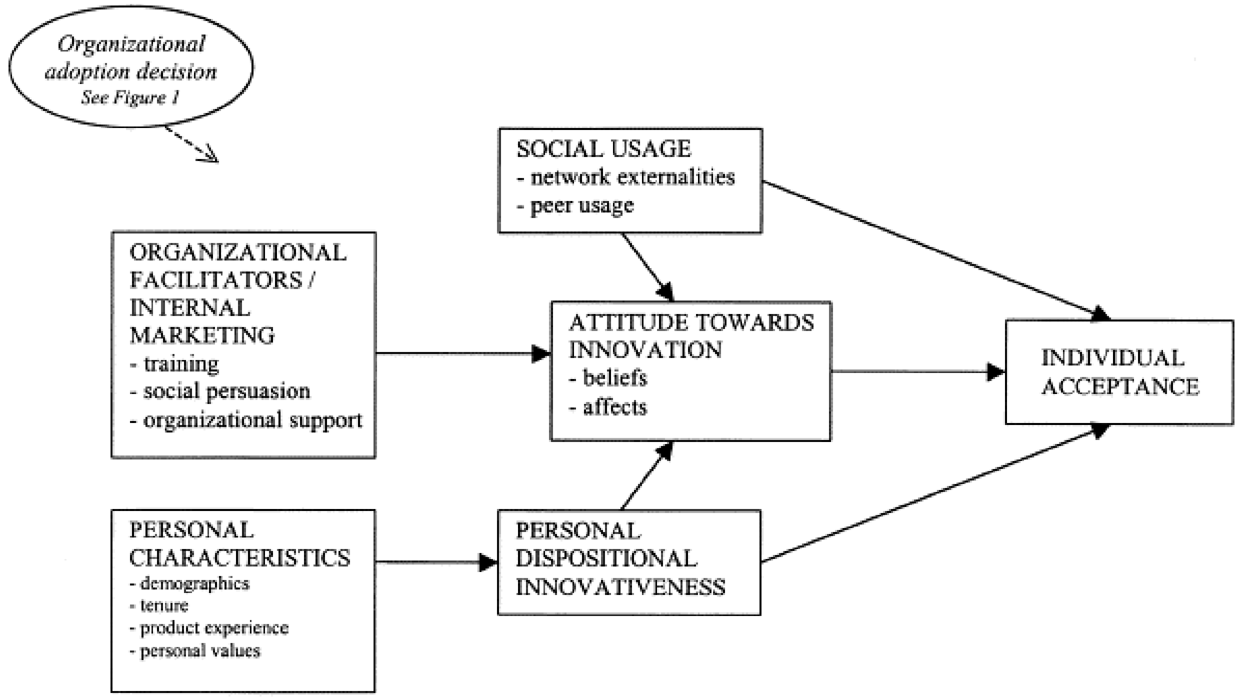


Figure 2. A conceptual framework of individual innovation acceptance in organizations (Frambach & Schillewaert, 2002, p. 167).

Situating the Research: Key Distinctions

Innovation versus innovation adoption. Frambach and Schillewaert's (2002) framework addresses the process and considerations related to innovation adoption but not innovation. Baregheh, Rowley, and Sambrook (2009) defined innovation, based on a synthesis of approximately 60 definitions from various disciplines: "Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace" (p. 1334). Innovation adoption differs from innovation in that innovation adoption refers exclusively to an individual's or organization's acceptance of an innovation (Greenhalgh & Rogers, 2010; Rogers, 2003; Straub, 2009).

Innovation adoption versus the diffusion of an innovation. The diffusion of an innovation is "the process in which an innovation is communicated through certain channels over time along the members of a social system” (Rogers, 2003, p. 5). Innovation adoption by individuals or organizations in a population is a micro-level subprocess of the macro-level process of the diffusion of an innovation (Straub, 2009), which becomes the sum of individual or organizational innovation adoptions within a population (Mahajan & Peterson, 1985; Stoneman, 2002).

Epidemic model of diffusion versus the economic model of diffusion. The two paradigms of diffusion research are the epidemic model of diffusion and the economic model of diffusion (Greenhalgh & Rogers, 2010; Stoneman, 2002). The first, which originates from a biological perspective, posits that all members of a population share identical characteristics and that adoption is the result of a random encounter between adopters and nonadopters (similarly to catching a flu). As the number of adopters increases, the rate of encounters and the rate of diffusion also increase. The result is a flattened S-shaped diffusion path as the population approaches saturation.

The second approach, the economic model of diffusion (Greenhalgh & Rogers, 2010), posits that members of a population differ and that adoption-related behaviours are more than random, chance encounters as the epidemic model suggests. Consequently, according to the economic model, differences in potential adopter characteristics and behaviours result in different adoption dates or, synonymously, differences in the degree of adoption (including nonadoption) at any point in time. The differentiating mechanisms of the economic model of diffusion are rank effects (e.g., differences in inherent characteristics, such as size), stock effects (e.g., the diminishing return of a firm’s additional adoption of an innovation), and order effects (e.g., the order in which a firm adopts an innovation relative to its competitors; Fusaro, 2009; Karshenas & Stoneman, 1993).

This study is situated in the economic model of diffusion paradigm rather than the epidemic model. Frambach and Schillewaert's (2002) framework calls for the examination of a multitude of organizational and environmental adopter factors and thereby aligns well with the economic model of diffusion paradigm, which posits that adoption is related to adopters' characteristics and behaviours.

Individual acceptance versus organizational adoption. A key distinction in this research is the difference between an individual's and an organization's adoption of a technology. Considerable literature exists on individuals' adoption/acceptance. The technology acceptance model (TAM) that Davis developed in 1986 was one of the most influential. Developed for academic settings, the concerns-based adoption model (CBAM) also focuses on the individual rather than the organization (Hold, Rutherford, Huling-Austin, & Hall, 1987). In 2003 Venkatesh, Morris, Davis, and Davis developed the unified model of technology adoption and use (UTAUT), based on the TAM and seven other models (theory of reasoned action, motivational model, theory of planned behaviour, combined TAM and theory of planned behaviour, model of PC utilization, innovation diffusion theory, and social cognitive theory), as a more comprehensive approach to explaining individual technology acceptance.

A limitation of the TAM and the UTAUT is that they explain individual acceptance of a technology rather than organization-level adoption (Vishwanath & Chen, 2011). The purpose of the TAM is to explain "the determinants of computer acceptance that is general, capable of explaining user behaviour across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified" (Davis, Bagozzi, & Warshaw, 1989, p. 989). The CBAM is concerned with "the teacher's perspective… [and] use of an innovation in classrooms" (Hold et al., 1987, p. 5). The UTAUT similarly explains "individual acceptance and usage decisions" (Venkatesh et al., 2003, p. 471). Frambach and Schillewaert's (2002) framework, on the other hand, which they developed using many of the same sources as for the UTAUT, is a more appropriate alternative for the study of the research problem. This framework consists of two parts: the organizational adoption decision (Figure 1) that influences and precedes individuals' decisions and individual technology acceptance (Figure 2).

Frambach and Schillewaert's (2002) Framework

Frambach and Schillewaert's (2002) framework helps researchers to conduct a comprehensive analysis of multiple factors, both human and nonhuman, that influence an organization's decisions to adopt (or not adopt) an innovation. This conceptual framework is the product of an extensive literature review on innovation adoption at both the organizational and individual levels. The details of the framework are presented in Table 3. Although Frambach and Schillewaert addressed both the organizational adoption level and the subsequent individual acceptance level, this research was limited to the superintendent's office's organizational-level adoption decision; the adoption and acceptance of technology by the teachers and administrators in districts schools (following the superintendent's office's adoption decision) is outside the scope of this study. Consequently, only the first portion of Frambach and Schillewaert's framework is applicable (Figure 1 but not Figure 2, which addresses individual use).

Similar to Frambach and Schillewaert's (2002) framework is Van de Wijngaert and Bouwman's (2011) framework, the general conceptual model of technology adoption and use (p. 87), which presents the technology adoption factors under the headings of *macro level* (government policy), *meso level* (organizational characteristics, such as size and sector), and

Table 3

Details of Frambach and Schillewaert's (2002) Framework of Organizational Innovation Adoption

Elements	Description	Subcomponents (including adoption impact where applicable)	Literature
PRECEDING AND DURING THE ORGANIZATIONAL ADOPTION DECISION			
Supplier Marketing Efforts	The efforts of suppliers and vendors can positively impact an organization's propensity towards adopting an innovation. Suppliers may target organizations that are heavy users of the preceding technology, heavy users of the product category, and/or reputed to be innovation adopters. The relationship between suppliers and organizations is largely based on communication, with suppliers often creating awareness of new products and downplaying adoption concerns. Supplier risk reduction efforts extend beyond communication, often involving economic and operational risk reduction incentives such as favourable financial terms and obligation-free product trials.	• Targeting (+) • Communication (+) • Risk reduction (+)	Easingwood & Beard, 1989; Frambach, Barkema, Nooteboom, & Wedel, 1998; Hultink, Griffin, Hart, & Robben, 1997; Ram & Jung, 1994; Robertson & Gatignon, 1986;
Social Network	The interconnectedness of an organization's IT leadership to other individuals and organizations positively impacts that organization's propensity towards innovation adoption. This is due to the increased flow of ideas and information about emerging possibilities/innovations within and beyond the organization's industry. Such information exchanges often occur informally, differentiating this element from environmental influences which tend to occur within the context of business operations, regulation, and competition.	• Interconnectedness/ network participation (+)	Fisher & Price, 1992; Lind & Zmud, 1991; Zaltman, Duncan, & Holbek, 1973

(table continues)

Elements	Description	Subcomponents (including adoption impact where applicable)	Literature
Environmental Influences	Environmental influences can consist of network externalities, such as the adoption of a standard by the organization's industry, and competitive pressures, such as the adoption of an innovation by an organization's competition. In the case of network externalities, the benefits of adopting an innovation are increased by occurrences in the external environment to the organization. Similarly, the actions of an organization's competition may serve as a catalyst for adoption as nonadoption may result in a competitive disadvantage.	• Network externalities (+) • Competitive environment (varies)	Baldwin & Scott, 1987; Gatignon & Robertson, 1989; Kamien & Schwartz, 1982; Katz & Shapiro, 1994; Markus, 1987; Robertson & Gatignon, 1986
Perceived Innovation Characteristics	The perceived characteristics of an innovation influence an organization's IT leadership's likelihood of adopting the innovation. The positive aspects of the innovation (relative advantage, compatibility, trialability, and observability), as they are perceived, should outweigh the negative aspects of the innovation (complexity and uncertainty) if adoption of the innovation is to occur/continue.	• Relative advantage (+) • Compatibility (+) • Complexity (-) • Trialability (+) • Observability (+) • Uncertainty (-)	Holak & Lehmann, 1990; Holak, 1988; Holak, Lehmann, & Sultan, 1987; Mansfield, 1993; Mathur, 1998 Nooteboom, 1989; Ostlund, 1974; Ostlund, 1974; Robinson, 1990; Rogers, 1995; Tornatzky & Klein, 1982; Venkatraman, 1991
Adopter Characteristics	The characteristics of the organization which is to use the innovation influence the adoption decision. The size of the organization is positively linked with its propensity towards innovation adoption. This is attributed to large organizations' structure, strategy, and culture that often have established mechanisms for implementing innovations. While organizational structures were found to have varying influence on innovation adoption, the organization's culture and strategic posture, specifically Organizational Dispositional Innovativeness and Leading Edge Status, were found to positively impact an organization's propensity for innovation adoption.	• Size (+) • Organizational structure (varies) • Innovativeness/strategic posture (+)	Cohn & Turyn, 1984; Damanpour, 1991 Han, Kim, & Srivastava, 1998; Hurley & Hult, 1998; Kennedy, 1983; Kimberley & Evanisko, 1981; Morisson, 1996; Srinivasan, Lilien, & Rangaswamy, 1999; Zaltman, Duncan, & Holbek, 1973

(table continues)

Elements	Description	Subcomponents (including adoption impact where applicable)	Literature
DURING AND FOLLOWING THE ORGANIZATIONAL ADOPTION DECISION			
Adoption Level	Innovation adoption is “the process through which an individual (or group of IT leaders) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision” (Rogers, 1995, p. 21). The adoption decision consists of two distinct stages: the initiation stage (awareness, consideration, and intention) which precedes the adoption decision, and the implementation stage (adoption decision and continued use) which follows the adoption decision.	• Awareness • Consideration • Intention • Adoption Decision • Continued Use	Bhattacherjee, 1998; Rogers, 1995; Zaltman, Duncan, & Holbek, 1973
Individual Acceptance	Following the innovation adoption decision at the organizational-level, an adoption decision occurs at the individual level. This secondary level is known as intra-organizational acceptance. An organization-level adoption decision has little value if individuals reject the innovation. While an investigation of the individual-level of cloud computing adoption in K-12 is beyond the resources available for this research, the main elements of individual-level innovation acceptance are listed to the right.	• Organizational facilitators/internal marketing • Personal characteristics • Social usage • Attitude towards innovation • Personal dispositional innovativeness • Individual acceptance	Agarwal & Prasad, 1998; Davis, Bagozzi, & Warshaw, 1989; Igbaria, 1990; Igbaria, 1993; Igbaria, Parasuraman, & Baroudi, 1996; Kraut, Rice, Cool, & Fish, 1998; Leonard-Barton & Deschamps, 1988; Thompson & Howell, 1991; Trevino & Webster, 1992; Venkatesh & Davis, 1999

micro level (individual characteristics, such as age, education). Though it shares many categories with Frambach and Schillewaert's framework, it is not as comprehensive, nor does it depict the connection between the adoption decisions of an organization's IT leadership and the eventual acceptance/use/adoption of the technology by the organization's users. For these reasons I selected Frambach and Schillewaert's framework as the central framework for this study.

Mitigating the Concerns of Traditional Diffusion and Adoption Research

Frambach and Schillewaert's (2002) framework helps to understand the factors that influence district-level K-12 IT leadership's adoption (or nonadoption) of cloud computing for district schools. Table 4 demonstrates that this framework also compensates for four of the major criticisms of adoption/diffusion research in general (Rogers, 2003).

Organizational Decision Making

The Contingency Decision-Making Framework: Overview

An organization's decision-making approaches vary depending on the organization's context and the challenges that its leaders face. There are two dominant features found in the context of decision making: first, clarity and/or consensus on the organization's problems/goals; and, second, knowledge within the organization of the approaches necessary to resolve the organization's problems and/or achieve its goals (Christensen, Marx, & Stevenson, 2006; Daft, 2013; Thompson, 1967). These two framing features of an organization's decision-making context serve as the x and y axes of the contingency decision-making framework in Figure 3. The level of consensus on an organization's goals, in combination with its members' awareness of a solution, illustrates the type of decision-making approach suited to the organization's context.

Table 4

Four Major Criticisms of Diffusion Research (Rogers, 2003, pp. 134-135) and Corresponding Research Design Considerations

Four major criticisms of diffusion research	How these criticisms are addressed in this research's design
1. The *pro-innovation bias*: the implication of most diffusion research that an innovation should be diffused to and adopted by all members of a social system, that it should be diffused rapidly, and that the innovation should be neither reinvented nor rejected.	This research is about the superintendent's office's IT leadership's decision to adopt or not adopt cloud computing. This research does not advocate, explicitly or implicitly, the use of cloud computing. Rather, it sought a better understanding of the interplay of the factors/considerations that contribute to K-12 district IT infrastructure decisions.
2. The *individual blame bias*: the tendency to hold an individual responsible for his or her problems, rather than the system of which the individual is a part.	A better understanding of a district's overall IT leadership's decision-making process was sought. This research explored whether such decisions are made by an individual or a team. This research also examined external factors such as vendor activity/marketing efforts. A strength of Frambach and Schillewaert's (2002) framework is that it takes into consideration the numerous factors that contribute to individuals' adoption decisions. This broad approach avoids the narrow focus of concerns identified in the individual blame-bias criticism.
3. The *recall problem* in diffusion research, which can lead to inaccuracies when respondents are asked to remember the time at which they adopted a new idea.	The viability of cloud computing as an option for K-12 district infrastructure is a recent and ongoing phenomenon. Cloud computing services can be adopted in a modular fashion (cloud-based e-mail only, online storage only, cloud-based e-mail and online storage, etc.). The adoption-decision process is therefore ongoing. These considerations minimize the recall problem.
4. The *issue of equality* in the diffusion of innovations, because socioeconomic gaps among the members of a social system are often widened as a result of the spread of new ideas.	The cost savings associated with cloud computing adoption compared to conventional infrastructure deployment create an opportunity for less affluent school districts to provide greater access to technology-enabled resources and practices (Craig et al., 2009; Tsaravas & Themistocleous, 2011).

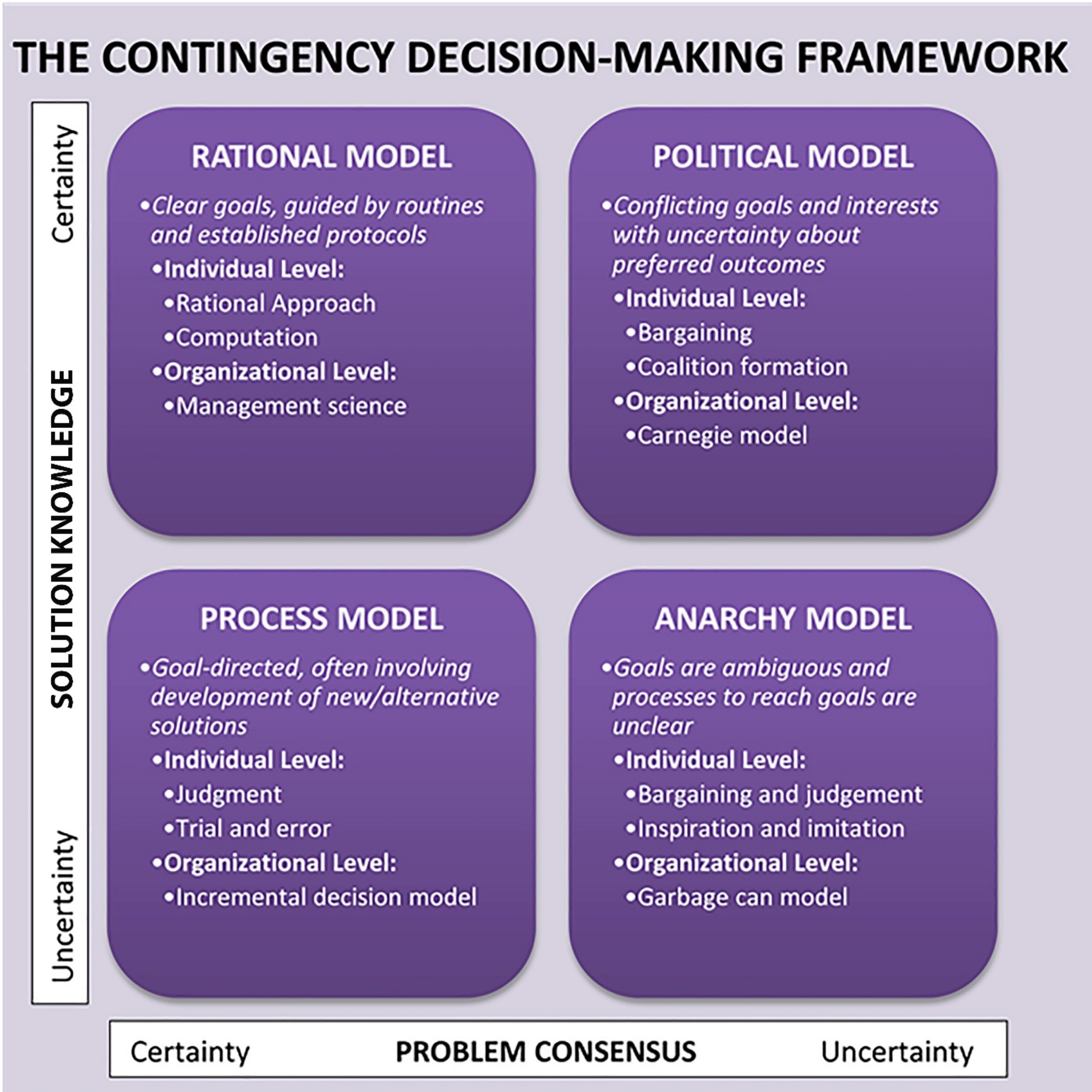


Figure 3. The Daft (2013) contingency decision-making framework.

The Four Models Within the Contingency Decision-Making Framework

The contingency decision-making framework consists of four models, each appropriate to the level of problem consensus and solution knowledge available to an organization: the rational-management science model, the political Carnegie model, the process-incremental-decision model, and the anarchy-garbage-can model (Daft, 2013). The following subsections describe these models in greater detail.

Rational model. The rational model in the contingency decision-making framework is appropriate to organizational situations with clearly defined goals/problems and sufficient knowledge about the required solution to address them (Daft, 2013). Decision-making in this context follows a rational approach in which managers should use systematic procedures and thinking to arrive at good decisions. At the organizational level, the rational model calls for a management-science approach and a thorough and often data-rich analysis of factors to aid in decision making. Although the rational model in its ideal form should yield an optimal decision because of its systematic, thorough evaluation of every reasonable alternative, it is, in reality, often constrained by resource limitations and an organization's internal politics.

Political model. The political model in the contingency decision-making framework is best suited to organizations where people have technical knowledge on how to achieve the organization's goals/priorities, but are uncertain about its goals/priorities. In the political model, leaders form coalitions/alliances with others who share similar goals and problem priorities. Unlike the rational model, the political model (sometimes referred to as the Carnegie model, from its origins at Carnegie-Mellon University) does not aim for an optimal solution defined by the organization's maximum levels of performance (Jones, 2012; Senior & Swailes, 2010). Rather, it is oriented towards *satisficing* (defined in Appendix A), whereby decisions are made to appease stakeholders' interests in the immediate and short term (Senior & Swailes, 2010; Simon, 1987). Such a decision-making process aims to meet most needs, rather than to find a solution to optimally meet a more specific single need.

Process model. The process model in the contingency decision-making framework is based on Mintzberg, Raisinghani, and Theoret's (1976) incremental decision-process model, where major decisions are the product of a series of small choices (Jones, 2012; Senior & Swailes, 2010). The incremental decision-process model consists of a series of interconnected phases (identification, development, and selection), underpinned by feedback loops. It recognizes that organizational decision making does not always follow a linear, orderly progression. This process model is most appropriate when an organization's members reach a consensus on problems/goals but are ambiguous about how to achieve these goals. It allows for trial and error and takes an iterative approach towards a solution.

Anarchy model. The anarchy model in the contingency decision-making framework is suited to ambiguous situations with respect to both organizational goals and the appropriate solutions required to address the goals. The anarchy model, also known as the garbage-can model, is appropriate in cases with high organizational uncertainty (ill-defined problems and preferences, unclear and/or poorly understood technology, and high turnover). In the garbage-can/anarchy model, organizational decision making takes on a random quality, and the problems, solutions, participants, and choices interact unpredictably (Jones, 2012; Senior & Swailes, 2010). Occasionally, through chance, they solve some problems.

Limitations of Alternative Models

I chose the Daft (2013) contingency decision-making framework for this adoption study because it concisely describes how decisions are made by leaders on behalf of an organization. The four models of the contingency decision-making framework are clearly defined along the axes of problem consensus and knowledge of the approaches necessary to achieve the organization's goals. I found alternative frameworks problematic for the purpose of this research because they contain considerable overlap within their models. For example, Bush (2011) presents 6 models of educational management (formal, collegial, political, subjective, ambiguity, cultural) and 10 models of leadership (managerial, instructional, transformational, participative, distributed, transactional, postmodern, emotional, contingent, and moral). Moreover, these alternative models lack well-defined axes, which were helpful in explaining the framework during interviews. The clarity and relative simplicity of the Daft (2013) contingency decision-making framework allowed me to work with the study's participants to accurately identify the decision-making process within their K-12 districts.

An Integrated Framework for Researching Cloud-Computing Adoption in K-12 Districts

The central question of this study is, "What factors influence district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for district schools?" I use a case-study approach to describe and interpret the current state of cloud computing adoption in large Western Canadian K-12 districts. I use an integrated framework, based on the three separate frameworks discussed in this chapter, to guide this research and examine the findings from the study's 75 cases/districts. This integrated framework is presented in Figure 4. In the following chapter, I will discuss this research's case study methodology and philosophical foundations in greater detail.

At the core of this study is Frambach and Schillewaert's (2002) framework for organizational innovation adoption. This framework guided the description and analysis of the decision making of each school district's IT leadership related to cloud computing adoption. Using the Frambach and Schillewaert's (2002) framework, I examine the interplay among human and nonhuman factors. I also use the existing literature, framed by a PEST analysis of the facilitating and inhibiting conditions for cloud computing adoption, to inform the analysis of

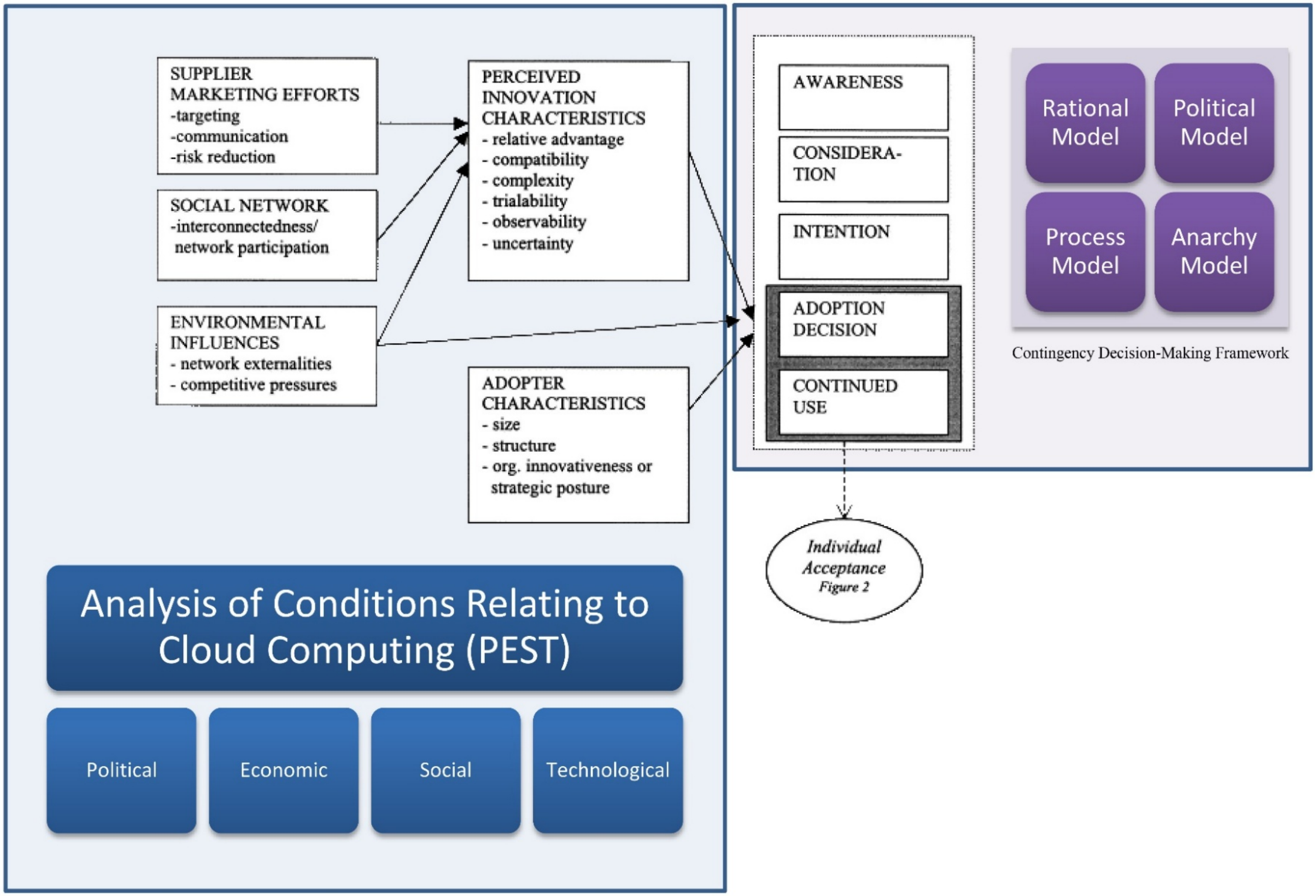


Figure 4. An integrated framework for the analysis of cloud computing adoption in K-12 districts.

Note. The PEST analysis deepens our understanding of Frambach and Schillewaert's (2002) framework's adoption factors (the light blue area) for cloud computing. The contingency decision-making framework informs the decision-making and adoption level portion of Frambach and Schillewaert's framework (the light purple area).

the participants' responses concerning the factors that influence the adoption decision. Similarly, I use the Daft (2013) contingency decision-making framework to better understand how an adoption (or nonadoption) decision emerges when Frambach and Schillewaert's five elements (supplier marketing efforts, social network, environmental influences, perceived innovation characteristics, and adopter characteristics) interact.

The integration of three distinct frameworks into my examination of cloud computing adoption by K-12 IT leadership helped me to connect the participants' responses to existing knowledge and identify new knowledge. I anticipated that their responses would at times echo the voices of others who have studied cloud computing, particularly for questions related to the categories of perceived innovation characteristics and environmental influences (Frambach & Schillewaert, 2002). However, it was also possible that the participants' responses would present new information that I had not found in the existing literature. The use of multiple frameworks served a practical purpose because asking the participants for a comprehensive explanation of all adoption factors (and related subfactors) was not feasible given the time constraints of a semistructured interview during a busy participant's workday. The semistructured interview approach (which I will discuss more thoroughly in chapter 3) allowed me to spend more time exploring new or particularly interesting cloud computing considerations with a participant. This was made possible by the PEST analysis, which provided valuable background information prior to the semistructured interviews.

The use of an integrated framework was also beneficial in identifying and resolving potential inconsistencies in participants' responses. When I brought these inconsistencies to participants' attention during the semistructured interviews, this allowed them to reconsider their responses, and/or to add nuances to their answers which then clarified these seeming inconsistencies. For example, if a participant repeatedly indicated political considerations as having a dominant impact on his or her district's decision-making process during the semistructured interview, but did not select the political model from the Daft (2013) contingency decision-making framework, it provided me with an opportunity to ask follow-up questions for clarification. In such instances, participants either reconsidered their choice within the contingency decision-making framework, or provided greater detail which remedied what I initially perceived as an inconsistency.

The use of three frameworks to identify, contextualize, evaluate, and verify this study's data was a critical design element intended to provide rich and accurate information on cloud computing adoption in Western Canadian K-12 districts. These three complementary frameworks provided an additional level of data *triangulation* (defined in Appendix A), in addition to those that will be described in chapter 3. The alignment between the conceptual framework and the research questions, presented earlier in Table 2, is illustrated in the conceptual framework map presented in Table 5. This conceptual framework map presents the research subquestions, the data collected and analyzed to answer these subquestions, and the scholarship/conceptual frameworks that have guided the approach to each question.

Contemporary Conditions and Challenges Affecting Educational Technology

In this section I present literature pertaining to some of the challenges that this research can help school districts address. This section serves as a foundation for the implications and recommendations chapter, where, based upon the conclusions of this research, I offer approaches that can be used by school districts to overcome some of their educational technology challenges.

Table 5

Conceptual Framework Map

Research Questions	Investigation and Data Required	Scholars and Frameworks	Use of Literature and Frameworks for Analysis and Interpretation
Q1. What are the IT leadership structures and processes at the district level for large Western Canadian K-12 school districts?	• Identify those involved in the IT infrastructure decision-making process through participant interviews and document analysis • Identify the key decision-making level within the process through participant interviews • Determine whether this process is universal or changes for decisions concerning cloud computing adoption.	CoSN, 2012; Maas, 2010; Contingency decision-making framework (Daft, 2013)	• CoSN (2012) and Maas (2010) informed the research design concerning who was responsible for IT infrastructure in large K-12 districts. This was later confirmed during participant recruitment and the referential sampling techniques used. Participant interviews and document analysis (e.g., organizational charts) provided further confirmation. • Using the contingency decision-making framework (Daft, 2013), participants were asked to identify a model which best described decision making within their organization. This added a deeper understanding of the decision-making process and facilitated triangulation.
Q2. What is the current level of cloud computing adoption in large K-12 school districts in Western Canada?	• Identify the type of software used for services such as SIS, LMS, Library, etc. through participant interviews and document analysis • Identify the platform used to deliver those IT services delivered (Public Cloud, Private Cloud, etc.) through participant interviews and document analysis	Frambach and Schillewaert (2002) framework; PEST	• The Frambach and Schillewaert (2002) framework was used to describe an organization's level of adoption of cloud computing infrastructure (awareness, consideration, intention, adoption decision, or continued use). • A PEST analysis was used to inform and triangulate participants' responses concerning the details of their IT infrastructure/cloud computing use.

(table continues)

Research Questions	Investigation and Data Required	Scholars and Frameworks	Use of Literature and Frameworks for Analysis and Interpretation
Q3. What is the interplay of human and nonhuman factors that influence infrastructure decisions by district-level IT leadership in K-12?	• Identify, through participant interviews, the absolute and relative impact of the following factors: supplier marketing efforts, social network, environmental influences, perceived innovation characteristics, and adopter characteristics.	Frambach and Schillewaert (2002) framework; PEST; contingency decision-making framework (Daft, 2013)	• Frambach and Schillewaert (2002) identified organizational adoption factors in their framework. Participants in my study rated and ranked these factors. • A PEST analysis and the contingency decision-making framework (Daft, 2013) was used to inform and triangulate responses.

The Importance of Educational Technology and Concerns over Access

The importance of education, and the role of information technology as a key element, is recognized globally.

> UNESCO together with UNICEF, the World Bank, UNFPA, UNDP, UN Women and UNHCR, organized the World Education Forum 2015 in Incheon, Republic of Korea, from 19–22 May 2015, hosted by the Republic of Korea. Over 1,600 participants from 160 countries, including over 120 Ministers, heads and members of delegations, heads of agencies and officials of multilateral and bilateral organizations, and representatives of civil society, the teaching profession, youth and the private sector, adopted the Incheon Declaration for Education 2030, which sets out a new vision for education for the next fifteen years. (UNESCO, 2015, p. 5)

The overarching vision of the document, presented as Sustainable Development Goal 4, is to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (p. 7). The importance of educational technology in achieving this goal is a recurring topic in the Incheon Declaration for Education 2030: "By 2030, all young people and adults across the world should have achieved relevant and recognized proficiency levels in functional literacy and numeracy skills. . . . ICT, particularly mobile technology, holds great promise for accelerating progress towards this target" (p. 47).

Despite the great promise ICT and mobile technology hold for facilitating teaching and learning, an ongoing challenge remains ensuring reliable access to all learners. This is particularly concerning to marginalized groups, for whom regular access to technology-enhanced learning experiences is problematic (Brown, 2017). In such environments, the lack of access to educational technology can exacerbate this problem: "One might further argue that as the world becomes more dependent on technology, learning technology may inadvertently widen [socioeconomic] gaps over time" (Tawfik, Reeves, & Stich, 2016, p. 599). The recommendations of my research, found in the final chapter, aim to mitigate and/or minimized the challenges faced by marginalized groups.

Digital Transformation and the Importance of IT Leadership

The role of senior IT personnel across multiple industries has shifted in recent years away from the traditional focuses of maintaining systems and controlling costs towards business innovation/transformation through technology (Dahlberg, Kivijärvi, & Saarinen, 2017; Fitzgerald, Kruschwitz, Bonnet, & Welch, 2014). This phenomenon is called *digital transformation*: "the realignment of, or new investment in, technology and business models to more effectively engage digital customers at every touchpoint in the customer experience lifecycle" (Solis, Lieb, & Szymanski, 2014, para. 6). In recent years, across multiple industries, IT departments and their leaders have become the drivers of innovation and digital transformation (Kokkinakos, Markaki, Koussouris, & Psarras, 2016; Singh & Hess, 2017). In education, IT leaders have a similar opportunity to transform their organizations and to advance teaching and learning within districts.

In this context of digital transformation, K-12 district leaders and the leaders of IT within these districts must work closely to fully realize the potential benefits of technology in serving the district's educational mission. For such an alignment to exist, IT leaders must have a deep understanding of their field/business (Chan, Sabherwal, & Thatcher, 2006; Mora, Wang, Raisinghani, & Gelman-Muravchik, 2017; Pearlson & Saunders, 2012; Queiroz, 2017). Within education, authors have expressed a similar demand for educators and district leaders to engage in relevant and ongoing professional development (Harris, & Hofer, 2017; Megginson, & Whitaker, 2017; Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2017).

The involvement of IT leaders within an organization's higher most senior decision-making processes has been an ongoing challenge: "The establishment of strong alignment between information technology (IT) and organizational objectives has consistently been reported as one of the key concerns of information systems managers" (Reich & Benbasat, 2000, p. 81). In this research, I present findings on the IT decision-making/leadership structures of Western Canadian K-12 districts. While some of these leadership structures facilitate the alignment between a district's IT leadership and its educational goals, some structures do not. In the final chapter, I provide recommendations as to how to organize leadership structures in order to more effectively facilitate digital transformation within K-12 districts.

The Global Demand for IT Talent and the Resulting Staffing Challenges

There is a global shortage of IT personnel with the skills necessary to support organizations' IT initiatives across multiple industries, particularly as they more fully embrace cloud computing and other new, related technologies (Contu, 2017; Florentine, 2017; Robert Half Technology, 2017). "When we compare clicks from job seekers to openings for cybersecurity roles posted by employers, we can see just how serious the talent shortage gets, and the scale of the risk it represents for organizations" (Culbertson, Humphries, Ivy, Kolko, & Rodden, 2017, para. 14). Beyond organizational leaders and IT managers, this global shortage also affects IT staff/practitioners in districts directly. Because of the growing volume of work and the challenge of finding qualified people to help, IT practitioners have reported being overloaded at unprecedented levels (Global Knowledge, 2017). According to the 2017 Global Knowledge salary report, "Nearly two-thirds of respondents indicated that their workloads were challenging, with 40 percent reporting workloads that are either very challenging or the worst they've ever seen" (p. 6).

In addition to the overall difficulty of finding qualified IT personnel to support cloud computing, because of the shortage of skilled employees and high level of competition for these employees, K-12 districts in Western Canada face additional financial challenges in securing IT talent. Of the 26 major industries listed in the 2017 Global Knowledge study on IT compensation, education services offered the lowest mean salary in the US and Canada, even behind nonprofit organizations. Furthermore, for all industries, "salaries in the U.S. average 32 percent higher than those in Canada" (p. 6). In light of these competitive financial pressures, both across industries and across the US border, Canadian K-12 districts must plan carefully to ensure that they have the necessary staff to keep their IT systems operational. In the final chapter, I present recommendations for districts that can help them address these IT staffing challenges.

CHAPTER 3: RESEARCH DESIGN

Overview

This chapter outlines the approach, ontology, research design, and ethical considerations for answering this study's central research question. First, I address the philosophical considerations of this research that situated the approach within established ontological and epistemological traditions. Second, I discuss the design of this research, including the delimitations and limitations. Third, I present my ethical considerations to ensure the participants' anonymity and confidentiality and proper handling of the data.

Philosophy

The ontological and epistemological beliefs/assumptions of the researcher shape the research. Figure 5 illustrates how this study's design (research questions, methods, and data analysis) is connected to the underlying theoretical perspectives (ontology, epistemology, and sociological-philosophical). In the following subsections I discuss the alignment of theory and research design in greater detail.

Researcher's Background and Philosophical Perspectives That Influence This Research

I have been the CIO for an independent K-12 school of 500 students in Vancouver, British Columbia, since 2004. When I am working just with technology, an objective reality dominates (e.g., planning and deploying servers, workstations, network equipment, etc.). Simply put, a power outage adversely affects technology-dependent learning activities (e.g., a biology presentation using 3D computer models of the circulatory system, shown on a digital projector) in a very visible and objective way. The relationship between electricity and the operation of the projector is direct, measurable, and quantifiable. However, my role as CIO also involves

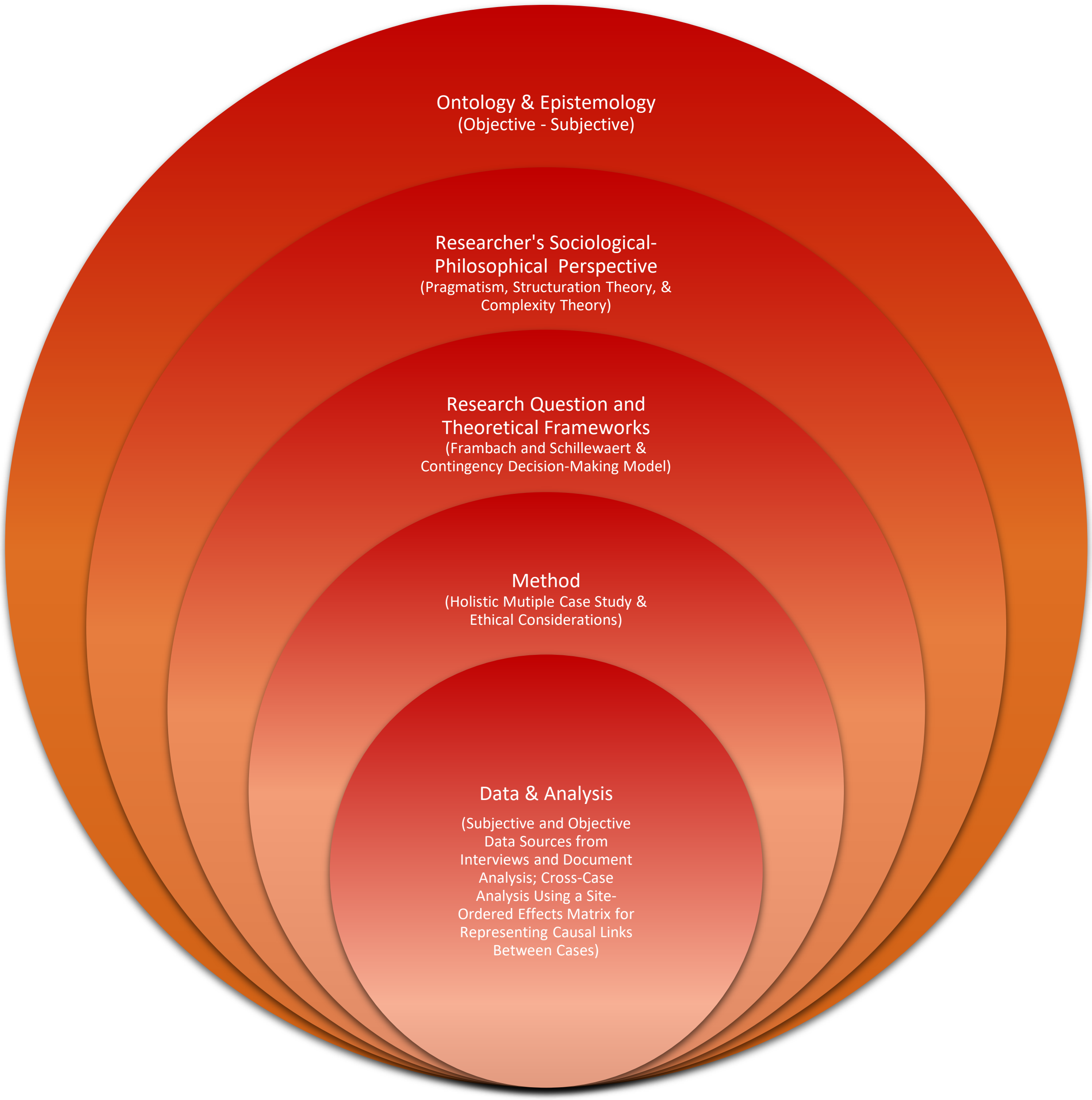


Figure 5. An overview of this research's design in relation to theory and philosophy.

working with faculty and administration to create a technology-supported learning environment within the school. In this interpersonal work, reality is largely subjective, and I have come to appreciate postpositivism/interpretivism. Teachers' satisfaction is subjective, complex, and results from the interplay of a multitude of factors. For example, teachers might be very satisfied with their new $300 computers (which they use primarily for basic e-mail and word processing) until they learn that other teachers have received new $2,000 computers. In my professional work as a leader and decision maker, in which I bridge the needs of personnel with appropriate technology, I have come to understand the limitations of a purely positivist, structural view. Simply put, a purely "build it and they will come" strategy is a gross oversimplification and misunderstanding of the complex reality of technology adoption and acceptance in organizations.

As the following sections will expand upon, my worldview as a researcher and professional is situated in pragmatism. My experience in many schools has informed my belief that technology-supported learning environment are the products of both objective and subjective factors. For this reason my research focused broadly on gaining an understanding of the complex interplay of both human and nonhuman that lead to the adoption (or nonadoption) of cloud computing within large Western-Canadian K-12 school districts.

Ontology and Epistemology: The Subjective-Objective Dichotomy

Ontology refers to the nature of reality, and *epistemology* refers to how one comes to know reality (Creswell, 2007; Crotty, 1998). Crotty clarified this further: "Ontology is the study of being. It is concerned with 'what is,' with the nature of existence, with the structure of reality as such" (p. 10). On the other hand, epistemology is "the nature of knowledge, its possibility, scope and general basis" (Hamlyn, 1995, p. 242). "Epistemology is concerned with providing a philosophical grounding for deciding what kinds of knowledge are possible and how we can ensure that they are both adequate and legitimate" (Maynard, 1994, p. 10).

Burrell and Morgan (1979) explained the dichotomy of a subjective or objective approach to research in their work:

> All social scientists approach their subject via explicit or implicit assumptions about the nature of the social world and the way in which it may be investigated. First, there are

> assumptions of an ontological nature—assumptions which concern the very essence of the phenomena under investigation. Social scientists, for example, are faced with a basic ontological question: whether the "reality" to be investigated is external to the individual—imposing itself on individual consciousness from without—or the product of individual consciousness; whether "reality" is of an "objective" nature, or the product of individual cognition; whether "reality" is a given "out there" in the world, or the product of one's mind. (p. 1)

From the subjective-objective dichotomy emerge corresponding research approaches consistent with my perspective. For instance, the realist, positivist approach to research lends itself to empirical, quantitative approaches in which, through the data-collection and data-analysis procedures, the researcher reveals indisputable and objective truths (Burrell & Morgan, 1979; Craib, 1984; Paul, 2005). On the other hand, the interpretivist, postpositivist approach to research lends itself to qualitative approaches, with the tacit assumption that the world and the interpretation of data from it are value laden, which thereby posits subjective realities (Gay, Mills, & Airasian, 2009; Lincoln, Lynham, & Guba, 2011; Merriam, 2009).

The subjective-objective dichotomy within ontology and epistemology is well established in the academy. Palys (2003) described this divide:

> Qualitative and quantitative study remain two distinct approaches to understanding and knowledge. Members of the two camps often don't even know how to talk to one another: they differ in the language they use to talk about research, the places they look in and find interesting, the questions they ask, the criteria by which they judge whether a piece of research is "done well," and even whether they consider certain work to be "research" at all. (p. 21)

Becker (1996, as cited in Palys, 2003) then argued the complementary nature of quantitative and qualitative research:

> Practitioners of qualitative and quantitative methods may seem to have different philosophies of science, but they really just work in different situations and ask different questions. The politics of social science can seduce us into magnifying the differences. But it needn't and shouldn't. (p. 65)

I approached this study from this complementary viewpoint. Using mixed methods, I examined both objective and subjective data from multiple cases (each case a large Western Canadian K-12 school district). In the following section on Frambach and Schillewaert's (2002) framework, I identify specific framework elements that are best suited to both subjective and objective investigations. In the sections following I use structuration theory and complexity theory to illustrate how to use subjective and objective data together in a complementary manner to promote a fuller understanding of each case.

The Subjective and Objective Aspects of Organizational Adoption

Frambach and Schillewaert's (2002) organizational adoption framework contains both objective and subjective elements (Appendix C). Adopter characteristics (e.g., school-district size) and environmental influences (e.g., government policies, specifically related to privacy), for example, can be measured objectively. However, the adoption decision of the IT leadership (an individual or a group of individuals) in an organization is ultimately subjective. In Frambach and Schillewaert's framework, the *perceived innovation characteristics* heading (e.g., complexity) captures the subjective perceptions of the organization's IT leadership (e.g., how difficult will the innovation be for staff to use?). This differs from the objective innovation characteristics (e.g., technical specifications). Moreover, the supplier marketing efforts and social network within Frambach and Schillewaert's framework capture the contributions of interpersonal interactions to the decision-making process and are also subjective.

In addition to Frambach and Schillewaert's (2002) framework, I used the contingency decision-making framework (Daft, 2013) to better understand a school district's central IT leadership's adoption-decision structures, influences, and process. An individual's description of an organization's decision-making process, how it both actually and officially functions, is subjective and information not likely to be available elsewhere (Gay et al., 2009).

Structuration Theory

Structuration theory, which Anthony Giddens (1984) developed, serves as a bridge across the subjective-objective divide within the field of organizational studies (Broger, 2011; Cunliffe, 2008; Senior & Swailes, 2010). At the heart of structuration theory is the following idea from Marx (1852): "*Die Menschen machen ihre eigene Geschichte, aber sie machen sie nicht aus freien Stücken, nicht unter selbst gewählten, sondern unter unmittelbar vorgefundenen, gegebenen und überlieferten Umständen*" ["Men make history, but not in circumstances of their own choosing]" (p. 115). From this idea Giddens (1991) developed a framework to "understand both how actors are at the same time creators of social systems yet created by them" (p. 204). Giddens (2001) deliberately attempted to avoid the objective-subjective dichotomy. Rather, he explained that the actions of individuals within these constraining structures make and remake social structure: "All social action presumes the existence of structure. But at the same time structure presumes action because 'structure' depends on the regularities of human behaviour" (p. 669).

Although it attempts to remedy some of the seeming incompatibilities and criticisms in the subjective-objective debate, structuration theory is not without its own supporters and critics

(Bryant, 1992; Cohen, 1986; Gregson, 1989; McLennan, 1984). On one hand, critics have perceived Giddens' (1984) theory as an unacceptable, incoherent mixture of realist, positivist, and idealist arguments; on the other hand, supporters have argued that the critics' empiricist, objectivist demands are unrealistic (Broger, 2011; Cohen, 1986). Recognizing the strengths of structuration theory's support, as well as acknowledging its criticisms, Broger expressed a sentiment that I share: "It would be presumptuous and wrong to believe that we can resolve these complex philosophical and theoretical questions. Rather, we seek to find pragmatic solutions to put his powerful theory to work in the context of organization theory" (p. 13).

Complexity Theory

Giddens' (1984) structuration theory, which describes the dialectic interplay between structures and the individuals within those structures, is consistent with and complements complexity theory (Morrison, 2005). Whereas structuration theory bridges the ontological/ epistemological divide between the objective and subjective, it resides solely at the philosophical/theoretical level (Broger, 2011). Complexity theory, on the other hand, resides at both the philosophical/theoretical and the practical level (Biesta & Osberg, 2010; Fonseca, 2002; Goldstein, Hazy, & Lichtenstein, 2010). Complexity theory parallels and expands upon structuration theory's understanding of the dialectic relationship between structures and individuals. Moreover, complexity theory expands upon this nonlinear understanding of patterns of influence.

Using the contrasts of simple and complicated phenomena, Weaver (1948) was one of the first to describe complexity (Davis & Sumara, 2006). A simple phenomenon has linear, predictable characteristics; a complicated phenomenon has linear, predictable characteristics, though a far greater number, which makes a complicated phenomenon more difficult to predict.

However, given sufficient time and data, a complicated phenomenon can be understood and predicted with accuracy (e.g., life insurance industry premium calculations in Canada). As Clarke and Collins (2007) summarized well, “For simple and complicated phenomena, the sum of the parts always constitutes the whole; no more, no less” (p. 161). In contrast, a complex phenomenon, despite sharing the characteristic of numerous variables with complicated phenomenon, rarely has predicable outcomes. Classic examples of complex phenomena include fashion trends, childrearing, the spread of flu viruses, weather systems, and so on. Characteristics of complex systems include, but are not limited to, networked rather than hierarchical structures, feedback loops, a capacity for self-organization/regulation, disequilibrium, and a nested, fractal nature that is irreducible (Clarke & Collins, 2007; Davis & Sumara, 2006).

A key notion in the complexity-theory literature is that improvements to complex systems are rarely the product of a singular intervention (Clark, 2012; Glouberman & Zimmerman, 2002; Greenhalgh, Plsek, Wilson, Fraser, & Holt, 2010). Rather, within contexts such as healthcare, in which patient health is a complex system/phenomenon, interventions that target multiple rather than single contributing factors often result in far greater improvements; for example, community supports, patient education, family involvement, and so on in conjunction with prescription medication compared to the prescription of medication alone to patients.

An Integrated Philosophical Foundation for a Multiple Case Study Approach

The core implication for this study from the field of complexity theory research is that the decisions of IT leadership with regard to infrastructure adoption are undoubtedly complex. Frambach and Schillewaert (2002) presented a comprehensive framework for the analysis of organizational adoption through the identification of organizational adoption factors, both human and nonhuman. Their framework also depicts some of the relationships among these organizational adoption factors (e.g., supplier marketing efforts inform perceived innovation characteristics). However, we know little about the interplay of these adoption factors; specifically, those that relate to the new and important phenomenon of cloud computing. Interactions among the perceptions of an innovation's complexity and compatibility, government regulations, competitive pressures, and organizational innovativeness, within the context of an adoption decision on behalf of the organization, are characteristic of a complex system. Consequently, a variety of data sources, some objective, others subjective, is required to examine these multiple characteristics. This approach is again consistent with the ontological-epistemological foundations of structuration theory (and complexity theory, with which it is compatible) and served as the basis for this research's multiple case study design. Ultimately, however, this research centred on the focal research question of how to better understand the factors that influence district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for districts. The methods of investigation are in service of this central question and draw back to my pragmatic orientation.

Pragmatism as a Foundation for Mixed-Methods Research

My worldview as a researcher, shaped by my professional work and life experiences, is situated within pragmatism. The pragmatic worldview is oriented towards outcomes, actions, situations, problems, and consequences (Biesta & Burbules, 2003; Creswell, 2007, 2009). This distinguishes the pragmatic worldview from other research paradigms in which the focus might be on antecedent conditions (Patton, 1990). Pragmatism's focus is first and foremost on the research problem; the researcher's choice of method then stems from the research problem. Pragmatism is appropriate for mixed-methods studies for this reason, because multiple data sources, qualitative and/or quantitative, can be used to address the central question(s) of the research (Creswell, 2009; Onwuegbuzie, 2012; Rossman & Wilson, 1985; Tashakkori & Teddlie, 1998). Table 6 presents the characteristics of pragmatism in greater detail and reveals the relevance of these characteristics to this research.

Research Design and Delimitations

Rationale for a Case-Study Approach

In this research I used a case-study approach to better understand decision making. Each of the 75 large K-12 districts in BC, Alberta, and Saskatchewan were examined independently, resulting in 75 cases. A classic definition of case-study research (Schramm, 1971) emphasizes its suitability to the study of decision making: “The essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions: why they are taken, how they were implemented, and with what results” (p. 6).

Yin (2009) offered additional clarification and three conditions for the use of a case-study approach over other approaches: (a) The research questions are explanatory (in contrast to “how many” or “where” questions, when a survey might be more appropriate), (b) the researcher examines a contemporary set of events (in contrast to historical events, for example), and (c) the investigator has little or no control over that which he or she is studying (in contrast to experimental research designs). Yin similarly presented his three conditions in his twofold operational definition of case studies (Table 7); this table includes both his definition and the corresponding aspects of this research that made a case-study approach the best means of addressing the research question.

Further justification for my use of a case-study approach is the close alignment of my specific research questions (Table 2) with the general goals of case-study research:

Table 6

The Characteristics of Pragmatism (Creswell, 2007, pp. 10-11; Creswell, 2009, p. 23) and Corresponding Research Design Considerations

Characteristics of pragmatism	Relevance to this study
Pragmatism is not committed to any one system of philosophy and reality. Pragmatists believe in an external world independent of the mind as well as those lodged in the mind. Truth is what works at the time. It is not based on a dualism between reality independent of the mind or within the mind. Thus, in mixed-methods research, investigators use both quantitative and qualitative data because they lead to the best understanding of a research problem.	This study was on the adoption of an innovation at the district/organizational level on behalf of the individuals in the organization. Using Frambach and Schillewaert`s (2002) framework, I investigated both objective and subjective elements of decision making. Pragmatism does not bind researchers to an exclusively objective or subjective perspective. Rather, pragmatism fosters an inclusive worldview that accommodates both. This is particularly beneficial to organizational research in which both objective realities and subjective perceptions impact adoption decisions.
Pragmatists do not see the world as an absolute unity. In a similar way, mixed-methods researchers look to many approaches to collect and analyze data rather than subscribing to only one way (e.g., quantitative or qualitative). Individual researchers have freedom of choice regarding methods, techniques, and procedures of research that best meet their needs and purposes. Pragmatist researchers look to the "what" and "how" to research based on its intended consequences—where they want to go with it For mixed-methods researchers, pragmatism opens the door to multiple methods, different worldviews, and different assumptions, as well as different forms of data collection and analysis.	This study benefited from the flexibility of a mixture of methods, techniques, and procedures. This mixture allows for data verification and triangulation. An example of this is information on adopter characteristics (from Frambach and Schillewaert`s framework); specifically, school-district population sizes. This information can initially be found through an online search of school districts and again verified in interviews with participants. Moreover, in this study employed a mixed-methods, sequential-exploratory design to facilitate a deeper analysis of the data. True to the characteristics of pragmatism, the research purpose is paramount, and all methods and data sources are derivatives of the research's central question.

Table 7

Robert Yin's (2009, p. 18) Definition of Case Study and the Corresponding Elements of This Research's Design

Elements of the case study definition	Corresponding considerations within this research
1. A case study is an empirical inquiry in which the researcher	
• investigates a contemporary phenomenon in depth and within its real-life context, especially when	This research examines both the contemporary, emerging phenomenon of cloud computing, as well as contemporary IT decision-making at the K-12 district level.
• the boundaries between phenomenon and context are not clearly evident.	Cloud computing offers an alternative to traditional IT infrastructure. IT infrastructure, by definition, is the context in which other IT activities occur. Cloud computing, as the central technology phenomenon of this study, is inseparable from the context of its adoption.
2. The case study inquiry	
• copes with the technically distinctive situation in which there will be many more variables of interest than data points; one result is that it	Frambach and Schillewaert's (2002) conceptual framework of organizational innovation adoption identifies multiple considerations/variables within the organizational adoption decision.
• relies on multiple sources of evidence, and the data need to converge in a triangulating fashion; another result is that it	Because of the variety of considerations/variables identified within Frambach and Schillewaert's (2002) framework, not all variables can be reduced to objective data. Consequently, a variety of data sources and triangulation need to be used to yield a more complete understanding of cloud computing adoption considerations by K-12 district IT leadership.
• benefits from the prior development of theoretical propositions to guide the data collection and analysis.	Existing literature on cloud computing is used to aid in the triangulation of the data from the participants. The PEST analysis of cloud computing (Appendix Table B1) serves as the backdrop for what is currently known about the factors that influence cloud computing adoption. This prior research informed the data collection and analysis. Moreover, Frambach and Schillewaert's (2002) framework and the contingency decision-making framework (Daft, 2013) guide this research at a macro level.

> To *explain* the presumed causal links in real-life interventions that are too complex for the survey or experimental strategies. A second application is to *describe* an intervention and the real-life context in which it occurred. Third, case studies can *illustrate* certain topics within an evaluation, again in a descriptive mode. Fourth, the case study strategy may be used to *enlighten* those situations in which the interventions being evaluated has no clear, single set of outcomes. (Yin, 2009, pp. 19-20)

I conducted this research to explain, describe, illustrate, and enlighten the complex interplay of human and nonhuman factors that influence district level K-12 IT leadership's adoption of cloud computing in large Western Canadian school districts. A school district's adoption of cloud computing is a contemporary, complex issue with no clear, single set of outcomes. It occurs in a real-life context, and numerous human and nonhuman factors (evident in the PEST analysis shown in Appendix Table B1) shape it. I therefore sought a deeper understanding of the relationships among the numerous factors that influence IT leadership's decision to adopt cloud computing. Last, I created a descriptive snapshot of current cloud computing adoption within large Western Canadian K-12 school districts.

Synergies between Mixed-Method Research and Case-Study Design

As presented in the previous section on the characteristics of case-study research, Yin (2009) states that an aim of such research is to explain real-life interventions or phenomena in a complex, contemporary setting. Mixed-method research is an appropriate tool to explore interventions and phenomena as it allows researchers to employ both qualitative and/or quantitative approaches (Creswell, 2009; Merriam, 2009; Mertens, 2015, Onwuegbuzie, 2012). "Mixed methods have particular value when a researcher is trying to solve a problem that is present in a complex educational or social context" (Mertens, 2015, pp. 328-329). This echoes

Yin's (2009) statement concerning case-study research's appropriateness for exploring complex phenomena.

The combination of a case-study design, which relies of multiple sources of evidence, with mixed-methods research, which contains both qualitative and quantitative elements, allows for a more thorough exploration of the research questions. The suitability of case study research for answering complex research questions, such as those of this study concerning the adoption of the innovation of cloud computing within K-12 education, is also argued by Merriam (2009): "Case study has proven particularly useful for studying educational innovations . . . and informing policy" (p. 51).

As I will present in the coming sections, the benefits of using both mixed-method research and a case-study design are particularly relevant to this research. This approach was especially suitable given the large volume of qualitative data which quantitative correlation analysis made possible to fully interpret. I will discuss the details of the mixed-methods approach I used later in this chapter.

Type of Case-Study Design and Unit of Analysis

For this study I used a holistic multiple-case design. The unit of analysis for this study were individual K-12 school districts. I used multiple case studies and took a holistic rather than an embedded approach. These two approaches differ in that researchers use a holistic approach to examine the unit of analysis holistically within the research context (e.g., the study of a school district as a whole, the use of multiple data sources, and the school district as the unit of analysis); researchers use an embedded approach to examine multiple units of analysis as part of a case within the research context (e.g., the study of a school district that involves discrete subcases, such as several schools as the unit of analysis). The choice of a holistic approach resulted in 75 cases, each a K-12 school district in BC, Alberta, or Saskatchewan with more than 5,000 students.

I thought about treating provinces as cases and school districts as the embedded unit of analysis but concluded that such a research design would have placed extraordinary emphasis on environmental influences (in this research, provincial differences such as privacy legislation and curriculum expectations), which would have deviated from Frambach and Schillewaert's (2002) framework. Moreover, applying a holistic multiple-case design increased the number of unique cases considerably beyond the three provinces/cases of an embedded multiple-case design. The choice of a holistic over an embedded design thereby better facilitated a replication approach (both literal and theoretical) and increased the generalizability of the study's findings (Gay et al., 2009; Yin, 2009).

Research Context and Participant Selection Rationale

"For multicase research, the cases need to be similar in some ways" (Stake, 2006, p. 1). In keeping with this design requirement for case studies, I examined K-12 IT leadership's cloud computing adoption within a specific, constrained context. An example of such a contextual constraint is a focus on urban areas, where cloud computing can be an alternative to traditional IT infrastructure for predominantly face-to-face instructional delivery oriented school districts (versus distance-delivery considerations for remote or rural schools). The delimitations in this section established, as much as possible, the homogeneous research context in which the overall environmental conditions were similar enough to enable the comparison of key differences in cloud computing adoption outcomes and the contributing causes (Gay et al., 2009; Palys, 2003; Stake, 2006). Within a homogeneous context, differences in adoption factors, both human and nonhuman, can become most apparent when they are linked to the district's adoption level of cloud computing. The following subsections discuss the key delimitations I used in narrowing the population and cases investigated in this study.

Internet access and minimum bandwidth considerations. A prerequisite for cloud computing is Internet access. Although this need is absolute, the Internet speed required for cloud computing use is a subjective grey area often linked to user patience. Some applications such as e-mail or text-driven discussion forums and Web pages will work, albeit slowly, with even a modest Internet connection. Streaming video, videoconferencing, satellite image maps, and other data-intensive activities, however, will be very slow, unusable, or unavailable with a slow Internet connection.

For the purpose of this study, I defined the minimum level of Internet access to support cloud computing in K-12 education as 5 Mbps download speed and 512 Kbps upload speed (Canadian Radio-television and Telecommunications Commission [CRTC], 2012b). For this reason, I included only geographic regions with this minimum level of Internet access in the study (CRTC, 2011; Shaw, 2012; Telus, 2013). This delimitation did not require that school districts (and their associated schools) have this minimum speed to be included in the study; rather, the regions in which the school districts are located required Internet service available at the minimum speed that I identified above because a school district's level of Internet service is a decision that that district makes within the context of the region's Internet service options.

An urban instead of rural/remote research context. This study is primarily of urban population centres, rather than rural areas, because of the considerable difference in the speed of Internet service between urban and rural areas. For instance, the household broadband Internet availability of a minimum of 5 Mbps download speed available in large population centres is in excess of 95%, whereas in rural areas the availability is less than 45% (CRTC, 2011, 2012a).

A key feature of cloud computing is the ability to access information anywhere through the Internet. Within the educational context, this includes access from both the school and the home. The pedagogical implication of this flexibility is that it allows the continuity of technology-enabled learning activities from school to home (Verma, Dubey, & Rizvi, 2012; Vouk, Sills, & Dreher, 2010). Although in this study I did not advocate for or against the adoption of cloud computing, in studying the factors that influence the adoption decision, it was important that I study cases that were as similar as possible; in this instance, regions where students have Internet access at both school and home. Schools might have an IT infrastructure with Internet service sufficient to support cloud computing activity for students and teachers on campus, but a comparable level of access is required in the home if technology-enabled teaching and learning are to continue beyond the physical school. The option for technology-enabled teaching and learning activities to transition seamlessly between school and home is a considerable benefit and a likely consideration in school district IT leadership's decision to adopt cloud computing. From this perspective, given the relatively low percentage of rural households with a minimum level of Internet speed compared to urban areas, where access exceeds 95%, the urban and rural research contexts represented a dichotomy: one setting in which students and teachers could access cloud computing resources from home and another setting where they could not. For this reason, to keep the research contexts as similar as possible, I studied primarily urban areas. This homogeneity of underlying conditions aided the analysis of the factors that determine the levels of cloud computing adoption among school districts.

An additional reason for this study's focus on urban centres is the avoidance of distance course delivery considerations to remote rural areas. The commute for students in rural areas is typically longer than that for students in urban areas; consequently, the cost and effort to attend a campus are often greater. This consideration is particularly relevant to low-resource students and students at risk of dropping out (Sander, 2008). Cloud computing within such a rural, remote context presents an opportunity to overcome the issue of transportation to the school campus (Behrend, Wiebe, London, & Johnson, 2011). This is complicated, however, by the varying degree of Internet availability in rural areas. Consequently, the considerations for cloud computing adoption by IT leadership in rural districts differ from those in urban districts. In this research I focused primarily on school districts in urban areas because the environments and challenges were likely to be more uniform.

An exclusively Western Canadian context. This research took place in the three western-most provinces of Canada, British Columbia, Alberta, and Saskatchewan, which share technological, cultural, and legal similarities that made them excellent candidates for the study. The purpose of this delimitation was again to create as homogeneous a context as possible for the investigation of IT leadership's adoption of cloud computing in K-12 districts.

These three provinces, from an Internet infrastructure perspective, share many similarities that made them suitable candidates for this study. The cost of Internet access varies greatly in Canada, but the costs were lowest in Western Canada (CRTC, 2012c). In these three provinces the Internet service providers were also consistent; namely, Shaw and Telus (Industry Canada, 2011a, 2011b). Again, these technical factors contributed to a more homogeneous research context in which the differentiating factors that affect IT leadership's decision to adopt cloud computing became more apparent.

The selection of the three Western Canadian provinces also added elements of uniformity to the study from cultural and legal perspectives. Differences exist among them, but they are much smaller than the differences among other regions within Canada (Bone, 2011; McGillivray, 2006). Examples of some of these less-similar Canadian regions are the northern Aboriginal, francophone, and maritime communities. Moreover, given the exclusively Canadian context, Canadian federal laws and standards apply to all cases. This again reduced the potential adoption differences because of legislation considerations, particularly compared to those in an international study.

The study of these three western provinces within Canada offers insight into how they address common international and legal issues. One issue that was particularly relevant to this research is whether the United States' 2001 Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act (USA Patriot Act) affects school districts' cloud computing adoption. A key feature of this act is that it allows the government of the United States to access the personal information of Canadians when it is held in the United States (McCarthy, 2002; Stoddart, 2005). The USA Patriot Act thereby creates privacy concerns for Canadian school districts, which differentiates them from school districts in the United Sates that do not have this additional consideration.

Large K-12 school districts with centralized IT leadership. Another design consideration in creating a more homogeneous research context for the study of IT leadership's adoption of cloud computing in K-12 school districts was the size of the school districts and their IT leadership structures. I restricted this study to larger school districts, which Maas (2010) defined as having 10,000 students or more. The rationale for this is that larger districts often enjoy economies of scope and scale that do not apply to smaller districts (Gray, Thomas, & Lewis, 2010). Conversely, these larger districts can face additional challenges that much smaller districts do not.

Large school districts often have centralized IT leadership, usually within or closely linked to the superintendent's office (Hanks, 2010; Major, 2013; Mendoza-Jenkins, 2009). In some cases, however, such as in independent school districts, IT leadership is decentralized, with many to nearly all IT decisions occurring at the local-school level (Holowka, 2008; Rymarz, 2013). Given the considerable differences between centralized IT leadership at the superintendent's level and decentralized IT leadership at the school level, I delimited this study to large school districts with centralized IT leadership. In this research I was open to the study of both large public and large independent school districts, provided that the IT leadership in their districts was centralized.

A focus on senior IT leadership. In addition to K-12 IT leadership at the district level within the superintendent's office, many school districts rely on lower-level IT support staff (Moses, Bakar, Mahmud, & Wong, 2012) who assist senior IT leadership in implementing and managing IT infrastructure (Resta, 2002). Similarly, at the school level the IT support staff help the users of IT to access, operate, and troubleshoot software, hardware, and network resources (Dexter, Anderson, & Ronnkvist, 2002). This lower-level IT support reports and is accountable to the IT leadership of a school district (Maas, 2010).

Though this lower-level IT support staff has valuable expertise that benefits both school-district IT leaders and school-level users of technology, I focused my study on the senior, district-level IT leadership within the superintendent's office for several reasons. First, the focus of IT support staff is largely technical because their role is to implement, maintain, and manage IT infrastructure within the school district. In contrast, senior IT leaders within a school district make decisions on the technology that IT support staff later implement. Senior IT leadership make the adoption decision on a technology such as cloud computing. Second, the role of senior

IT leadership within K-12 education is far more than a purely technical position. These senior leaders require an awareness of and skills in teambuilding, instruction, professional development, business, leadership, and politics (CoSN, 2012; Maas, 2010). Because in this study I examined both the human and nonhuman factors that influence an adoption decision, senior IT leadership was a more appropriate focus than lower-level IT support staff. Third, lower-level IT support staff report and are accountable to district-level senior IT leadership (Maas, 2010; Resta, 2002). This suggests that they should be aware of the dominant issues that lower-level IT support staff face. Fourth, cloud computing allows organizations to save money by outsourcing IT support staffing costs to cloud computing providers (Appendix Table B1). Although such an outsourcing decision might benefit a school district overall, it would most likely reduce the number of IT support staff jobs within the school district (e.g., the adoption of a cloud-based e-mail service such as Gmail would make district-level e-mail server management jobs obsolete). Consequently, concerning the adoption of cloud computing, school district IT support staff would have been in a conflict of interest that would potentially have interfered with this study.

Study Population, Case Selection, and Participant Sampling

Study Population

The existing literature defined a large school district as 10,000 students or more (Maas, 2010): "This cut-point was established to eliminate small school districts whose size is not likely to allow the economy of scale that would support or require a CIO or equivalent position" (p. 55). However, Maas conducted his research in the United States, where citizen populations and school district sizes differ from those in Canada. Maas's cut-point resulted in 906 eligible school districts; it was informed by a report released from the United States Department of Education (Gray et al., 2010). Maas eventually received 125 completed responses to his survey of the 906 eligible school districts, which resulted in a reasonable representation of the population within his sample.

Within the provinces of British Columbia, Alberta, and Saskatchewan is a small, finite number of large school districts with 10,000 students or more. In 2013 British Columbia had 19 school districts with student populations exceeding 10,000, Alberta had 9, and Saskatchewan had 3 (Appendix C). Applying Maas's (2010) cut-point of district enrolment exceeding 10,000 students would likely have resulted in too small a sample size to produce generalizable findings (Adams & Umbach, 2012). Given my aim in this research to study school districts large enough to have economies of scale for their IT infrastructure, I included districts of 5,000 students or more. The minimum 5,000-student enrolment cut-point fulfilled my need for a substantial population to sample while still allowing me to compare similar cases that shared economies of scale in their IT infrastructure (Maas, 2010; Stake, 2006). With the constraint of 5,000+ students within a school district, the number of eligible school districts in Western Canada for this study expanded to 33 in British Columbia, 30 in Alberta, and 13 in Saskatchewan. This design decision increased the population of districts eligible for study from 31 to 76. As Alberta Distance Learning Centre (Appendix C) is not a conventional school district, I omitted it from this study. Consequently, the number of eligible school districts comprising this study's population was 75 (N=75).

Sample Frame and Participant Sampling

The sample frame for this study was the entire population of the 75 eligible districts. As each district was a unique case within this case study, it was necessary for me to interview the leaders involved in the IT infrastructure decisions for each of the 75 cases. The invitation of participants to this study was guided by publicly available organizational charts and/or staff directories from the district websites. The selection of participants was informed by the literature review on IT leadership in K-12 districts (CoSN, 2012; Maas, 2010). *Referential/snowball sampling* (defined in Appendix A) was used to confirm the participants' suitability for the study through phone conversations with the staff of the superintendent's office (Frank, 2012). This was also used to identify other potential participants. I then contacted participants directly by both phone and e-mail to further confirm that they indeed held positions of leadership concerning IT infrastructure for their district, and that they were appropriate for this research based on the roles/descriptions found in the literature review.

This study's participants were predominantly the most senior IT leaders within a K-12 district (e.g., Director of Educational Technology, Superintendent of Technology, etc.). In larger districts, where IT roles were further specialized, possible participants also included those in the role of IT Infrastructure Manager (or equivalent). In rare instances, when the district's overall IT leader and/or lead IT infrastructure specialist were unavailable, a knowledgeable direct subordinate or peer was interviewed. This occurred in fewer than 10% of the study's cases. Such instances were so rare, and IT infrastructure leadership roles were so specialized, that I required a year-long data-collection period in order to interview suitably knowledgeable participants.

The participant recruitment process revealed that the IT infrastructure leadership role within a K-12 district was highly specialized. This echoed the literature review and confirmed that very few people within a district were knowledgeable of both IT infrastructure details and the decision-making process for the district (CoSN, 2012; Maas, 2010). While this study will later demonstrate that a district's IT infrastructure decision-making process is highly collaborative, the number of individuals who are knowledgeable in both the details of the district's IT infrastructure and the district's leadership processes is limited. This is supported by the fact that the number of participants from each district/case was typically one. At the end of the interviews I asked participants: "Is there anyone else in your organization who would be able to provide an alternate yet equally deep perspective on these questions?" In only four of the 75 cases (5%) were additional participants identified. This confirmed the earlier referential/snowball sampling information provided by the superintendent's office staff.

In total, I conducted 80 interviews for the 75 cases of this study. Table 8 presents the demographic details of the size and provincial distribution of the cases studied in this research. This table also presents the number of interviews that comprised each case category.

Participant Recruitment

I conducted participant recruitment over the course of a year, yielding a 100% participation rate from each of the 75 eligible districts. I do not believe that any single element of my participant recruitment approach was solely responsible for this high participation rate. Rather, I believe that it was the combination of all of the approaches and factors described in the following paragraphs that produced this result.

I began participant recruitment by sending professionally printed participant-invitation packages to the superintendent's office of each district to provide information about the study to the district's most senior leadership; this allowed IT leaders to participate in the study, knowing that their district's senior leadership was informed of the study. Furthermore, the invitation package facilitated referential/snowball sampling, in which a superintendent passed on the participant-invitation package to the individual(s) responsible for IT (Frank, 2012). My past experiences informed this approach to participant recruitment, which yielded above-average participation rates (Holowka, 2008). Similarly, the recent work of Patricia Hull (2012) with

Table 8

Case Sizes: Categories and Distribution by Province

	Description of case categories	Variable name	Population of eligible cases (N=)	Sampled cases (n=)	Participation level	Number of participant interviews
Entire study	All cases in the study	ALL	75	75	100%	80
Size categories	Extra-large cases (25 K+)	XL	8	8	100%	9
	Large cases (15-24.9 K)	L	14	14	100%	14
	Medium cases (10-14.9 K)	M	9	9	100%	9
	Small cases (5-9.9 K)	S	44	44	100%	48
Province categories	All cases in British Columbia	BC	33	33	100%	35
	All cases in Alberta	AB	29	29	100%	32
	All cases in Saskatchewan	SK	13	13	100%	13
Province and size categories	British Columbia extra-large cases (25 K+)	BC-XL	4	4	100%	5
	British Columbia large cases (15-24.9 K)	BC-L	9	9	100%	9
	British Columbia medium cases (10-14.9 K)	BC-M	6	6	100%	6
	British Columbia small cases (5-9.9 K)	BC-S	14	14	100%	15
	Alberta extra-large cases (25 K+)	AB-XL	4	4	100%	4
	Alberta large cases (15-24.9 K)	AB-L	2	2	100%	2
	Alberta medium cases (10-14.9 K)	AB-M	3	3	100%	3
	Alberta small cases (5-9.9 K)	AB-S	20	20	100%	23
	Saskatchewan extra-large cases (25 K+)		0	0	N/A	0
	Saskatchewan large cases (15-24.9 K)	SK-L	3	3	100%	3
	Saskatchewan medium cases (10-14.9 K)		0	0	N/A	0
	Saskatchewan small cases (5-9.9 K)	SK-S	10	10	100%	10

nursing deans supports the recruitment strategies that I used with busy senior organizational leadership participants:

> The high rate of participation may also have reflected the researcher's strategy of using Canada Post to send initial invitation letters and follow-up documentation to potential participants. A number of the nursing deans in this study perceived this strategy as a sign of respect that in turn, influenced their decision to participate in the research. They also indicated that an initial e-mail invitation would likely have been summarily dismissed. . . .
>
> I want to thank you for the way in which you notified me by a letter of introduction followed by another letter with more information. In this age of e-mail, I found that a series of letters was a very respectful approach and captured my attention for more than a nanosecond. (pp. 86-87)

Following the distribution of printed participant-invitation packages to each district and a waiting period of over a month, I proceeded with personalized telephone invitations to the senior IT leader(s) of each district. The use of referential sampling and other publically available documents from district websites (e.g., organizational charts, press releases, meeting minutes, employee directories, etc.) added an early element of triangulation. These multiple sources used during the participant recruitment stage of this research supported this study's goal of examining the IT leadership structures of K-12 school districts.

A key factor that added to the successful recruitment of participants for this study was the year-long data-collection period. Many participants were unavailable during the first several attempts to reach them. In other instances, key district IT leadership positions were vacant and being filled. The long data-collection period made it possible to follow up with potential participants many months after the initial contact, and to wait for district hiring processes to complete.

Another key factor that made possible the 100% participation rate in this study was the compelling, relevant, and timely nature of the research. The topics of cloud computing adoption and the role of IT in education were relevant to the research participants as they continued to refine IT infrastructure in K-12 in their roles as district IT leaders. Very little research on IT infrastructure in Western Canadian K-12 districts has been conducted at such a detailed level, and access to the resulting report from my research deepened the participants' understanding of the practices of the districts around them. Similarly, superintendents and those perhaps less focused on IT were interested in the reporting structures of districts with regard to IT leadership. Last, near the end of the data-collection period, the few remaining districts that had not yet participated were willing to do so once they heard of the study's size, scope, and level of participation. Simply put, these remaining districts did not want to be left out of a study that included all of the other districts around them.

Data Collection

Legitimation, Truthfulness, and Validity

Guiding this research were the concepts of truthfulness and validity. Within a complex, contemporary research context over which I had little or no control as the researcher—the characteristics of this study that made it ideal for the multiple case-study approach—I had to take certain measures to ensure an accurate, truthful representation of my study topic. These measures included construct validity, internal validity, external validity, and reliability (Kidder & Judd, 1986; Yin, 2009). The role of these measures, as Wolcott (1994) pragmatically described them, is less about "the science of getting it right" and more about "trying not to get it wrong"

(p. 347). Within mixed-methods research/mixed research, these concepts of a truthful representation of data have also been termed legitimation and inference quality (Clark & Creswell, 2008; Teddlie & Tashakkori, 2003; Onwuegbuzie & Johnson, 2006). Table 9 presents four measures of truthfulness/validity and shows how they manifested in this research.

Multiple Data Sources and Triangulation

The three conditions that Yin (2009) identified as optimal for a case-study approach are a complex, explanatory question; contemporary events; and little or no control over what the researcher is studying. These three challenging conditions were present in this study in that I sought a better understanding of the factors that influence district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for district schools. The data-collection procedures in this study were therefore of paramount importance to ensure validity and truthfulness and facilitate rich, insightful analysis of the data. The following subsections illustrate how my data-collection procedures achieved these aims.

A key feature of case-study research is that it calls for multiple sources of data to develop a more comprehensive and trusted depiction of individual cases (Creswell, 2007; Merriam, 2009; Stake, 2006). The unit of analysis in this holistic multiple case study was Western Canadian K-12 school districts with central IT leadership. The phenomenon of study was the adoption of cloud computing, particularly the processes and influences that affect the decision making of central IT leadership for a district's schools. Though Frambach and Schillewaert's (2002) framework identifies multiple factors that contribute to the adoption (or nonadoption) decision, the decisions of the IT infrastructure design rest with the IT leadership of a school district's superintendent's office. The IT leadership should have knowledge of the organizational decision-making processes, the participants, and the influences, as well as a technical

Table 9

Validity and Reliability Considerations Within This Research (Definitions From Kidder & Judd, 1986, pp. 26-29)

Concept	Definition	Presence within this study
Construct validity	The identification of correct operational measures for the concepts being studied	What factors influence district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for school districts? I conducted an extensive literature review to find suitable conceptual frameworks to address the concepts identified within the research question (i.e., factors that influence organizational innovation adoption and organizational decision making). I also conducted an extensive literature review on cloud computing that informed the design of this research and aided in the analysis of multiple sources of data found in the cases.
Internal validity	The establishment of a causal relationship, whereby certain conditions are believed to lead to other conditions, as distinguished from spurious relationships	Frambach and Schillewaert's (2002) framework, based on a substantial body of prior literature, depicts a pattern of influences and causal relationships related to organizational innovation adoption. This general framework served as a guide for this investigation specific to cloud computing adoption within large, Western Canadian K-12 school districts. I also used triangulation (the use of Daft's, 2013, contingency decision-making framework) and multiple sources of data to ensure internal validity.
External validity	The domain to which a study's findings can be generalized	My aim in this study was to make analytic rather than statistical generalizations. I examined multiple cases to better understand how organizational adoption elements interact in the context of cloud computing adoption in K-12 school districts. I sought a better understanding of the interplay of the factors that contribute to adoption or nonadoption decisions to be able to apply my understanding from the cases beyond just those that I studied (an aim of analytic generalization to achieve external validity). The emphasis of this study was on the understanding of relationships among adoption-decision elements rather than the mere description of the case characteristics.
Reliability	Assurance that the study can be repeated and achieve the same results	This study closely followed established conventions for case-study research based on the academic literature. I recorded and analyzed the data using a case-study database and a matrix to compare the cases and guide the collection of the data to ensure that I investigated the cases similarly. Furthermore, I triangulated the data by using multiple sources and interpreted them by using conceptual frameworks from peer-reviewed academic literature.

understanding of the IT infrastructure (CoSN, 2012; Maas, 2010). For these reasons the primary source of data was semistructured interviews with representatives of each school district's IT leadership (e.g., the school district's CIO).

Documentary and archival analysis yielded additional information for each case and resulted in data triangulation (Patton, 2002). "With data triangulation, the potential problems of construct validity also can be addressed because the multiple sources of evidence essentially provide multiple measures of the same phenomenon" (Yin, 2009, pp. 116-117). I conducted documentary and archival analyses by using a variety of sources that ranged from documents from the case participants on IT infrastructure details/plans to government policy documents. These were all public documents, either already available from the district's website or documents that a participant shared with me that were to be imminently published/updated by the district. These additional sources of data, which I will describe in the coming paragraphs, both complemented the interview information and supplemented information on each case in instances in which the interviewees might not have had knowledge of certain case conditions (e.g., the details of a province's privacy legislation, etc.).

The use of documentary and archival analysis to complement the use of semistructured interviews with the school district IT leadership was particularly beneficial to this study (and the aims of data triangulation for apparent construct validity). Other sources of evidence were much less suitable. For instance, the data-collection approaches of examining physical artifacts or using a think-aloud technique, direct observations, and participant observations were either poorly suited or highly problematic within the time and resource constraints of a doctoral study (e.g., Hawthorne effect, access to secure international cloud computing facilities, etc.; Burke, 2011; Daft, 2013; Palys, 2003; Rugg & Petre; 2007).

To verify the participants' descriptions of their IT infrastructure, I used multiple data sources. I consulted online district documents that included district newsletters, current and archived, that described technology initiatives. I confirmed e mail, Learning Management System (LMS), and library infrastructure, whenever possible, through district or school website portals, which identified the software used. These websites often contained training materials on these technologies for staff. I also used meeting minutes and district financial statements to confirm districts' software use. Last, I used Domain Name System (DNS) records and IP information to confirm the locations of the district servers. The DNS, IP, and location information indicated whether a district hosted its servers in its own data centre, or whether it outsourced its infrastructure to a data centre located elsewhere (e.g., at the software vendor's data centre).

The multiple sources of data that I gathered complemented and supplemented the semistructured interviews. I compared the transcripts and the field notes that I took during the interview process with publicly available documents and information that I gathered during the PEST analysis (Appendix B). These included information on Internet services available in the region, educational policies, government privacy legislation, etc. To verify the participants' descriptions of the leadership structures in their districts, I viewed district websites that included organizational charts, district staff directories, and district newsletters. In some instances the participants e mailed supporting or updated documents to me. These multiples sources allowed me to verify the data I gathered and to produce a detailed understanding of each case/district.

I also used software-vendor websites to triangulate the participants' descriptions of their IT infrastructure and seek information on the software version and the infrastructure available for that software. For example, some vendors offered software that they hosted directly, whereas others offered only software that is installed on customers' servers. This was particularly valuable in differentiating between public cloud and non-public cloud infrastructure. Moreover, participants used multiple names for the same software. This made the triangulation of their responses against the software vendor's information critical. Appendix G contains a complete list of the software that participants identified, including abbreviated and common names.

Multiple Levels of Questions to Guide the Evidence Collection and Analysis

Truthful representation of the cases that I studied was critical to this research. A design approach that I used to achieve this aim was multiple data sources to facilitate the data triangulation and ensure both construct and internal validity. A second design approach involved the questions that I asked and my awareness of potential biases. The use of multiple levels of questions and my attempt to mitigate biases are the topics of this subsection.

Recalling the four criticisms of diffusion research (Rogers, 2003) that I presented in the last chapter, I consciously reduced the pro-innovation bias in the questions that I posed to this study's participants. Though I sought a better understanding of the factors that influence cloud computing adoption (a recent, novel innovation), I did not advocate the use of cloud computing over traditional IT infrastructure. From my extensive review of the literature, I recognized that the design decisions of IT infrastructure within organizations are the result of a complex, multifaceted evaluation of numerous factors (e.g., cost, privacy/security, actions of competitors, etc.). An organization such as a school district must evaluate its environment and priorities and determine whether cloud computing or traditional IT infrastructure is best suited to its needs. I have no bias towards or against the adoption of cloud computing.

A design challenge was ensuring that I engaged the participants in interviews on a novel and potentially superior technology without implying a bias of pro-innovation. For this reason I applied the interview technique of downward laddering to the semistructured interview script in Appendix D to avoid prejudicing the participants (Creswell, 2009; Rugg & Petre, 2007). Moreover, I described this study to the participants as a study of current large K-12 school district IT infrastructure—a truthful depiction that deemphasized cloud computing.

A concern associated with a pro-innovation bias (Rogers, 2003) is that it can motivate the study participants to misrepresent or over represent information in accordance with their perceptions of what the interviewer would like to hear (Davies & Baker, 1987; Hood, 2010). For this reason I designed the research questions to present both cloud computing and traditional IT infrastructure comparably. I was similarly concerned about questions on school districts' decision-making processes, because the participants might not have wanted to present themselves or their organizations unfavourably. To mitigate the bias of interviewees towards a favourable representation over accuracy, Yin (2009) recommended the use of multiple levels of questions (Table 10) to delineate the scope of the questions within the full context of the research. For instance, the level 1 question differs from the level 2 question, which I asked with regard to each interviewee's case.

Data Organization within a Case-Study Database

The use of a database in case-study research serves multiple purposes. A database adds both transparency and reliability to a study by allowing the examination of original data and the replication of the analysis/conclusions (Yin, 2009). A research database also aids researchers in managing a vast amount of data (Creswell, 2009; Gay et al., 2009; Merriam, 2009; Yin, 2009). For both of these aims, I employed a custom research database that I created to organize the case data.

Table 10

Five Levels of Questions Guiding Data Collection and Analysis (Yin, 2009, p. 87)

Question type	Presence within this study
Level 1: Questions asked of specific interviewees	Refer to the semistructured interview script in Appendix D for specific questions for the interviewees in each case.
Level 2: Questions asked of individual cases	I asked the level 1 questions of the interviewees; the level 2 questions address the purpose of these questions. For example, in Appendix D, questions 1-3 ask the participants to identify who is responsible for IT infrastructure decisions and how such decisions are made within a school district. The level 2 question that drives these level 1 questions was, "Which of the four quadrants of the contingency decision-making framework best describe the decision-making processes and structures of the interviewee's school district?" The rationale for the distinction between the level 1 and level 2 questions was that the participants might have felt uncomfortable describing their organization's decision-making approach as consistent with terms such as the *anarchy model* or *political model* of decision making. Consequently, the level 1 questions asked the participants to identify the characteristics of their decision-making process, which I then analyzed and assigned the most appropriate decision-making model to the case.
Level 3: Questions asked of the pattern of findings across multiple cases	An example of a level 3 question, which required a cross-analysis of the data from multiple cases, is, "Does the level of adoption of cloud computing vary with the size/student population of school districts (e.g., are 10,000+ student population school districts, compared to schools within the 5,000-7,500 stratification, greater or lesser adopters of cloud computing?)?"
Level 4: Questions asked of the entire study	Level 4 questions applied to the entire study and were subquestions of the study's central question: "What factors influence district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for district schools?" Examples of level 4 questions are: 1. "What are the IT leadership structures, influences, and processes in K-12 districts?" 2. "What is the current state of cloud computing adoption in K-12 districts in Western Canada?" 3. "What is the interplay of factors that influence infrastructure decisions by district-level IT leadership in K-12?" I grouped the questions in the semistructured interview script (Appendix D) in relation to these three guiding questions.
Level 5: Normative questions about policy recommendations and conclusions that go beyond the narrow scope of the study	A level 5 question, which will guide future policy and influenced the recommendations, might be, "What intervention (or group of most impactful interventions) need to be applied to increase the adoption of cloud computing within K-12 school districts?"

I organized the research data to facilitate the separation of original participant data from my comments and analysis. A major consideration in organizing the study's data was to ensure that they were available in an open format for the benefit of future researchers who might wish to examine the data. I organized all of the interview recordings and transcripts, including supporting documents from the participants, by province, district, and participant. The inclusion of the audio recording with the transcript made it possible to review the nuances of natural language and tone during the analysis (Gibbs, Friese, & Mangabeira, 2002; Stacey & Vincent, 2011). I then added field notes and other supporting documents added to the document collection for each case and used separate folders to organize my cross-case analysis and tabulations. These included the Microsoft Excel and IBM SPSS Statistics 23.0 files that I used for the statistical analysis. This organization facilitated the examination and annotation of a considerable volume of data and simultaneously preserved the original data for potential future scrutiny.

Mixed-Methods Triangulation Design: Data-Transformation Model

In this study I employed the data-transformation model mixed-methods triangulation design (Figure 6). The data-transformation model is similar to the sequential-exploratory model in that quantitative analysis follows an initial qualitative analysis. The transformation model differs from the sequential-exploratory model in that the transformation model involves the transformation of qualitative data into quantitative data for analysis. This negates the need for a second phase of data collection, which is a key characteristic of sequential models. This mixed-methods approach was well suited to the predominantly qualitative nature of the data:

> Priority is given to the qualitative aspect of the study. The findings of these two phases are then integrated during the interpretation phase. At the most basic level, the purpose

> of this design is to use quantitative data and results to assist in the interpretation of qualitative findings. . . . Morse (1991) indicated that one purpose for selecting this design would be to determine the distribution of a phenomenon within a chosen population. It is useful to a researcher who wants to explore a phenomenon but also wants to expand on qualitative findings. In addition, this design could make a largely qualitative study more palatable to a quantitatively oriented adviser, committee, or research community that may be unfamiliar with the naturalistic tradition. (Creswell, Plano-Clark, Gutmann, & Hanson, 2003, pp. 227-228)

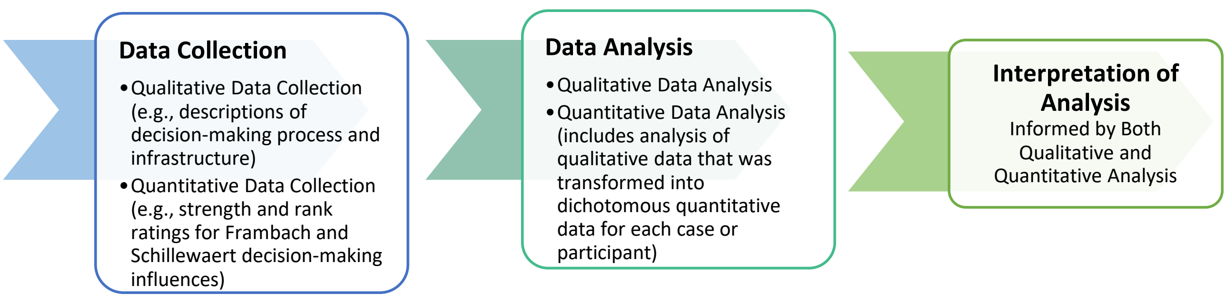


Figure 6. Mixed-methods triangulation design: Data-transformation model.

Figure 7 presents a timeline of activities related to this research, according to the data-transformation model mixed-methods triangulation design.

Research Design and Pre-Data Collection	*October 2013*	Approval of research proposal at candidacy examination
	March 2014	Ethics approval obtained from University of Calgary's Conjoint Faculties Research Ethics Board
	March 2014	Preparation of printed research invitations and piloting of recruitment approach
	April 2014	Distribution of printed research invitations
Data Collection	*May 2014*	Semi-structured interviews and recruitment efforts begin (5 interviews)
	June 2014	Semi-structured interviews and recruitment efforts continue (16 interviews)
	July 2014	Semi-structured interviews and recruitment efforts continue (13 interviews)
	August 2014	Semi-structured interviews and recruitment efforts continue (12 interviews)
	September 2014	Semi-structured interviews and recruitment efforts continue (4 interviews)
	October 2014	Semi-structured interviews and recruitment efforts continue (2 interviews)
	November 2014	Recruitment efforts continue (0 interviews)
	December 2014	Recruitment efforts continue (0 interviews)
	January 2015	Semi-structured interviews and recruitment efforts continue (10 interviews)
	February 2015	Semi-structured interviews and recruitment efforts continue (5 interviews)
	March 2015	Semi-structured interviews and recruitment efforts continue (11 interviews)
	April 2015	Semi-structured interviews and recruitment efforts conclude (2 interviews)
Data Analysis (Qualitative)	*April 2015 to December 2015*	Qualitative analysis. Triangulation of data using interview transcripts, recordings, field notes, and document analysis. Coding of data and preparation of descriptive statistics. Creating draft representation of data in figure and table form to assist with data analysis.
Interpretation of Analysis	*January 2016 to April 2016*	Drafting findings chapter and creating concise visual representations of data.
Data Analysis (Quantitative)	*May 2016 to December 2016*	Quantitative analysis. Statistical analysis of findings. Correlation analysis through Person's Chi-square test and Fisher's Exact test of all variable combinations.
Interpretation of Analysis	*January 2017 to June 2017*	Drafting of analysis of findings chapter and creating concise visual representations of data
Dissertation Preparation	*July 2017 to October 2017*	Refining analysis and analysis of findings chapters
	November 2017	Writing of conclusion chapter
	December 2017 to February 2018	Refining of dissertation

Figure 7. Research activities corresponding to the data-transformation model mixed-methods triangulation design.

Data Analysis and Interpretation

This study's underlying theoretical frameworks/prepositions, as well as the central question (including its subdomains; Yin, 2009), guided the analysis and interpretation of the data that I collected from multiple case studies. In this section I discuss how my data analysis and interpretation foster a better understanding of this study's central question.

A Deeper Understanding of K-12 District IT Leadership

Appendix D contains the semistructured interview script that I used to collect data that describe the IT leadership of K-12 districts. The first three questions of the semistructured interview script (Part A) address the decision-making process of the IT infrastructure of school districts. These questions elicited who was involved in these decisions and how they made their decisions. I analyzed the natural language responses to these interview questions by using gist/thematic analysis (Rugg & Petre, 2007), which is "a method for identifying, analyzing and reporting patterns within data" (Braun & Clarke, 2006, p. 79). I used theoretical rather than inductive thematic analysis for the following reasons:

> An inductive approach means the themes identified are strongly linked to the data themselves. . . . In contrast, a "theoretical" thematic analysis would tend to be driven by the researcher's theoretical or analytic interest in the area, and is thus more explicitly analyst-driven. This form of thematic analysis tends to provide less a rich description of the data overall, and more a detailed analysis of some aspect of the data. The choice between inductive and theoretical maps onto how and why you are coding the data as well. You can either code for a quite specific research question (which maps onto the more theoretical approach) or the specific research question can evolve through the

> coding process (which maps onto the inductive approach). (Braun & Clarke, 2006, pp. 83-84)

The use of theoretical thematic analysis thereby aligns the data-analysis procedures with my underlying philosophical orientation towards pragmatism: an emphasis on the underlying research question and its underlying theoretical frameworks.

The theoretical thematic analysis of the data facilitated the placement of cases within Daft's (2013) contingency decision-making framework. For instance, an interviewee who described IT leadership's decision making as oriented primarily towards keeping most stakeholders happy (over optimal efficiency/performance) fits the political model of decision making within the contingency decision-making framework. This deeper understanding of K-12 district IT leadership informed the broader analysis of the factors that influence cloud computing adoption in K-12 (Appendix D, Part C).

A Snapshot of Current Cloud Computing Adoption

A key piece of information in this study of cloud computing adoption within Western Canadian K-12 districts is the level of their cloud computing adoption. Questions 4 to 6 in the semistructured interview script (Appendix D, Part B) elicited the data necessary to determine this level. I again used theoretical thematic analysis to place the participants' natural language responses within categories that I developed from the existing literature (Frambach & Schillewaert, 2002; Lin, 2011; Rogers, 2003). These categories were consistent with research design conventions: they aligned closely with the theoretical framework and were exhaustive in nature, mutually exclusive, and conceptually congruent (Merriam, 2009).

Questions 4 to 6 of the semistructured interview script serve several purposes: (a) to depict the IT infrastructure of each case within the study (both traditional infrastructure and cloud computing use), (b) to facilitate the analysis of cloud computing adoption within each case (to inform Part C of Appendix D), and (c) to create a collective snapshot of current cloud computing adoption and diffusion within large Western Canadian K-12 school districts. To achieve this third purpose, I used descriptive statistics to present the collective adoption data from the multiple cases that participated in this study. These descriptive statistics are presented in the following findings chapter and include the frequency of occurrence of infrastructure platforms within an infrastructure domain, such as library systems. These descriptive statistics also include the frequency of occurrence software types within an infrastructure domain, the mean rank and strength of influence rating of organizational adoption influences, etc.

A Better Understanding of the Interplay of IT Infrastructure Decision Factors

From the responses to the semistructured interview questions of Part C in Appendix D, I gained insight into the interplay among the human and nonhuman factors that influence the IT infrastructure decisions of large Western Canadian K-12 districts. These questions, based on Frambach and Schillewaert's (2002) framework, asked the study participants to both rank and rate the influence of human and nonhuman factors on their IT infrastructure decisions.

Questions 7 and 8 in Appendix D asked the interviewees to rank the three factors of Frambach and Schillewaert's (2002) framework that influenced their adoption and nonadoption of cloud computing (environmental influences, adopter characteristics, and perceived innovation characteristics). The purpose of these questions was to determine the relative influence of each factor on the adoption or nonadoption decisions, respectively. Descriptive statistics summarized the information from both individual provinces and the study as a whole.

For questions 9 and 10 I used a Likert rating scale to explore the interviewees' perceptions of the influence of factors on, first, each organization's perception of cloud computing/infrastructure technology and, second, the overall adoption decision-making process. Questions 9 and 10 were necessary because, even though questions 7 and 8 identified the relative influence of the adoption factors in relation to each other, these questions did not identify the overall strength of the factors. For instance, environmental influences and adopter characteristics might both have had very little influence on the adoption decision, even though the participants might have ranked environmental influences first, ahead of adopter characteristics. Descriptive statistics again summarized the information from both individual provinces and the study as a whole.

The final question of Part C in Appendix D's semistructured interview script, question 11, asked the participants to rank the impact of the theoretical elements of Frambach and Schillewaert's (2002) framework on the cloud computing adoption decision. As with questions 7 and 8, the purpose of question 11 was to obtain the participants' descriptions of the relative strength of Frambach and Schillewaert's adoption factors within the cloud computing adoption context of large Western Canadian K-12 districts. Descriptive statistics summarized the information from both individual provinces and the study as a whole. The more detailed rating and ranking information from the preceding questions further informed the ranking of these factors.

I present an illustrative example of the importance of both the ranking and rating questions. For instance, the participants might have ranked the element of environmental influences (e.g., a provincial government's privacy legislation) as the most impactful element in the adoption of cloud computing. They might also have described it on the Likert rating scale as having a very high impact on cloud computing adoption. The second most impactful element, and all of the following elements, might have had a very low impact on the cloud computing adoption decision. For this reason, the rating and the ranking questions of Part C played important roles in clarifying the interplay of the factors that influence infrastructure design decisions within K-12 districts.

The optional interview questions that I asked at the end of my conversation with participants (only if time permitted) facilitated additional triangulation/verification of a case's dataset and my interpretation. I entered these additional data into the research database and thematically analyzed them. I used the external data sources described earlier, in concert with the PEST analysis (Appendix B), to verify and enrich the information that I collected from the body of other semistructured interviews.

Correlation Analysis

Correlation analysis permitted me to answer the central research question by statistically analyzing the relationships among the study's many findings. These findings included leadership structures, decision-making processes, IT infrastructure, and the priorities that shape IT infrastructure. By finding the statistically significant relationships among these factors I was able to answer the third research question "What is the interplay of human and nonhuman factors that influence infrastructure decisions by district-level IT leadership in K-12?" Figure 8 is a matrix of the findings that I analyze in this chapter. Table 11 provides additional detail on the variables in each row and column heading of Figure 8. This figure presents the conceptual guide I used to investigate the interplay of the human and nonhuman factors that influence IT infrastructure decisions in K-12 in Western Canada.

Correlation analysis was essential in answering the third research question given the large volume of variable combinations in this study. Table 11 is a category summary of the 223 unique variables that I examined. From a matrix of 223 by 223 variables, 49,729 possible

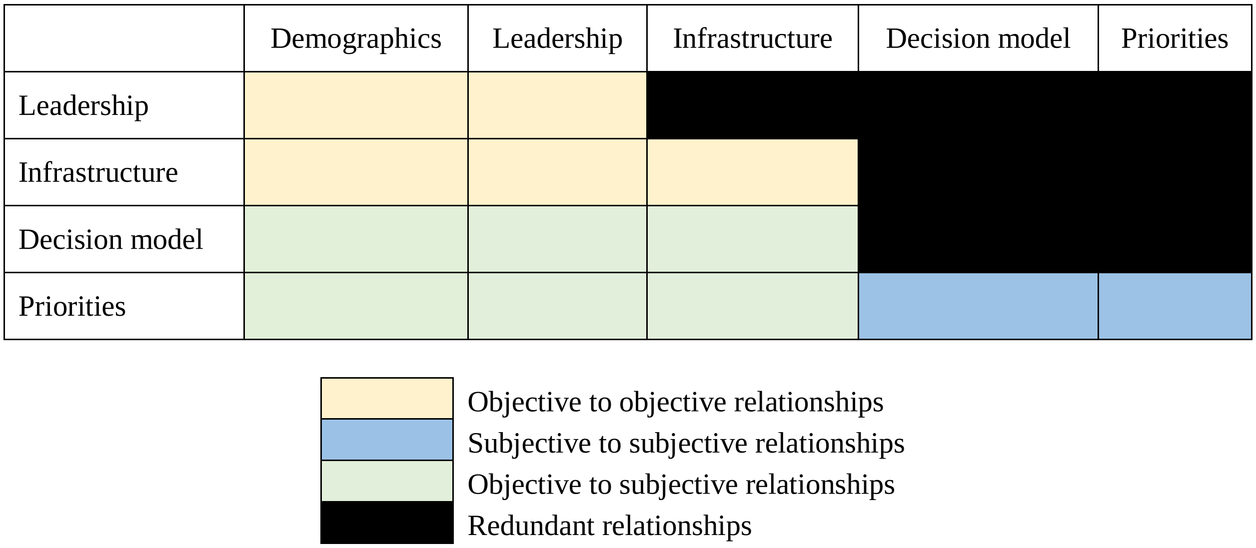


Figure 8. Matrix of statistical-relationship analysis.

Table 11

Subvariables in the Matrix of Statistical Analysis

Objective findings			Subjective findings	
Demographics	Leadership	Infrastructure	Decision model	Priorities
British Columbia	Level	SIS Platform	Rational	Supplier Strength
Alberta	Branch	SIS Software	Process	Supplier Rank
Saskatchewan	Level and Branch Combination	LMS Platform	Political	Social Network Strength
Small Cases		LMS Software	Anarchy	Social Network Rank
Medium Cases		Library Platform		Environmental Strength
Large Cases		Library Software		Environmental Rank
Extra Large Cases		Authentication Platform		Technology Strength
		Authentication Software		Technology Rank
		E-mail Platform		Adopter Strength
		E-mail Software		Adopter Rank
		Financial Platform		
		Financial Software		
		Website Platform		
		Social Media Use		

relationship combinations exist. However, in addition to the total study, I calculated this relationship matrix for each of the three provinces, four size categories, and 10 province-size combination categories (18 size groupings in total). This resulted in 895,122 possible relationship combinations, underscoring the need for the use of a powerful statistical software package, namely the 64-bit version of IBM SPSS Statistics 23.0.

Statistical Analysis Techniques Used to Identify and Describe Correlations

The first step in analysis was to establish the *p*-value to determine the threshold for statistical significance. I used a significance level of 5% ($\alpha = 0.05$), which is the conventional significance level that educational research uses (Gay, Mills, & Airasian, 2009). No special circumstances applicable to this research required a deviation from this norm. I entered this 5% significance level for all the statistical calculations I conducted for this study within IBM SPSS Statistics 23.0. Findings that fell below this 5% significance level threshold I rejected as being not statistically significant.

The second step in analysis was to identify the statistically significant relationships among the study's many findings detailed in chapter 4. I calculated Pearson's Chi-square and Fisher's Exact test for all variable combinations. I used these tests concurrently for exploratory purposes during the preliminary data analysis to mitigate the inherent limitations of each statistical test. For example, Pearson's Chi-square test has an expected value requirement of 5, and this was a concern in this study for calculations that involved the smaller province-size groupings. Similarly, Fisher's Exact test, recommended for smaller samples because it does not have an expected value requirement, has a propensity to be overly conservative and cause Type II errors (Freeman & Campbell, 2007; Lydersen, Fagerland, & Laake, 2009). The use of both tests concurrently made possible an additional degree of verification of the findings. With very few exceptions, Person's Chi-square test and Fisher's Exact test identified the same relationships. Supporting the statistics literature, the more conservative Fisher's Exact test failed to identify new relationships that Pearson's Chi-square test had not already described.

The third step in conducting the analysis was to calculate the phi coefficient of each statistically significant relationship that I found. The phi coefficient describes the strength of each relationship on a scale between -1.0 and 1.0 (Davis, 1971). A 1.0 relationship means that when one factor occurs, the other factor always occurs; a -1.0 relationship means that when one factor occurs, the other factor never occurs. Table 12 presents a more detailed description of the phi coefficient scale and the corresponding relationship descriptions.

Organization of Statistically Significant Relationships

Objective versus subjective findings. As Figure 8 shows, the relationships among the factors in this study are objective to objective, subjective to subjective, and objective to subjective. The objective findings describe truths that I verified and triangulated for each of the 75 cases from multiple sources. I described the methods that I used for verification in the section on data triangulation in chapter 3. When I conducted more than one interview in a case, the separate interviews confirmed the objective findings. In contrast, in the subjective findings, each of the 80 interviews that I conducted produced an equally valid perspective that could not be combined or reduced. Consequently, for the objective-to-objective relationship analysis I used a dataset of 75 (75 records for 75 districts/cases). For the subjective-to-subjective and subjective-to-objective relationship analyses, I used a dataset of 80 (80 interviews from the 75 districts/cases). Because of this dichotomy, I discuss the objective relationships first and the subjective relationships afterwards in chapter 5.

Exclusive and nonexclusive relationships. Figure 8 and Table 11 present the variables that I examined for statistically significant relationships. With the exception of the decisionmodel-to-decision-model relationships, identified in Figure 8 as a redundant relationship, the variables that I examined were nonexclusive of each other. For example, unlike the decision-model findings in which each respondent could make only one exclusive choice, a school district could use both public cloud and a form of private cloud simultaneously to provide e-mail services (e.g., Microsoft Exchange for staff e-mail and Microsoft Office 365 for student e-mail).

Table 12

Phi Coefficient Values and Corresponding Relationships (Davis, 1971)

Values	Appropriate phrases
+.70 or higher	Very strong positive relationship
+.50 to +.69	Substantial positive relationship
+.30 to +.49	Moderate positive relationship
+.10 to +.29	Low positive relationship
+.01 to +.09	Negligible positive relationship
0	No relationship
-.01 to -.09	Negligible negative relationship
-.10 to -.29	Low negative relationship
-.30 to -.49	Moderate negative relationship
-.50 to -.69	Substantial negative relationship
-.70 or lower	Very strong negative relationship

For this reason, I examined the leadership-to-leadership, infrastructure-to-infrastructure, and priorities-to-priorities relationships.

Limitations

I intended this study to be more than descriptive research. Not only did it create a snapshot of cloud computing adoption and senior IT leadership in the K-12 districts studied, but it also helped me to gain insight into the relationships among the human and nonhuman factors that contribute to the adoption decision. To achieve this explanatory aim, I designed this research to examine cases that share as much as possible in common and allow me to highlight the differences in both IT leadership and cloud computing adoption within large K-12 districts in Western Canada. This research design, however, as with any research design, has certain inherent limitations. The topic of organizational innovation adoption and leadership is complex and involves multiple factors, many over which I had little or no control. Although I aimed to explore the research's central question as fully as possible within the time and resource constraints of a doctoral study, this investigation had certain limitations that are the topic of the following paragraphs.

The primary instrument for this research was semistructured interviews with the IT leadership of K-12 districts. A limitation was the subjective nature of this approach because I sought interviewees' perceptions and recollections instead of exclusively objective, empirical data (Gay et al., 2009; Palys, 2003). Whenever possible, I confirmed and cross-referenced their responses with other available data (e.g., other participants' responses, supplemental documentation, etc.). Frambach and Schillewaert's (2002) framework is comprehensive and includes a multitude of factors, which facilitates some degree of triangulation of interview data. Unfortunately, within the constraints of doctoral research, it was impossible to verify all of the participants' responses in the interviews. However, the limitation of the subjective nature of interviews is a qualitative research challenge not unique to this study. As other authors have argued, the benefits of interviews often exceed the potential challenges, especially in the social sciences (Christians, 2005; Denzin & Lincoln, 2005). This is particularly applicable to this study because the adopter characteristics within Frambach and Schillewaert's (2002) framework, applied to a district's students and teachers from the perspective of central IT leadership, are arguably more subjective/perceptive than objective.

The delimitations that I discussed in the previous section balanced the goals of specificity and universality. On one hand, the delimitations facilitated the analysis of IT leadership and cloud computing adoption in K-12 districts because of their comparable backgrounds and brought to light the differences that resulted in varying degrees of cloud computing adoption. On the other hand, the delimitations constrained the analysis of the factors in large K-12 school districts in Western Canada that have central IT leadership and broadband Internet. Although in this research I gained insight into K-12 district IT leadership and cloud computing adoption for the benefit of academics and practitioners everywhere, a limitation of the research is that as the similarities to the districts in this study diminish, so too does the applicability of the findings.

Ethical Considerations

The ethical conduct of all involved in this research was of paramount importance. Consequently, I took all reasonable steps to ensure that every aspect of this research both followed the general principles of ethical conduct expected of researchers and adhered to the specific guidelines of the Conjoint Faculties Research Ethics Board (CFREB) of the University of Calgary (2013b). Rugg and Petre (2007) eloquently identified the general principles of ethical conduct expected of researchers:

> As a researcher you have a duty of care in various directions. You have a duty of care to your subjects; you are legally obligated to treat them with due care and respect. You also have a duty of care to people you're working with: for instance, if you have research assistants, you need to treat them with due care and respect. In addition, you have a responsibility to other members of society. (p. 56)

The guidelines and publications of the University of Calgary's (2013b) CFREB informed this research's design. Involvement in this study was voluntary, and I informed the participants of the purpose and nature of the study, including the data-collection procedures and how I intended to use the data. I offered the participants a choice in how I would record the data and an opportunity to verify the accuracy of their responses (e.g., I asked them about the acceptability of audiotaped interviews; they had the right to request that the recording be stopped or interrupted at any time and the option of reviewing the transcripts of their interviews). I did not collect gender, age, and other demographic data from the participants. Moreover, they were free to withdraw from the study at any time without penalty. I informed the participants by using forms based on templates that the CFREB provided. Similarly, research assistants, such as those who transcribed the interview audio recordings, were required to complete the appropriate CFREB confidentiality form (University of Calgary, 2013b).

In addition to ensuring informed consent through the use of CFREB publications, I designed this research to ensure no foreseeable risks, harms, or inconveniences to the participants, particularly with respect to their professional reputations. I have not identified individual cases or the IT leaders whom I interviewed in this multiple case study. An expansion of the eligible population of school districts (school districts of 5,000+ students and larger were eligible to participate in this study, an increase from the originally planned 10,000+ cut-point) was a research design decision intended to ensure that, even with a typically low response rate, the number of sampled cases would be large enough to avoid the identification of individual cases (Adams & Umbach, 2012).

I handled the participants' data during and after this study with diligence and an awareness of my duty of care to all involved. I conducted the interviews privately and have treated all of the resulting data as confidential. I have stored the data, both physical and digital, in secure locations to which only I have access. I have also stored a backup of this study's data on a hard drive in my personal safety deposit box. As per the academic requirements of the University of Calgary, I will store the original data securely in this manner for a period of five years, after which I will destroy it (University of Calgary, 2013a). As the researcher, I understand and value the trust of the participants in this study. I therefore ensured that I handled all of the data responsibly and in compliance with the standards of the CFREB and the guidelines of the Government of Canada Panel on Research Ethics (2005).

CHAPTER 4: FINDINGS

Overview

In this chapter I present the findings from every school district of 5,000 students or more in British Columbia, Alberta, and Saskatchewan (75 cases in total) in response to the central research question of "What factors influence district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for district schools?" I have organized the findings in this chapter according to the research questions that I presented in Table 2 of chapter 1. First, I illustrate the leadership structures and decision-making processes of school districts concerning IT infrastructure. Second, I describe the current IT infrastructure in the study's 75 cases. Third, I present the influences/priorities that guide K-12 district leaders in shaping the IT infrastructure decisions for their districts. Table 13 presents an overview of the findings sections and subsections in this chapter, organized by research subquestions and guiding frameworks. The findings in this chapter are presented according to the size categories defined in Table 8 of chapter 3:

- All 75 cases in the study (variable name ALL)
- Extra-large cases of districts with 25,000 students or more (variable name XL)
- Large cases of districts with 15,000 to 24,999 students (variable name L)
- Medium cases of districts with 10,000 to 14,999 students (variable name M)
- Small cases of districts with 5,000 to 9,999 students (variable name S)
- All cases in British Columbia (variable name BC)
- All cases in Alberta (variable name AB)
- All cases in Saskatchewan (variable name SK)

Table 13

Findings Section Overview

Research Questions	Guiding Frameworks	Findings Section	Findings Subsections
Q1A. Who is responsible for IT infrastructure decisions in the K-12 district? Is it an individual or group? Q1B. How are IT infrastructure decisions made? What is the process? Q1C. Do cloud computing IT infrastructure decisions follow this process or are they handled differently? If so, how?	Daft, 2013	IT Leadership Structures and Decision-Making Processes	• Hierarchy Levels and Branches Responsible for IT in K-12 Districts • Decision-Making Process Description • Contingency Decision-Making Framework
Q2A. What is the extent of cloud computing adoption in large Western Canadian K-12 school districts? Q2B. Do the following technologies use traditional IT infrastructure or cloud computing? Q2C. What are the future plants of Western Canadian K-12 school districts concerning their IT infrastructure? Adoption? Continued use? Etc.	Frambach and Schillewaert, 2002	IT Infrastructure and Cloud Computing Adoption	• Infrastructure Platform and Software Use o SIS o LMS o Library o Authentication o E-mail o Financial Systems o Websites o Social Media • Adoption Stages o Awareness o Consideration o Intention o Adoption Decision o Continued Use

(table continues)

Research Questions	Guiding Frameworks	Findings Section	Findings Subsections
Q3A. What human or nonhuman factors have the greatest influence over the decision to adopt cloud computing? Q3B. What is the influence of human and nonhuman factors (absolute and relative)?	Frambach and Schillewaert, 2002	Influences on IT Infrastructure	• Supplier Marketing Efforts • Social Network • Environmental Influences • Perceived Innovation Characteristics • Adopter Characteristics

Leadership Structures and Decision-Making Process Findings

In this research I explored the leadership structures and decision-making processes that determine IT infrastructure in Western Canadian K-12 school districts. To understand the decision-making processes, it is first necessary to identify and describe the individuals within K-12 districts who are involved in them. In the first section of the semistructured interviews, which focused on IT leadership, I asked the interviewees to describe the organizational hierarchy related to IT in their K-12 district and then to identify the critical decision-making level within their organization's hierarchy that is responsible for IT decisions. This level accepts input from lower organizational levels, evaluates options, and makes decisions/recommendations for the subsequent approval or rejection of the more senior layers of the organization. Last, I asked the interviewees to choose a descriptor from the contingency decision-making framework (Daft, 2013) that best described their organization's decision making in the area of IT infrastructure: rational model, process model, political model, or anarchy model. In the following subsections I present these findings in detail.

Hierarchy Levels and Branches Responsible for IT in a K-12 District

The organizational hierarchy of Western Canadian K-12 districts is consistent with a bureaucratic organization. "Each functional department has its own hierarchical mode of organization. . . . Note the chain of command that runs from the top to the bottom of the organization" (Morgan, 2006, p. 20). To better understand IT infrastructure decision making in a K-12 district, it is first necessary to situate the leaders responsible for IT infrastructure within the broader context of the organization's hierarchy/chain of command. To interpret and represent the organizational hierarchies of 75 districts across three provinces consistently, with varying titles for similar roles, I used Daft's (2013) and Jones's (2013) complementary frameworks of organizational levels/descriptors. In Table 14, I define these two frameworks and give examples of the corresponding titles at each level from each province. The examples in Table 14 illustrate the vertical differentiation/division of labour within large K-12 district in Western Canada, inclusive of both IT and non-IT duties. Appendix Table E1, which I discuss in greater detail later in this section, provides a thorough depiction of the chain of command with regard to exclusively IT roles.

Levels of hierarchy found among decision makers. Presenting IT roles with other roles of similar scope and importance from non-IT areas, such as building maintenance, learning services, and finance, helps to understand them within the broader organizational context. I asked the study participants to identify the critical decision-making level of their organization that is responsible for making IT infrastructure decisions. For example, an Information and Communications Systems Manager (Level 3/Function) might make decisions for IT infrastructure in a district. The Secretary Treasurer (Level 2/Division), Superintendent (Level 1/Organization), and Board of Education (Level 1/Organization) would then merely approve the decisions/recommendations. In such a chain of command, I would code the IT decision making as occurring at the Level 3/Function level, at which options are weighed and a critical decision is made for the district. Figure 9 presents this study's findings on the hierarchy level at which IT decisions concerning IT infrastructure are made. It contains findings from the entire study, as well as detailed breakdowns of the findings by size and province.

Figure 9 reveals that the middle levels of the organization typically make IT infrastructure decisions for a K-12 district in Western Canada. In 59% of the districts that I studied, personnel made IT infrastructure decisions at the Level 3/Function level. Similarly, in 37% of the districts, they made these decisions at the Level 2/Division level. In only 4% of the

Table 14

Organizational Hierarchy Levels of Decision Makers Within Large Western Canadian K-12 Districts

Daft (2013) hierarchy levels	Jones (2013) descriptors	Description	Examples of corresponding titles in British Columbia	Examples of corresponding titles in Alberta	Examples of corresponding titles in Saskatchewan
Level 1	Organization	The level at which an organization's mission, vision, and governance are set. This level consolidates all sub divisions and establishes a unified strategy for the entire organization..	• Board of Education • Chief Executive Officer • Superintendent	• Board of Trustees • Superintendent of Schools	• Board of Education • Director of Education
Level 2	Division	This level serves the organization's highest overarching strategy through the division of labour into a few major organizational focuses.	• Director of Human Resources • Director of Innovative Learning • Director of Instruction • Secretary Treasurer	• Assistant Superintendent (Learning Services) • Assistant Superintendent (Support of Schools) • Managing Director (Financial Services) • Secretary Treasurer	• Chief Financial Officer • Deputy Director School Services • Deputy Director Student Achievement • Superintendent of Curriculum and Instruction • Superintendent of Human Resources
Level 3	Function	This level contains the senior management responsible for specific functions within an organization. These specific functions are critical elements of the few major organizational focuses of the level above.	• Director of Operations • District Vice-Principal Technology • Maintenance Supervisor • Manager of Human Resource Services	• Curriculum and Resource Support • Finance Manager • Transportation Supervisor	• Human Resources Manager • Information and Communications Systems Manager • Transportation Manager
Level 4	Sub-Function	This level contains the leaders of specializations/roles required to complete the various functions of the organizational level above.	• Manager of Operations • School Principals • Vice-Principals	• Administrative Services (Transportation) • Manager of Facilities • Payroll Supervisor	• Information and Communications Systems Assistant Manager • Manager IT Services • Supervisor Network Services • Supervisor Technical Support
Level 5	Role	This level contains the individuals responsible for executing the organization's mission and vision directly through their very specific duties.	• Accounts Payable Clerk • Admin Assistant • Maintenance staff • Reception • Teacher	• Bus Driver • Computer Technician • Finance Technician • Mechanic • Network Technician	• Data Systems Analyst • Developer Analyst • Payroll Assistant • Technical Support Technician

districts did personnel make IT infrastructure decisions at the more specialized Level 4/Sub-Function level. Neither the lowest level (Level 5/Role) nor the highest level of the district (Level 1/Organization) was responsible for making critical IT infrastructure decisions.

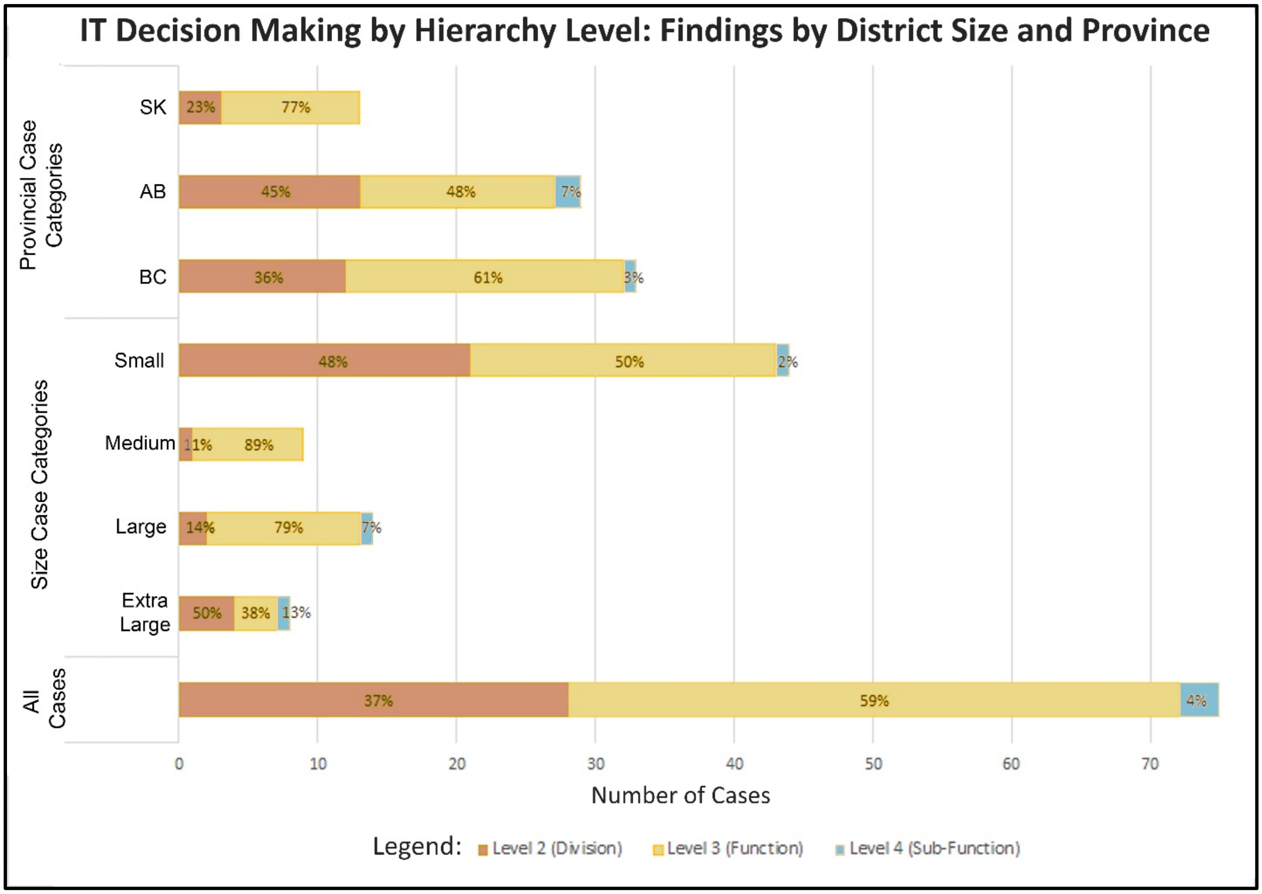


Figure 9. IT decision making by hierarchy level: Findings by district size and province.

Organizational branches found responsible for IT infrastructure decisions. In addition to asking the participants to identify the critical decision-making level of their organization, I asked them to describe the reporting hierarchy for IT infrastructure decisions in their district. I cross-referenced the responses from the interviews with organizational charts from my document analysis and found that the responsibility for IT infrastructure varied across districts. There was a variety of district branches under which IT responsibility was found. A finding of the study is that in British Columbia, Alberta, and Saskatchewan, IT infrastructure is either a major organizational focus in itself or falls into one of four other major organizational focuses: instruction and innovative learning; services, infrastructure, and facilities; finance; or human resources. Appendix Table E1 presents the organization of IT under these major organizational branches of responsibility. This table also presents the chain of command within each branch, organized according to Daft's (2013) and Jones's (2013) frameworks, with a comprehensive list of IT-related titles at each level.

In large Western Canadian K-12 districts, the responsibility for IT infrastructure was most often situated under branches that correspond to instruction and innovative learning (43%) and finance (35%). These findings are presented in Figure 10. Less frequently, personnel made IT infrastructure decisions within the branches of IT/Technology (13%); services, infrastructure, and facilities (8%); and human resources (1%).

Insights from the combination of hierarchy and branch findings. A key finding of this study is that the hierarchy level responsible for IT decisions in a district is often influenced by the organizational branch in which IT is situated. Figure 11 depicts these findings concerning the connections between hierarchy level and organizational branch. The connections between hierarchy level and organizational branch are important as the hierarchy level is a function of the organizational branch's focus and the expertise or focus of the personnel within it. As the following paragraphs will illustrate in greater detail, district branches that are explicitly concerned with technology most often have IT infrastructure decisions made at higher hierarchy levels. Conversely, in branches that are not explicitly concerned with technology, such as finance, lower hierarchy level personnel, who have greater IT expertise, are trusted to make the IT infrastructure decisions.

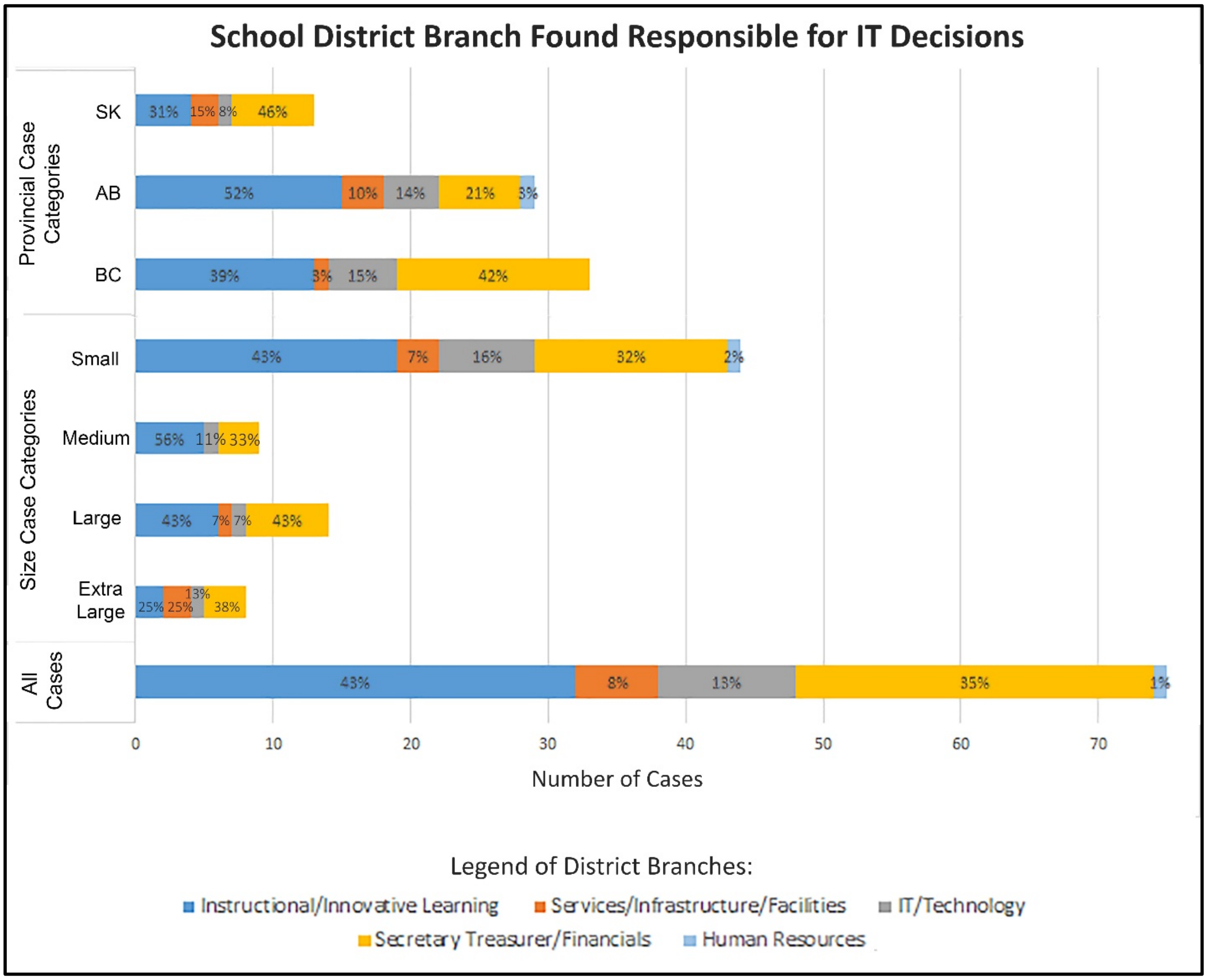


Figure 10. School district branch found responsible for IT decisions.

A finding of this study is that when IT decisions are situated within the branches of finance or services, infrastructure, and facilities, critical decisions about IT infrastructure are most often made at the lower, Level 3/Function level (in 73% and 67%, respectively, of all of the study's districts under these two branches). This is reasonable because those at the higher Level 2/Division level of these more general district branches might lack the technical expertise

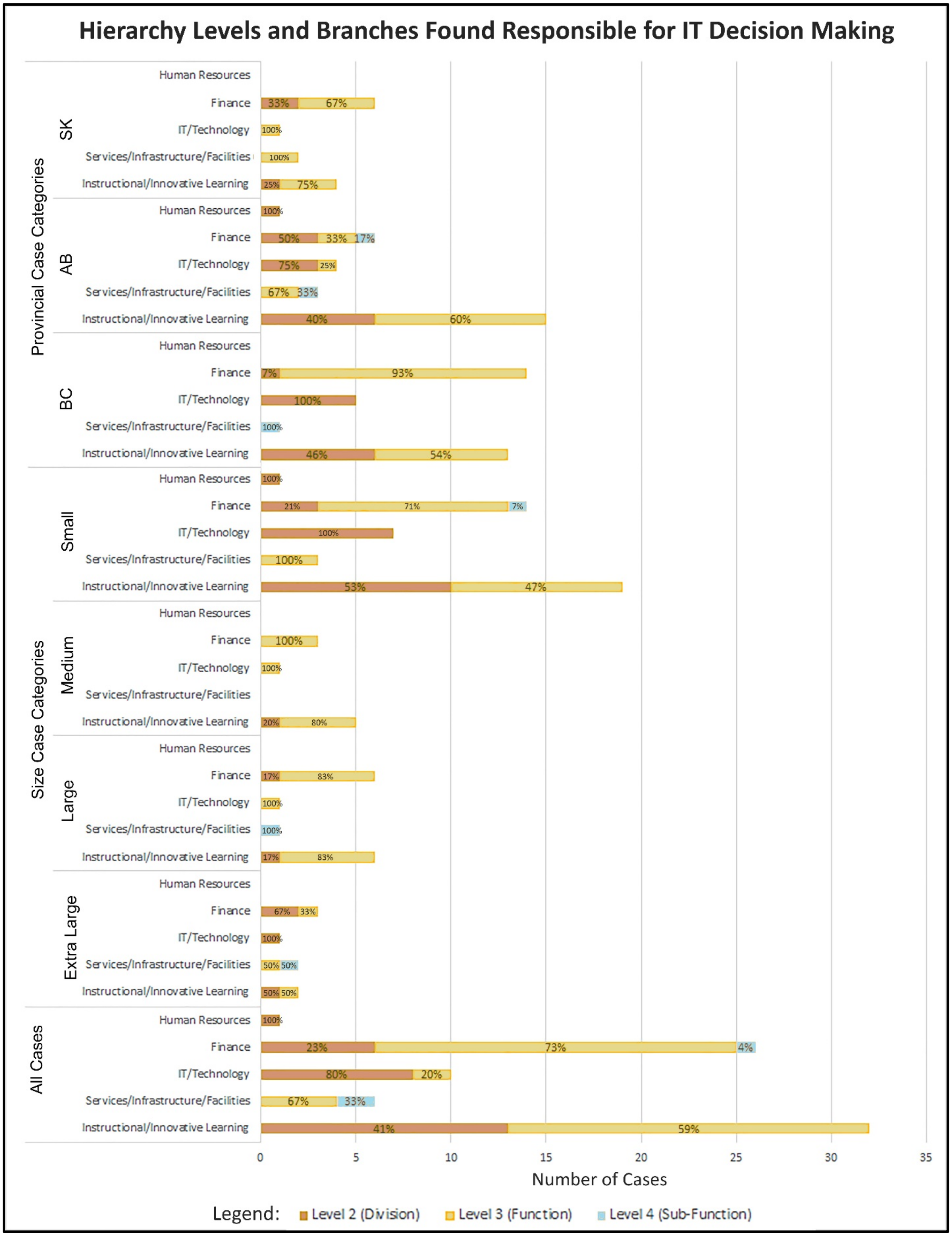


Figure 11. Hierarchy levels and branches found responsible for IT decision making.

to evaluate IT infrastructure offerings themselves. Within these branches, Level 4/Sub-Function personnel are also consulted (4% and 33%, respectively).

Contrasting the non-IT focused branches and their lower hierarchy levels for IT infrastructure decision making is the IT/Technology branch and its consistently higher hierarchy level of decision making. When IT responsibility is situated in its own branch, IT/technology, personnel most frequently make decisions at the higher, Level 2/Division level (80%).

IT responsibility in the branch of instructional/innovative learning is a mixture of higher and lower hierarchy levels. The instructional/innovative learning branch is the most common location for IT responsibility in all districts. In this branch, IT decisions are made by personnel at the lower Level 3/Function (59%) and the higher Level 2/Division (41%) levels.

In Alberta, one district in the small, S size category situated IT responsibility within the human resources branch of its organization and personnel made critical IT infrastructure decisions at the Level 2/Division level (100%). Some respondents from other districts and provinces reported that the responsibility for IT was previously situated within the human resources branch of their district, prior to the reorganization of the district. I believe that IT in this district is a miscellaneous portfolio of responsibilities and/or is assigned under the human resources branch because of the exceptional technical abilities of the staff in that branch. Because only a single district situated IT within its human resources branch, further discussion of the human resources branch will be minimal.

The IT decision makers in K-12 districts. By combining the study’s findings on hierarchy levels and district branches responsible for IT decision making, it is possible to also identify the roles/positions in a district’s leadership who are most often responsible for IT infrastructure decisions. Table 15 presents an overview of the people found in specific roles who

Table 15

School District Hierarchy Level, Branch, and Decision-Maker Roles

Frequency of occurrence	Hierarchy level	Organizational branch	Generic IT Decision Maker Roles	Examples of IT Decision Maker Titles
25% (n=19)	Level 3 (Function)	Instruction and Innovative Learning	• Director of Teaching and Learning • IT Manager	• Director of Technology for Learning • District Principal Innovative Learning • Learning Technologies Manager
25% (n=19)	Level 3 (Function)	Finance	• Director of Information Technology	• Director of Information Technology • Director of Information Technology and Digital Communications • Manager of Information Services
17% (n=13)	Level 2 (Division)	Instruction and Innovative Learning	• Director of Learning Services	• Assistant Superintendent of Learning Services • Associate Director of Instruction, Learning & Information Services • Deputy Superintendent -Learning Services • Director of Student Learning and Innovation
11% (n=8)	Level 2 (Division)	IT/Technology	• Director of Information Technology	• Administrator of Information Technologies • Director of Information Technology • Director of Technology and Chief Information Officer • District Vice-Principal Technology
8% (n=6)	Level 2 (Division)	Finance	• Chief Financial Officer	• Chief Financial Officer • Secretary Treasurer • Superintendent of Business & Finance and Technology Services
5% (n=4)	Level 3 (Function)	Services, Infrastructure, and Facilities	• Director of Information Technology	• Director of Information Technology • Manager of Information Systems • Supervisor of Communication Information & Technology
3% (n=2)	Level 3 (Function)	IT/Technology	• Director of Information Technology	• Director of Information Technology • Manager of Technology
3% (n=2)	Level 4 (Sub-Function)	Services, Infrastructure, and Facilities	• IT Manager	• Infrastructure Manager • Manager of IT Services • Supervisor Network Services
1% (n=1)	Level 4 (Sub-Function)	Finance	• IT Manager	• IT Manager • Network Administrator • Server Administrator
1% (n=1)	Level 2 (Division)	Human Resources	• Director of Human Resources	• Associate Superintendent (Human Resources)

were responsible for IT infrastructure decisions. Appendix Table E1 expands upon this, providing a comprehensive list of position titles in each branch and level. A key finding of this study is that in half of the large K-12 districts in Western Canada, the Director of Technology for Learning (25%), or equivalent, and the Director of Information Technology (25%), or equivalent, handled the responsibility for IT infrastructure. As I discussed in earlier sections, the role/position responsible for IT infrastructure in a district is related to both the organizational branch and the hierarchy level within that branch.

Decision-Making Process Description

In addition to asking the participants to identify the organizational hierarchy level and branch responsible for IT decision making, I asked them to describe how they made decisions. The purpose of the latter request was to better understand the interplay of factors that influence the adoption (or nonadoption) of cloud computing for district schools. The participants' rich descriptions offered insights into how district IT decisions are made. In the following subsections I describe the key elements of decision making concerning IT infrastructure in Western Canadian K-12 districts.

District awareness of IT needs. An important element of the decision-making process for districts is how district leaders become aware of IT needs. Typically in Western Canada, end-users and network support staff are the first to identify the IT needs of a K-12 district. These emerge during the day-to-day activities of the district's users, such as teachers and school office staff, and the district's IT staff resolve them. They communicate the IT issues to the higher levels of the IT department during meetings, both formal and informal, which informs the IT department and the district's leadership of the occurrence of IT issues such as ageing, deteriorating, and/or failing systems. This is the foundation for planning future IT upgrades to mitigate the problems.

> We take calls, we're talking with the teachers all the time, so that's where the majority of it [IT needs] comes from - is from what the teachers want and what's needed in the school. So that's what we base our plans on. (Bo, p. 2)

Appendix Table F1 presents additional corroborating quotations from district staff in each of the three provinces that I studied and illustrates the important role of IT staff in providing information on IT to inform the district's decision-making process.

Technology advisory committees. I found that in many K-12 districts, a technology advisory committee informs the IT infrastructure decision-making process. Although the district needs that IT support staff present (which I discussed in the previous subsection on the awareness of IT needs) are important in addressing existing issues, technology advisory committees make possible a more proactive, inclusive, and forward-looking decision-making process. A finding of this study is that whereas the focus of K-12 district IT departments is often on maintaining and upgrading existing systems, the technology advisory committees help districts to look beyond their existing systems to explore more dramatic changes/improvements.

> We also have a technology council which I chair, and the technology council is an advisory group to the superintendent's team, and the advisory council is made up of representatives from all the major stakeholders in the organization, so it's an internal advisory and it's made up of members of the 5 areas of our schools, principals sit on that advisory, from our elementary, middle, and senior high schools, and then we have representatives through all of our superintendents and service unit teams. So it's a table

> of about 16 people and all major technology decisions, we have a process for bringing them forward, a project approval process, and a discussion format. We meet twice a month and all technology decisions go through - initially - that advisory council. (Ami, p. 1)

Appendix Table F2 contains additional representative quotations from personnel in all three provinces concerning the use and composition of technology advisory committees.

As the quotations show, technology advisory committees often include a diverse group of stakeholders who range from teachers, elementary principals, high school principals, superintendents, associate superintendents, Chief Financial Officers, and Directors of IT to maintenance foremen, and so on. The committees often meet several times a year to discuss IT needs and set future technology direction for their districts. This study found that the diversity of concerns and expertise on districts' technology advisory committees enables a richer assessment of needs for district planning purposes.

Collaboration among senior leadership. An important element of districts' decision-making processes for IT infrastructure is the collaboration among stakeholders at the senior levels of the district. The IT support staff and technology advisory committees both bring forward areas of concern and ideas to enhance the districts' IT infrastructure. This collaborative approach results in information from numerous stakeholders:

> Now, if we talk about IT type projects, that affect the district, we do have an advisory committee, and we may get to that later, but that's the district technology advisory committee, DTAC, is what we call it. And that includes the superintendent, secretary treasurer, director and myself, but also director of Ed Services, educational services. So

> that committee really brings in all areas of business and the educational side of the district. (Brook, p. 1)

After district leaders collect sufficient information on IT infrastructure needs and possible solutions, they evaluate the available options. This process is collaborative, involving other district personnel:

> The manager of technology reports to the assistant superintendent. It's an interesting arrangement, but the decisions are usually made almost on a team basis, so even though on the chart we have the assistant superintendent on the top who ultimately has the decision making powers, but the way we operate here, the team of usually the three of us will make the decision as a group. (Blair, p. 1)

Appendix Table F3 presents additional quotations from the study participants that describe this collaborative decision making within districts among its leaders. One participant described the collaboration among senior leaders as a consensus model. A key finding from this investigation of the decision-making processes of Western Canadian K-12 districts is the high degree of consultation and collaboration that occurs within an organization prior to and during the decision-making process.

The cloud computing adoption decisions process. In addition to seeking an understanding of the overall decision-making processes on IT infrastructure in the districts, I wanted to explore whether the process of evaluating/adopting cloud computing was similar within these districts. The participants revealed that the cloud computing adoption decision-making process almost always fits into a district's existing decision-making processes on IT. As a researcher, I was not surprised by this finding, given the robust and collaborative decision-making process that I described in the preceding sections. Appendix Table F4 includes representative quotations from the participants and demonstrates that the cloud computing adoption process is largely the same as it is for other IT infrastructure decisions. In the majority of the districts, the cloud computing adoption decision is identical to normal infrastructure decisions. In a few districts, cloud computing decisions involved additional consultation with the district's privacy personnel to ensure that the district would remain compliant with provincial and national legislation:

> No [difference], I guess the only thing that would get [additionally] involved is we would also involve our senior team and that's more for information, because stuff to move to public cloud or we have those discussions obviously about security, privacy, that kind of stuff, so that's FYIs for the senior management team. (Blair, p. 2)

Contingency Decision-Making Framework Findings

Through the contingency decision-making framework, I examined district leaders' perceptions of the IT infrastructure decision-making processes within their districts. As I described in chapter 2, the Daft (2013) contingency decision-making framework consists of four models: the rational model, the process model, the political model, and the anarchy model. As Figure 3 shows, these models illustrate an organization's decision-making orientation based on the axes of solution knowledge and problem consensus. Figure 12 presents this study's findings of the distribution of these decision-making models, organized by size and province.

Across the districts in this study, with the exception of the anarchy model (1%), the distribution of the other models in the districts was balanced: rational model (30%), process model (37%), and political model (31%). In the following chapter on the analysis of findings, I

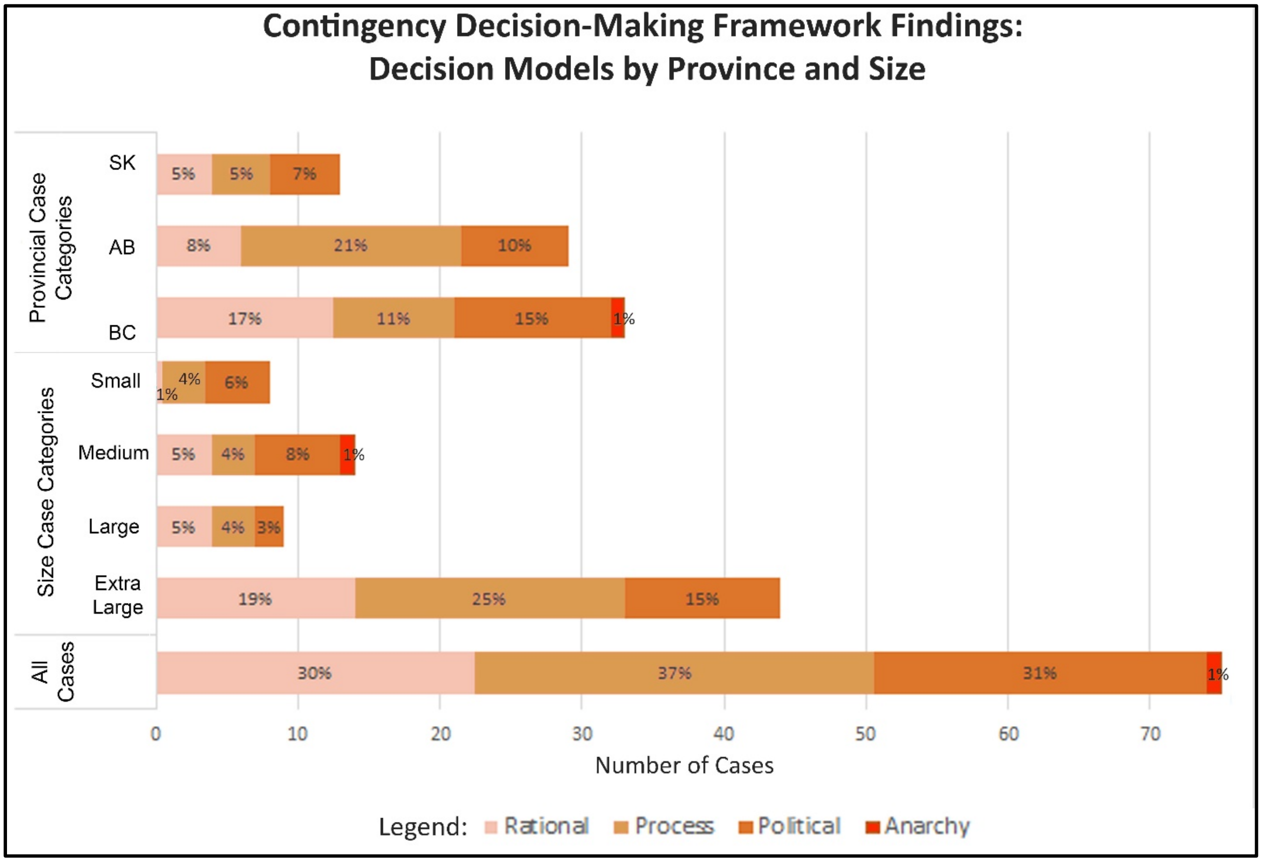


Figure 12. Contingency decision-making framework findings: Decision models by province and size.

will discuss the correlations that I found with the contingency decision-making framework's models, such as the relationships between models, district size, and a district's province.

Summary of Leadership Structures and Decision-Making Processes Findings

This section examined who is responsible in Western Canadian K-12 districts for making IT decisions and how IT infrastructure decisions were made. Key findings in this section, in response to the research questions presented in Table 13, are discussed below.

IT responsibility within Western Canadian K-12 districts is typically located within the instructional/innovative learning or financial branches of districts. These IT leaders have titles such as Director of Technology for Learning or Director of Information Technology, respectively. In 50% of districts, IT infrastructure decisions were made by one of these two positions.

IT infrastructure decisions in Western Canadian K-12 districts are made through a highly collaborative processes. First, district IT needs are brought to the attention of the IT leadership through input from sources such as service technician observations and student or teacher troubleshooting requests. Second, technology advisory committees are used to engage a district's stakeholders to identify future projects. Third, the districts in this study demonstrated a high degree of collaboration among senior district leaders concerning the delivery and management of IT infrastructure projects.

The decision to adopt or not adopt cloud computing by a Western Canadian K-12 district follows the regular IT infrastructure decision-making process closely. The majority of participants said that the process is the same. In a few cases, the participants said that cloud computing adoption decisions follow a similar process but involve additional consultation with the district personnel responsible for compliance privacy legislation. Overall, this study found that the adoption decision for cloud computing does not differ substantially from the normal IT infrastructure adoption decision-making process described above.

I also asked the study's participants to identify the models of the Daft (2013) contingency decision-making framework that most closely resemble the decision-making process within their districts. The anarchy model was the least common (1%), while the process model (37%) was the most common. The rational model and the political model were found in 30% and 31% of cases respectively.

IT Infrastructure and Cloud Computing Adoption Findings

In this study I examined the IT infrastructure of all school districts of 5,000 students or more in British Columbia, Alberta, and Saskatchewan. I specifically examined how IT leaders in K-12 districts in Western Canada provide the following IT-related functions: Student Information System (SIS), Learning Management System (LMS), library services, network security/authentication, e-mail, website(s), financial/accounting services, website(s), and social-media communications. In this section I present these findings, first in an overview, and then in detail, organized by district size and location.

IT Infrastructure Coding Categories

I organized the delivery of K-12 district IT-related functions according to five infrastructure categories, based on the NIST definition of cloud computing in Table 1. Table 16 presents these five infrastructure category definitions, as I have applied them to this research. I used these definitions in discussions with the participants, as well as in coding the research data.

I omitted hybrid cloud, an additional NIST cloud computing category, from Table 16 and the preliminary coding system that I used in this study because hybrid cloud is “a composition of two or more distinct cloud infrastructures (private, community, or public)” (NIST, 2011, pp. 2-3). I coded each instance of IT infrastructure and cloud computing separately. In chapter 5, in my analysis of findings, I will discuss the use of hybrid cloud by districts as I explore the complementary use of infrastructure platforms and software.

Cloud Computing Versus Traditional Infrastructure Overview

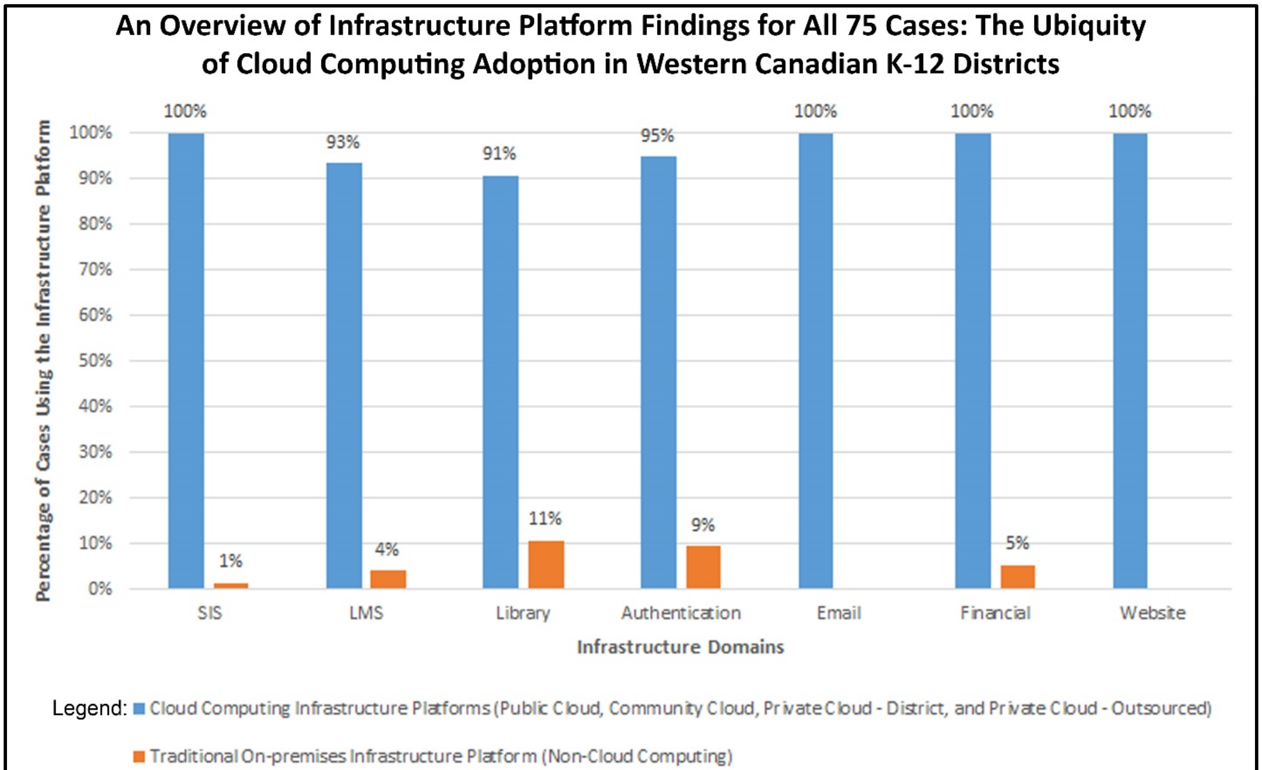
At a macro level, I examined cloud computing adoption in Western Canadian K-12 school districts through the basic dichotomy of cloud computing and non-cloud computing infrastructure. As defined in Table 16, non-cloud computing is traditional, on-premises-only

Table 16

IT Infrastructure Data-Coding Categories

General infrastructure categories	Specific infrastructure categories	Definitions used to code data
Cloud Computing Categories	Public Cloud	“The cloud infrastructure is provisioned for open use by the general public.” (NIST, 2011, pp. 2-3) This includes software services provided by Google and Microsoft, such as Google Apps for Education and Office 365, respectively.
	Community Cloud	“The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns” (NIST, 2011, pp. 2-3) This includes MyEducation BC, a Student Information System (SIS) made available to schools in British Columbia through the British Columbia Ministry of Education.
	Private Cloud - District	“The cloud infrastructure is provisioned for exclusive use by a single organization” (NIST, 2011, pp. 2-3) This includes infrastructure that is owned, managed, and/or operated by the school district, usually as part of the school district’s data centre.
	Private Cloud - Outsourced	“The cloud infrastructure is provisioned for exclusive use by a single organization” (NIST, 2011, pp. 2-3) This includes infrastructure that is owned, managed, and/or operated by a third party on behalf of the school district.
Non-Cloud Computing Categories	Traditional On-Premises	This infrastructure category describes non-cloud infrastructure. Infrastructure in this category is not accessible over the Internet and is restricted to the LAN or WAN of the school district.

infrastructure that is not accessible by other devices or users through the Internet. Figure 13 presents an overview of cloud computing versus traditional IT infrastructure findings for all 75 cases in this study. In this figure I use the key IT-related functions/domains of K-12 districts to illustrate the percentage of districts in the study that used cloud computing and/or traditional IT infrastructure to deliver these IT-related functions. An important note concerning Figure 13 is



Note. Percentages may not add to 100% in each infrastructure domain. This is due to the complementary and/or supplementary use of multiple infrastructure platforms.

Figure 13. An overview of infrastructure platform findings for all 75 cases: The ubiquity of cloud computing adoption in Western Canadian K-12 districts.

that the IT function/domain categories may exceed 100% in total due to the complementary or supplementary use of cloud computing with traditional, non-cloud computing infrastructure.

As Figure 13 shows, cloud computing is ubiquitous in British Columbia, Alberta, and Saskatchewan. Every district of 5,000 students or more in these provinces (100%) uses cloud computing to deliver SIS, LMS, financial, e-mail, and website functions. By definition, e-mail and website functions are available through the Internet, and districts must therefore deliver them by one of the four cloud computing platforms categories outlined in Table 16. For the functions of LMS, Library, and security/authentication, Western Canadian K-12 districts used one of the four variations of cloud computing service platforms extensively (93%, 89%, and 95% of all cases use cloud computing for these functions, respectively). I infrequently found traditional on-premises-only infrastructure in this study. When I did, the cases used traditional infrastructure to complement and supplement cloud computing. For example, with regard to SIS, 100% of the districts used cloud computing to deliver SIS functions. One case (1%) also used an on-premises traditional SIS system in addition to its cloud computing SIS. Similarly, for financial and accounting functions, I found traditional infrastructure in 5% of the cases, even though 100% of the cases used some form of cloud computing to deliver these functions. For LMS, library, and authentication/security functions, the cases used traditional IT infrastructure in a very limited way as well, with occurrences in only 4%, 11%, and 9% of cases, respectively.

In the following sections I expand upon the overview presented in Figure 13 and discuss in detail the IT infrastructure findings for each of the IT-related functions/domains. I have organized these more detailed findings by the case size and province categories, consistent with those presented in Table 8. Additional details concerning findings are found in Appendix H. This section answers one of the major subquestions of this study: “What is the current level of cloud computing adoption in large K-12 school districts in Western Canada?”

An Overview of IT-Infrastructure Domain/Function Categories

The IT infrastructure of K-12 districts in this research is composed of multiple technologies that address specific IT-related functions/domains in the districts. These domains include the management of student records, the delivery of online instructional materials, library services, financial services, e-mail delivery, and others. Table 17 is an overview of the IT-related functions that I examined in this study. It includes a concise description of each infrastructure area and lists the corresponding software, organized by infrastructure-platform

Table 17

An Overview and Description of IT Infrastructure Domains

IT domain/ function	Description	Public cloud	Community cloud	Private cloud–district based	Private cloud–outsourced	Traditional
Student Information System (SIS)	This refers to the software used by a school district that is responsible for student records, such as contact information, schedules, and marks.	• Maplewood Student Information System • PowerSchool • SchoolLogic	• BCeSIS and/or MyEducation BC	• CIMS • Genius SIS • Maplewood Student Information System • PowerSchool • SchoolLogic	• PowerSchool	• Turbo-School • Windsor
Learning Management System (LMS)	This refers to the course management system that allows teachers to make available content for students. It also allows students to submit assignments, take tests/quizzes, and participate in online discussions.	• Blackboard • Desire2Learn (now Brightspace) • Edmodo • Google Apps for Education (GAFE) • Office 365		• Blackboard • CIMS • Custom/Other/Own • Desire2Learn (now Brightspace) • FirstClass LMS • Moodle • PowerSchool • Scholantis and/or SharePoint • SchoolConnect • WordPress	• Blackboard • Moodle	• Moodle
Library	This refers to software relating to the management of library resources, such as books, journals, and other resources.	• Destiny • L4U • LibraryWorld • LS2 • Mandarin • Maplewood Library • OPALS • OverDrive • Symphony	• Alberta Regional Library Systems	• Alexandria • Destiny • Insignia Library System • L4U • Lexwin • Librarian Pro • Mandarin • Symphony	• Insignia Library System • Koha	• Alexandria • Destiny • L4U

(table continues)

IT domain/ function	Description	Public cloud	Community cloud	Private cloud–district based	Private cloud–outsourced	Traditional
Financial/ Accounting	This function relates to the management of school district finances. This includes accounting software.	• atrieveERP • Bellamy • MyBudgetFile • School Cash Suite		• Altus Dynamics • atrieveERP • Bellamy • Cayenta • CIMS • Dynamics NAV • PeopleSoft Financial Management • School Cash Suite • SDS	• SDS	• Simply Accounting (now Sage 50) • QuickBooks
Authentication/ Security	This refers to a district's security and user credential management. These credentials allow students and staff to login to school computers and access resources securely.			• Active Directory • eDirectory • ExtremeZ-IP (now Acronis Access Connect) • LemonLDAP:NG • OpenLDAP • ownCloud • Samba		• Active Directory • *No authentication, Local 1 Account
E-mail	This refers to the software by a district to deliver e-mail to its staff and/or students. This refers specifically to the server side of e-mail e.g., Microsoft Exchange), rather than the end-user side of e-mail (e.g., Microsoft Outlook)	• Google Apps for Education (GAFE) • Office 365		• DeskNow • Exchange (Exchange 2007, Exchange 2010, and Exchange 2013) • FirstClass • GroupWise • IceWarp • Zimbra		

category as shown in Table 16. The following sections present this study's findings concerning the IT infrastructure platforms and software used to deliver these district functions.

Student Information System (SIS)

SIS infrastructure platforms. As Figure 14 shows, districts most commonly delivered SIS via private cloud platform. 51% of the cases used a private cloud infrastructure for this IT infrastructure domain. In addition, 39% of the cases used community cloud to deliver SIS functions. Only 11% of the cases used public cloud, and only 1% of the cases used traditional and outsourced platforms.

In British Columbia, community cloud (BCeSIS/MyEducation BC) is the dominant SIS platform in 88% of the province's cases. British Columbia is the only province with BCeSIS/MyEducation BC. Because of its ubiquity in that province, cases of all sizes use it. This results in a wide distribution of the community cloud platform across the study's district size categories. Cases of all sizes and in all provinces used private-cloud delivery of SIS functions. Private cloud is the most common SIS infrastructure platform in Alberta and Saskatchewan; in 83% and 77% of the cases, respectively. In British Columbia 12% of the cases used private cloud; it was most likely displaced by the dominant use of community cloud. Private cloud was the only SIS infrastructure platform in Saskatchewan and Alberta for districts larger than 10K students.

I found public cloud use by districts as an SIS platform only in cases within the S size category in this study. As the districts increased in size, they abandoned public cloud solutions in favour of either community cloud or private cloud. The districts used private cloud–outsourced and traditional infrastructure platforms infrequently for SIS functions. I did not find

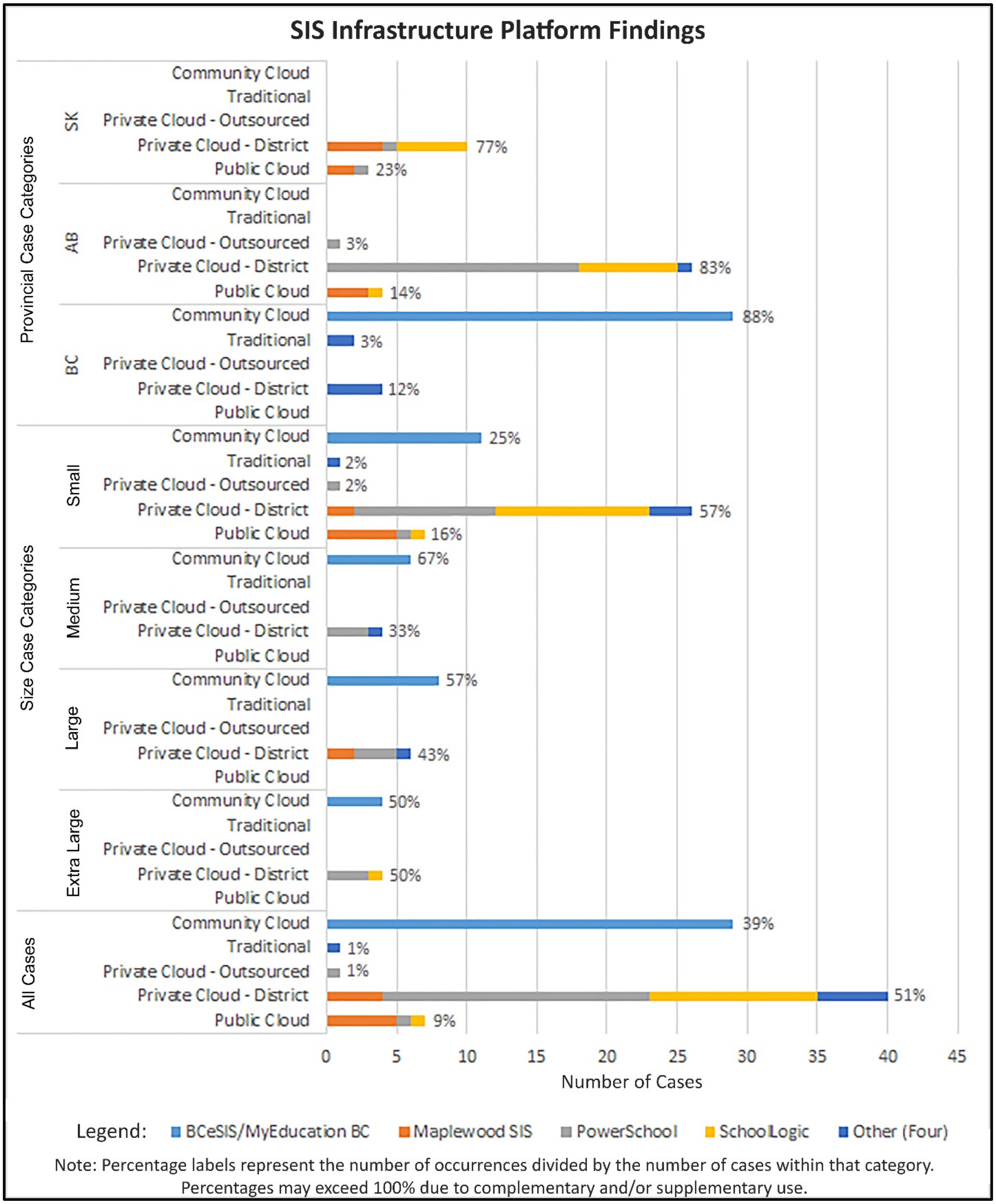


Figure 14. SIS infrastructure platform findings.

them in Saskatchewan at all, and only in the smallest districts, in the S case size category, in British Columbia and Alberta.

Similar to the findings for public cloud, I found that when districts are larger, they move towards greater use of private cloud–district or community cloud. When these larger districts make this shift, they move away from private cloud–outsourced and traditional platforms.

SIS software. As Figure 15 shows, in 39% of all of the cases and in 88% of the cases in British Columbia the most common SIS software was BCeSIS/MyEducation BC. This software can be delivered only through the cloud computing platform; it is limited to British Columbia because the British Columbia Ministry of Education manages it for schools within the province. The second most common SIS software was PowerSchool. This software was delivered on the Public cloud, Private cloud–district, and private cloud–outsourced platforms. I found it in 28% of all cases. Though cases in British Columbia did not use it, I found it in Alberta and Saskatchewan. In Alberta it was the dominant SIS software in 66% of all cases, which was the heaviest use. In Saskatchewan 15% of all cases used it to a lesser extent.

The third most common SIS software in the study was SRB, which I found only in Alberta and Saskatchewan in 17% of all cases. It was the second most used SIS software in both these provinces.

The fourth most common SIS was Maplewood, which 12% of all cases used. Despite its use in a small number of cases overall, Maplewood was the dominant SIS in 46% of all cases in Saskatchewan. They delivered Maplewood on public and private cloud platforms.

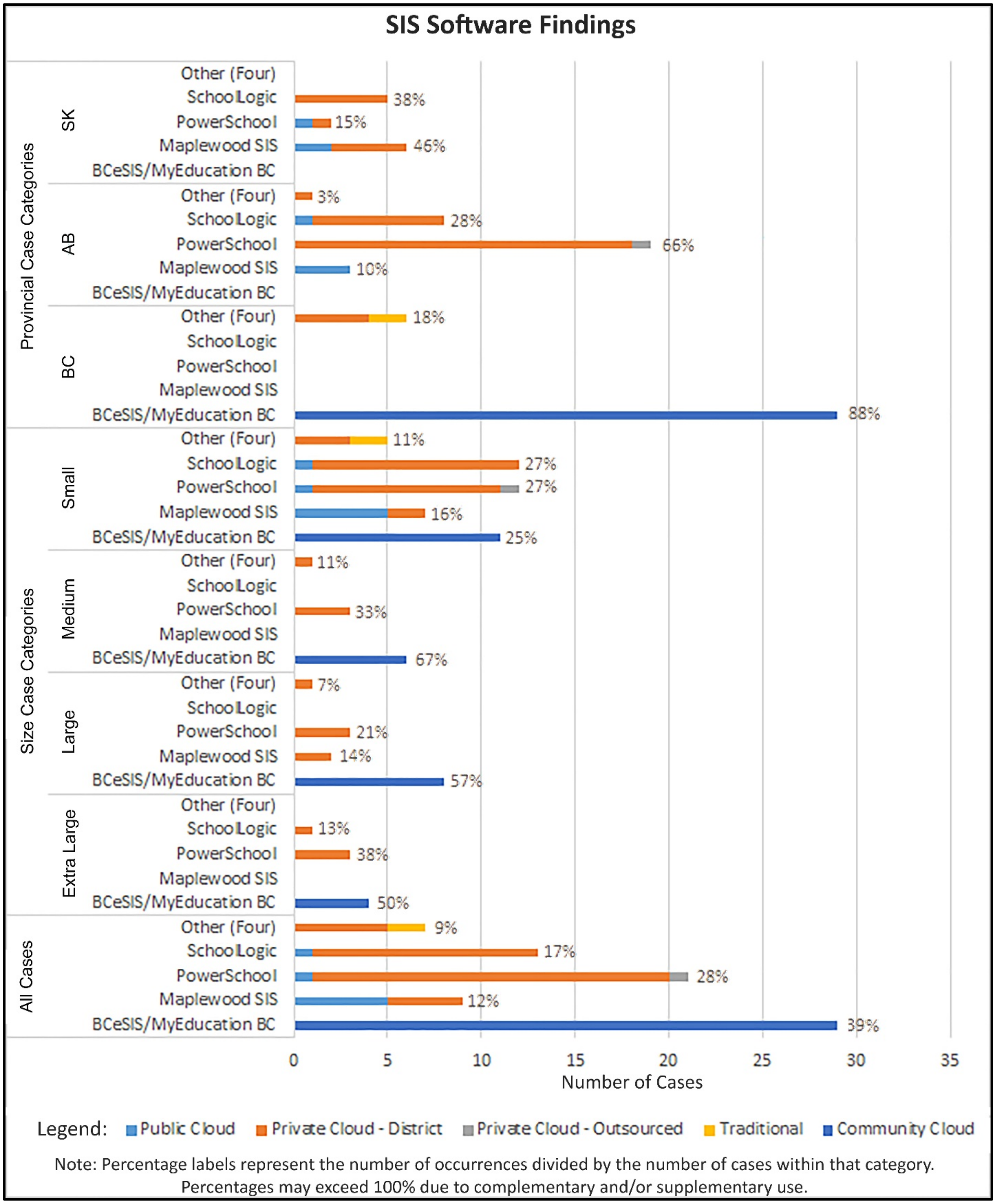


Figure 15. SIS software findings.

Learning Management System (LMS)

LMS infrastructure platforms. As Figure 16 shows, 83% of the cases most commonly delivered LMS by private cloud infrastructure. In every district size and in every province, private cloud was by far the most dominant infrastructure platform for LMS.

Public cloud was the second most common infrastructure platform that 21% of the cases used to deliver LMS functions. Alberta used public cloud for LMS functions most heavily (38% in Alberta, 15% in Saskatchewan, and 9% in BC). By district size, the use of public cloud was relatively evenly distributed, with a range of 23%-33% in the four size categories, with the exception of the L category, in which only 7% of the cases used public cloud.

The third most common infrastructure platform that 13% of the cases used to deliver LMS functions was private cloud–outsourced. In British Columbia and Alberta, 18% and 14% of the cases used private cloud–outsourced, respectively. None of the cases in Saskatchewan used private cloud–outsourced. According to size, the use of private cloud–outsourced in districts generally increases as the districts get larger.

Traditional, on-premises infrastructure was the least common platform that only 4% of the cases used to deliver LMS functions. British Columbia and Alberta used traditional infrastructure in 6% and 3% of their cases, respectively. None of the cases in Saskatchewan used traditional infrastructure. Similarly, according to size, none of the cases in the S or M size categories used traditional LMS delivery. The use of traditional infrastructure to deliver LMS functions increased with district size. This is evident in British Columbia and Alberta (7% in the L category, 25% in the XL category).

LMS software. The most common LMS software used by Western Canadian K-12 districts was Moodle. This software was found in 81% of all cases. It was also the most

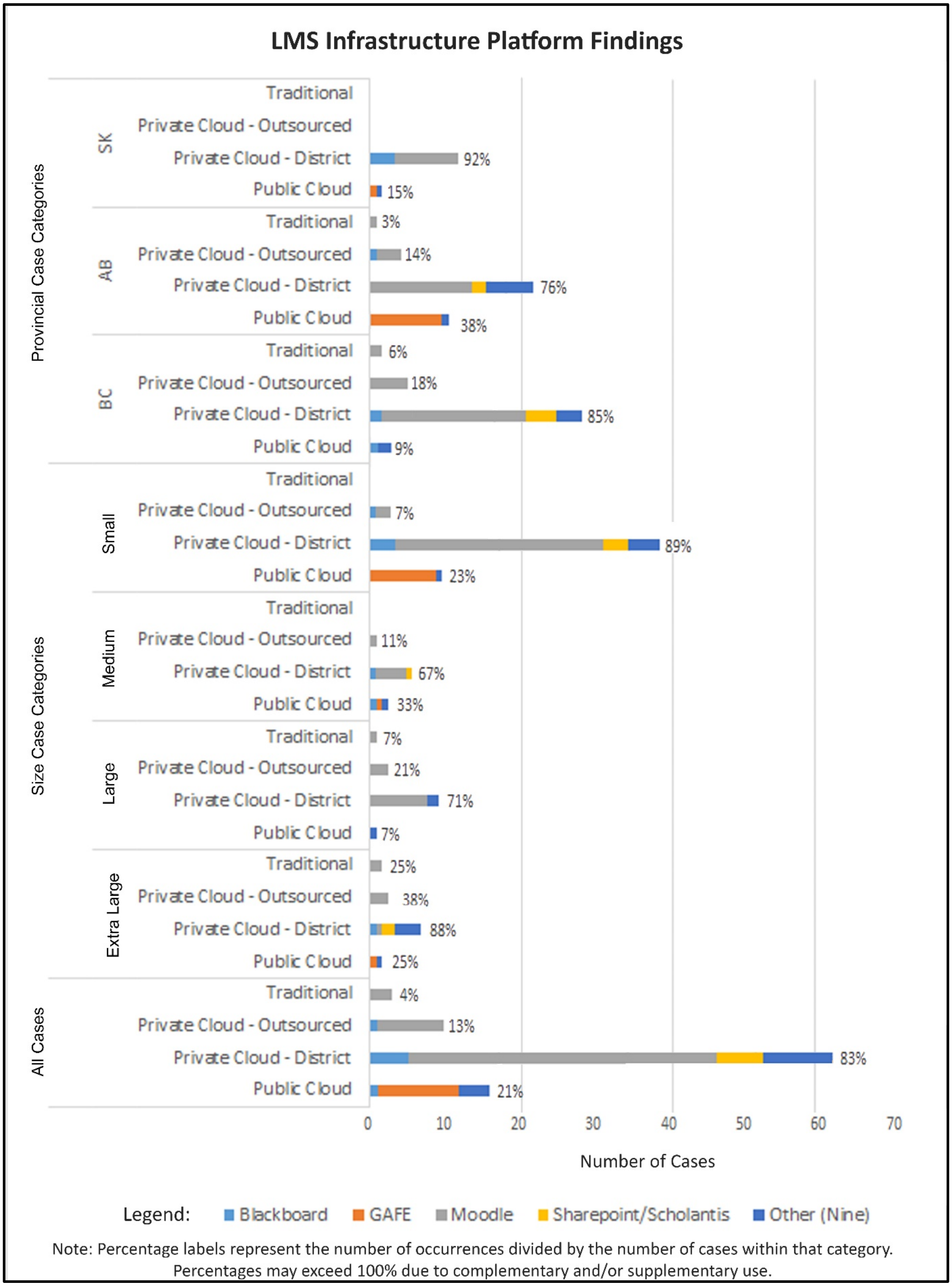


Figure 16. LMS infrastructure platform findings.

common LMS in all three provinces and in all case size categories. LMS software findings are presented in Figure 17. Although districts most commonly delivered Moodle by private cloud, some also delivered it on private cloud–outsourced and traditional infrastructures.

Google Apps for Education (GAFE) was the second most commonly occurring LMS software that 15% of all cases used. In Alberta 34% of the cases used GAFE the most extensively. In Saskatchewan, 8% of the cases used GAFE. None of the districts in British Columbia used it. GAFE is available only through public cloud.

Blackboard was the third most common LMS that 11% of the cases used. I found its use in all three provinces and all size categories, with the exception of the L category. The districts delivered Blackboard through cloud, private cloud–district, and private cloud–outsourced, though most frequently, in 75% of the cases, they delivered it through private cloud district infrastructure.

The fourth most frequently used LMS software was Scholantis/SharePoint. Although I did not find it at all in Saskatchewan, 7% of the cases in Alberta and 15% in British Columbia used it. Though absent from the L size category, it was present in all other size categories. As the cases increased in size, the use of Scholantis/SharePoint also increased (9% in the S category, 11% in the M category, and 25% in the XL category). The districts used private cloud exclusively to deliver Scholantis/SharePoint. I found considerable diversity in the LMS software that the districts used. As Figure 17 reveals, the cases used software other than the top four that I listed to deliver 20% of the LMS functions. They included Desire2Learn, Office365, Edmodo, WordPress, CIMS, a custom solution, SchoolConnect, FirstClass LMS, and PowerSchool. The cases delivered them most frequently by using private cloud–district (73%), followed by public cloud (27%).

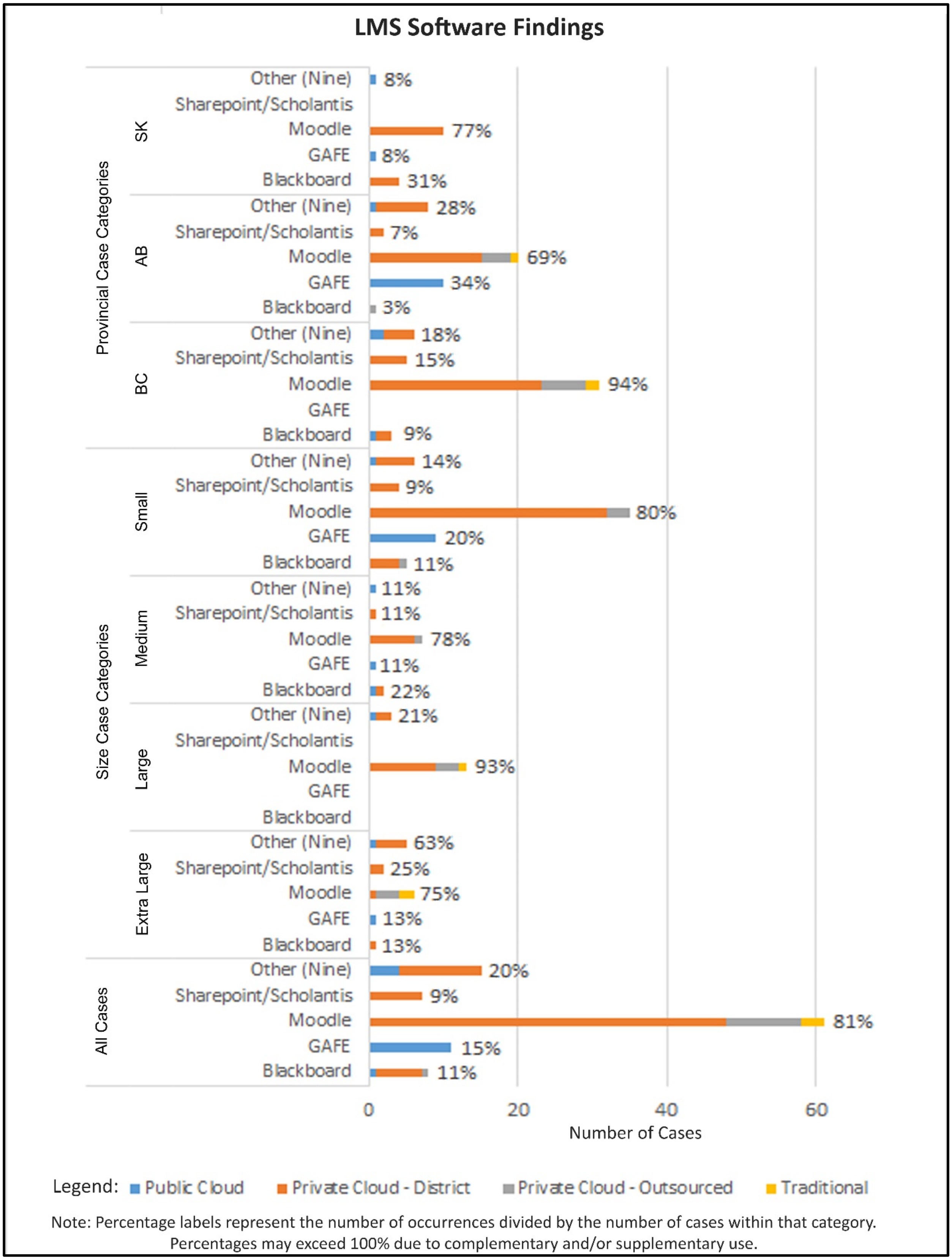


Figure 17. LMS software findings.

Library Systems

Library infrastructure platforms. Private cloud infrastructure was the most common infrastructure platform to deliver library functions in Western Canadian K-12 districts. Library infrastructure platform findings are presented in Figure 18. Private cloud infrastructure was the dominant platform for library services in all three provinces and all size categories, used in 68% of the cases.

The second most common infrastructure platform that 21% of the cases used to deliver library functions was public cloud. I found private cloud in all provinces and all size categories. The districts' use of public cloud increased slightly in both the smallest (S) and the largest (XL) case size categories. This is perhaps because of the limitations of district-owned platforms (traditional and private cloud–district) in the S case size category, and the greater student population needs of districts in the XL case size category. Perhaps the districts in the M and the L case sizes were best suited for private cloud–district use.

Traditional infrastructure was the third most common infrastructure platform that 11% of all cases used to deliver library infrastructure platforms. I found traditional infrastructure in all provinces. Cases in the M size category used it most commonly—22% of the cases—but those in the L size case category did not use it. Cases in the S and XL size categories used traditional infrastructure for library infrastructure: 11% and 13%, respectively.

Private cloud–outsourced was the least common infrastructure platform. It was used in 3% of the study's cases to deliver a district's library functions. Alberta cases in the size categories S and L were the only districts that used private cloud–outsourced to deliver library functions.

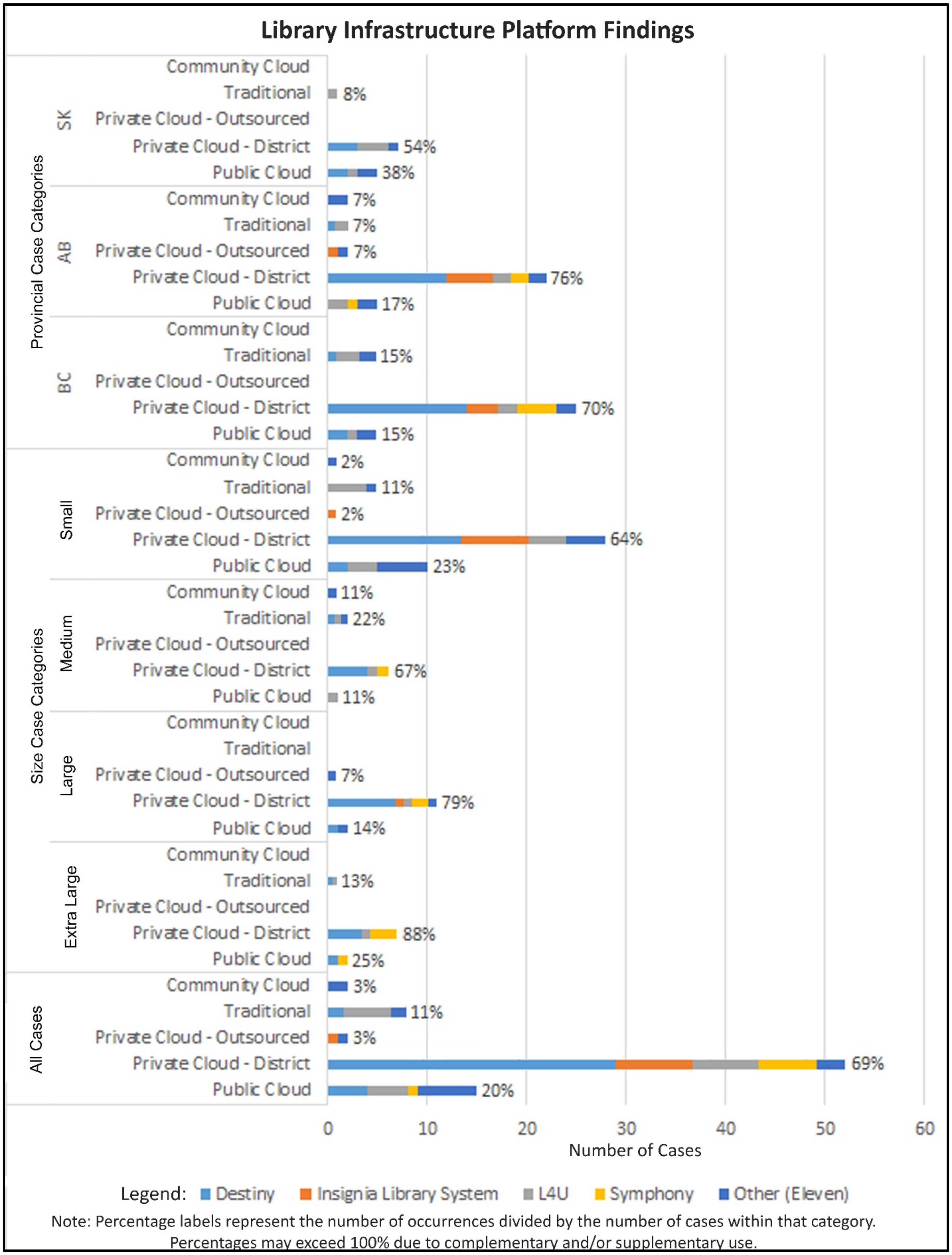


Figure 18. Library infrastructure platform findings.

Library software. Follett Destiny was the dominant library software used by Western Canadian K-12 districts. As Figure 19 illustrates, Follett Destiny was found in 48% of cases and was the main library software in all province and size case categories. I found Follett Destiny on the public cloud, private cloud–district, and traditional platforms. The most common delivery platform was private cloud, which accounted for 83% of all Follett Destiny use.

The second most commonly used library software that 23% of the cases in Western Canada used was L4U, in all provinces and all size categories. The districts used public cloud, private cloud–district, and traditional infrastructure to deliver L4U. The smaller cases—namely, those in the S and M categories—delivered L4U on all three platforms. In the larger, L categories and XL categories, the cases delivered L4U exclusively on district infrastructure, either through private cloud–district or traditional infrastructure.

The third most common library software that 12% of the cases used was Insignia. Insignia was absent in Saskatchewan, but British Columbia and Alberta used it. In these two provinces I found it in the S and L categories in 18% and 7% of the cases, respectively. This trend indicates reduced use of Insignia as districts grow in size; the absence of Insignia from the XL category entirely emphasizes this. The cases most frequently used private cloud–district to deliver Insignia, and only 1% of the cases delivered it on traditional infrastructure in the smallest S category.

The fourth most common library software that 9% of the cases in Alberta and British Columbia, but not Saskatchewan, used was Symphony. It was similarly absent from the smallest district size category, S. I found Symphony in small numbers in the M and L categories in 11% and 14% of the cases, respectively. However, notably, 50% of the largest cases, those in the XL category, heavily used Symphony. The absence of XL cases in Saskatchewan is perhaps a

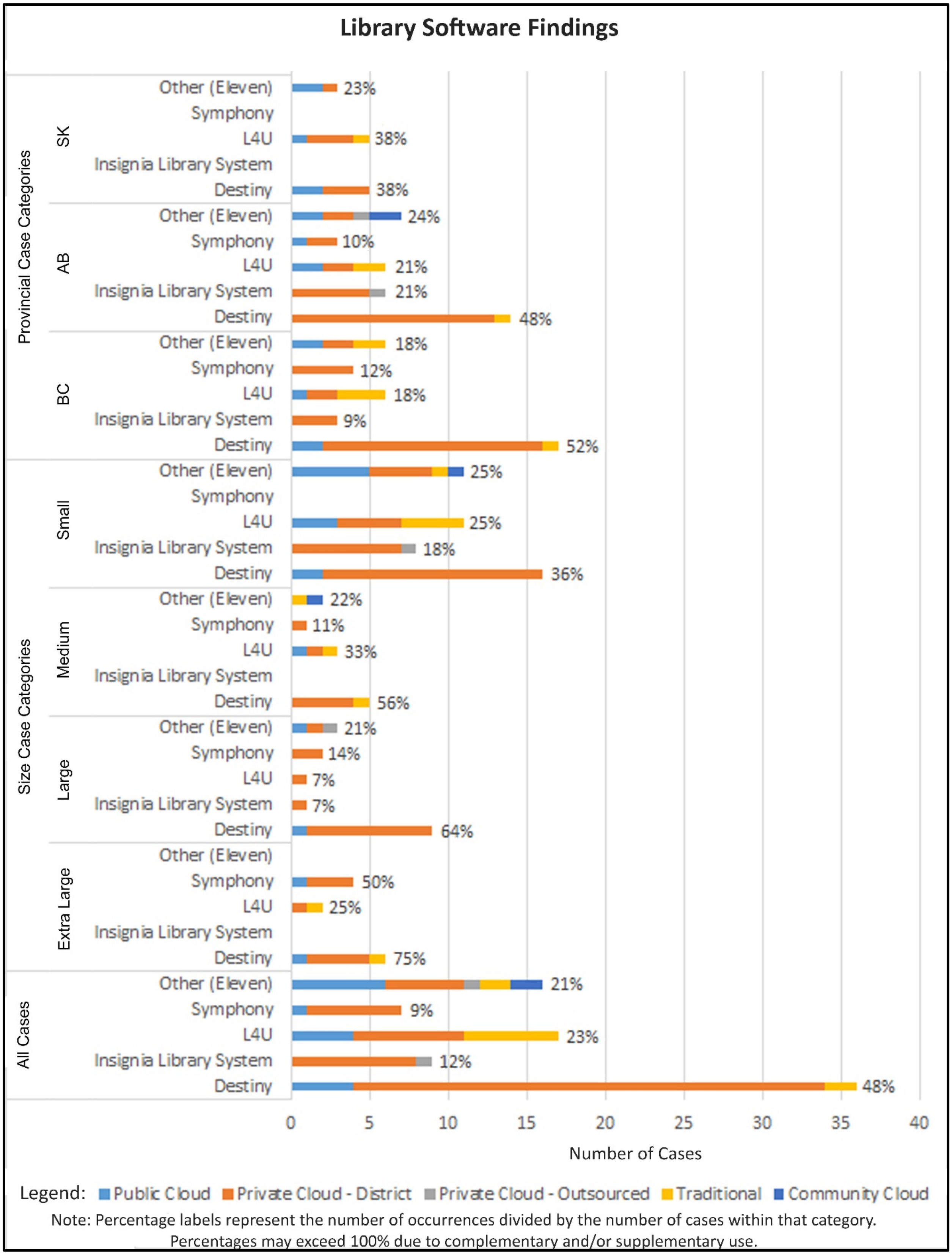


Figure 19. Library software findings.

correlate of/contributing factor to the lack of Symphony in Saskatchewan. The cases used public cloud and private cloud–district to deliver Symphony, though most frequently they used private cloud–district.

The cases in British Columbia, Alberta, and Saskatchewan used 12 other library software types, for a total of 21% across all cases. I found them in all provinces and all sizes, with the exception of the XL category, in which the cases used Follett Destiny, Symphony, and L4U exclusively. I found the greatest diversity in library software in the smallest size category, S, in which the cases used 9 other library software types, outside of the main four that I listed above. This represents 25% of all cases.

Authentication Systems

Authentication infrastructure platforms. As presented earlier in Table 17, authentication infrastructure refers to the infrastructure used to manage user credentials and accounts. Cases were found to most commonly use district-based private cloud to deliver authentication functions. This is evident in Figure 20. Of all cases, 95% that included 5,000 students or more in British Columbia, Alberta, and Saskatchewan used private cloud–district to perform user-authentication and security functions. I found private cloud–district-based authentication in 100% of British Columbia's cases. Similarly, 100% of the districts of 10K students and more (M, L, and XL case categories) used a private cloud–district approach to user authentication. In Saskatchewan and the S size grouping, the percentage of cases that used this approach for authentication was also high (92% and 91%, respectively).

The cases used traditional, on-premises-only infrastructure for authentication and security sparingly. Only 9% of the cases used on-premises, traditional infrastructure. In British Columbia, Alberta, and Saskatchewan, the distribution of on-premises infrastructure for

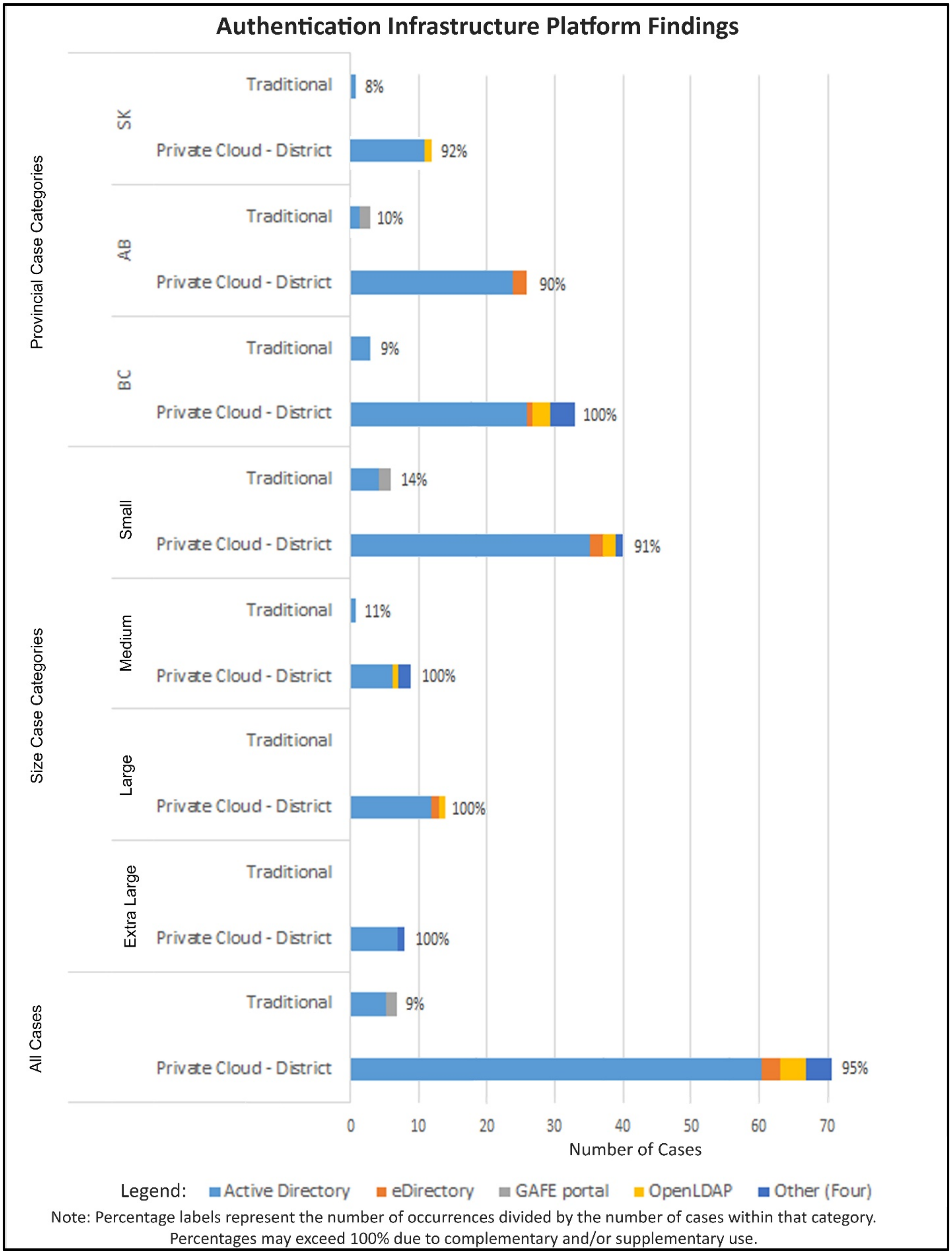


Figure 20. Authentication infrastructure platform findings.

authentication was 9%, 10%, and 8%, respectively. On-premises, traditional infrastructure was most common in the smallest cases in this study; 14% of the cases in the size category of S and 11% of the cases in the M size category used it. None of the larger cases—namely, those with 15K students or more—used traditional infrastructure.

None of the cases used public cloud, community cloud, or private cloud–outsourced infrastructure platforms for authentication purposes.

Authentication software. The most common authentication software, in 95% of the cases in this study, was Active Directory. I found it in all of the province and size categories. This finding is presented in Figure 21. Saskatchewan had the highest occurrence of Active Directory, in 100% of its cases. The rate of use of Active Directory in British Columbia and Alberta was high as well; 97% and 90% of the cases, respectively.

Active Directory was prominent in all of the study's size categories. Occurrence rates were 98%, 89%, and 86%, respectively, in the S categories, M categories, and L categories. All of the cases (100%) in the largest category, XL students, used Active Directory. This largest size category also had the lowest variety of software for authentication; these cases used only 13% of other authentication software to complement Active Directory (contrasted to the smaller size categories in which, to a small extent, the cases used alternatives to Active Directory).

The second most common authentication software was OpenLDAP, though only 5% of the cases in the study used it. Only 9% of the cases in British Columbia and 8% of those in Saskatchewan used OpenLDAP, but it was absent in Alberta entirely. OpenLDAP was similarly absent from the largest size category of XL students, but present in a small percentage in all other size categories (5% in the S category, 11% in the M category, and 7% in the L category). The cases used OpenLDAP both as an alternative to Active Directory and to complement Active

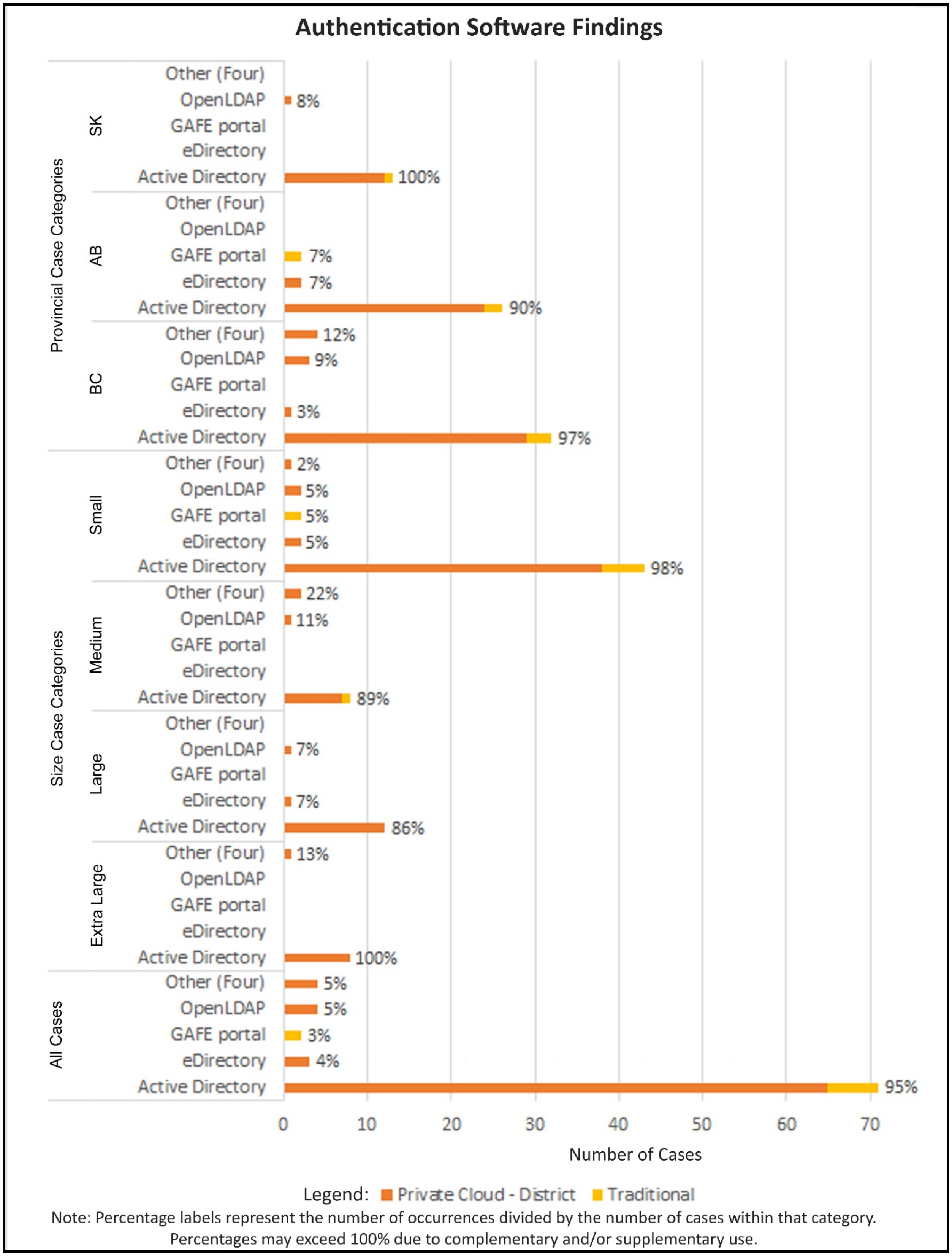


Figure 21. Authentication software findings.

Directory. Only the cases in the smallest size category used both simultaneously. The cases used private cloud–district based exclusively infrastructure to deliver OpenLDAP.

The third most common authentication software was eDirectory, which I found in only 4% of the cases. They used eDirectory as an alternative to Active Directory, but none of the cases used the two simultaneously. Alberta (7%) and British Columbia (3%) used eDirectory to a limited extent, but Saskatchewan did not use it at all. Similarly, eDirectory was absent from the XL size category and M size category. In the S size category, 5% of the cases used eDirectory; and in the L size category, 7% of the cases used it. The cases used the Private Cloud–District platform exclusively to deliver eDirectory.

The fourth most common approach to authentication was to create a single-user profile on a local, school computer (traditional infrastructure only), which served as a conduit to access GAFE. Only 3% of all cases in this study used it both in parallel with and as an alternative to Active Directory. Cases in only the smallest size category of S used this approach (5%), and they were all in Alberta (7%). I did not find this approach in any other province or size category.

In addition to the top four authentication software types and approaches that I described earlier, 5% of the cases used four other authentication software types. They were only in British Columbia (12%), where they occurred in all size categories, with the exception of the L category, from which it was absent. These other approaches varied in their frequency of occurrence: 2% in the S size category, 22% in the M category, and 13% in the XL category. The cases used these four other authentication software types both as alternatives to and to complement the dominant authentication software, Active Directory. The cases used the Private Cloud–District infrastructure platform exclusively to deliver the four other authentication software types: ExtremeZ-IP, LemonLDAP:NG, ownCloud, and Samba.

E-mail Systems

E-mail infrastructure platforms. I found that 81% of all cases used the district-based private cloud platform the most commonly to deliver e-mail functions. This finding is presented in Figure 22. Saskatchewan had the highest number of cases (100%) that used private cloud–district to deliver e-mail functions, and British Columbia had the next highest number (97%). The majority of Alberta cases used private cloud–district-based infrastructure for e-mail purposes, though the percentage of use (55%) in all cases was considerably less than in Saskatchewan or Alberta. I commonly found private cloud–district-based e-mail infrastructure platforms in all size categories. They ranged from 75%, 89%, 100%, and 75% in the S, M, L, and XL categories, respectively. Private cloud–district based was the most prevalent infrastructure platform for the delivery of e-mail in this study.

The second most common approach to e-mail infrastructure was public cloud, which 61% of all cases used. This approach was most common in Alberta, where 97% of the cases used public cloud for e-mail functions. In Saskatchewan, 62% of the cases used public cloud for e-mail. British Columbia was the only province in which fewer than half—30%—of the cases used public cloud. Alberta's use of public cloud for e-mail is noteworthy for two reasons: Its use was considerably greater than that in the other neighbouring provinces. It was also the only province that used public cloud infrastructure to a greater extent than private cloud–district based for e-mail. In the size category, smaller cases used public cloud to a far lesser extent than the largest cases did. For example, in cases of S, M, and L sizes, the frequency of occurrence was 61%, 44%, and 57%, respectively. On the other hand, 88% of the cases of XL size used public cloud for e-mail. It is also noteworthy that the XL size category was the only one in which public cloud infrastructure exceeded the use of private cloud–district infrastructure.

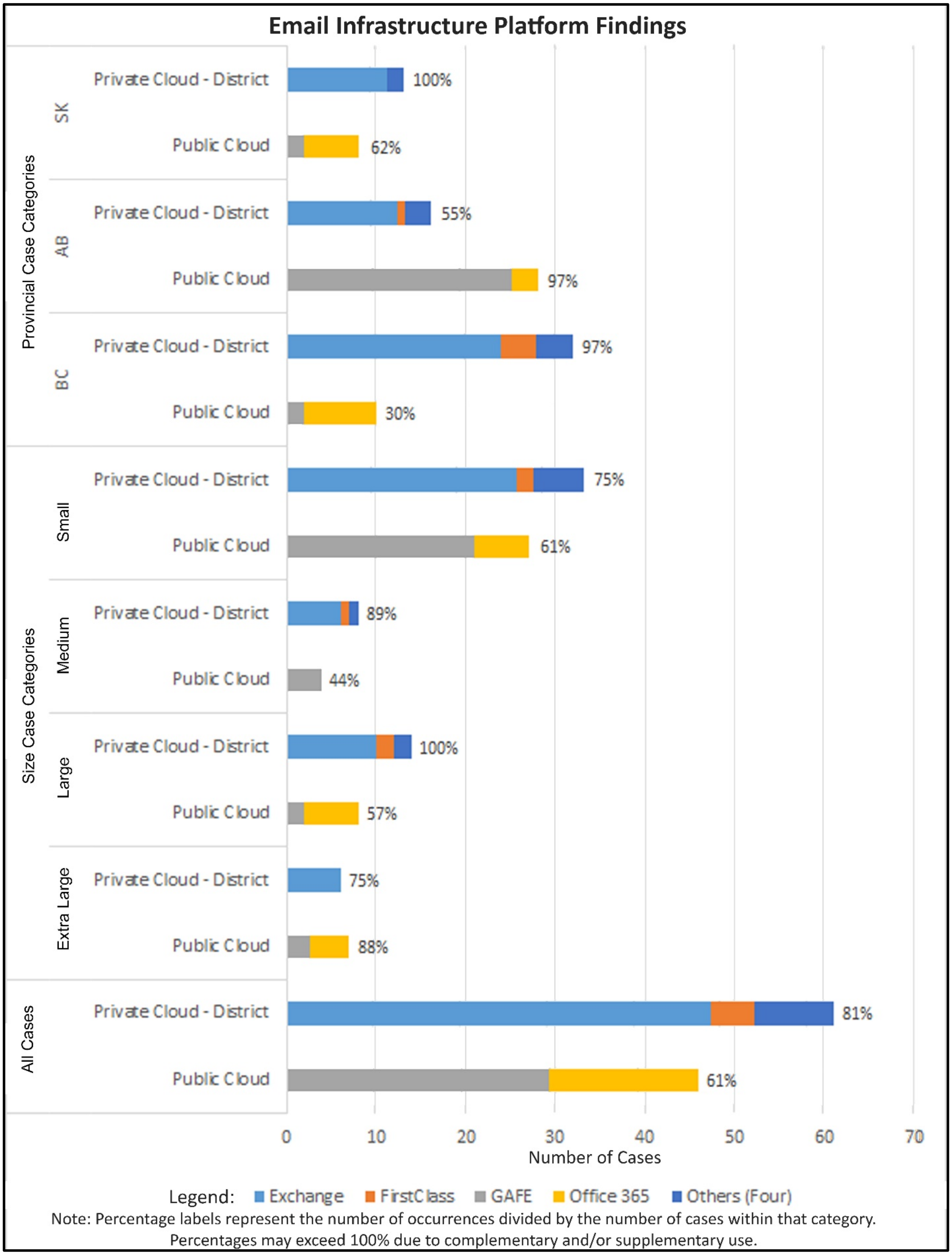


Figure 22. E-mail infrastructure platform findings.

The high use of both private cloud and public cloud infrastructure platforms in the study, regardless of province or size category, reveals that districts often use the two platforms complementarily. This complementary use of platforms and their associated software is the focus of the infrastructure findings in the next chapter on my analysis of the findings.

The districts in this study did not use Community Cloud and Private Cloud–Outsourced as infrastructure platforms for e-mail delivery. Similarly, traditional, on-premises infrastructure was, by definition, not a possible category for e-mail delivery infrastructure.

E-mail software. The most common e-mail software found in this study was Microsoft Exchange, which was used in 65% of the cases studied. Figure 23 presents the findings for e-mail software use by the cases in this study. Cases in all provinces used Exchange; the greatest frequency was in Saskatchewan (92%), followed by British Columbia (73%) and Alberta (45%). I found its use in all size categories as well; more than half of the cases in each category used the software. The frequency of use was as follows: 61% in the S category, 67% in the M category, 71% in the L category, and 75% in the XL category. All of the cases used the private cloud–district platform to deliver Exchange.

The second most common e-mail software was GAFE, which includes Google's e-mail package, *Gmail*. I found the use of GAFE in 40% of all cases, in all provinces, and in all size categories. Alberta used GAFE the most (90%), followed by Saskatchewan and British Columbia, which used it considerably less (15% and 6%, respectively). In the size categories, the use of GAFE was greatest in the smallest category of S; 48% of the cases used it, followed by the M and XL categories, in which 44% and 38% of the cases used GAFE, respectively. The smallest percentage of use was in the L size category, in which only 14% of the cases used it. GAFE was available only on the public cloud platform.

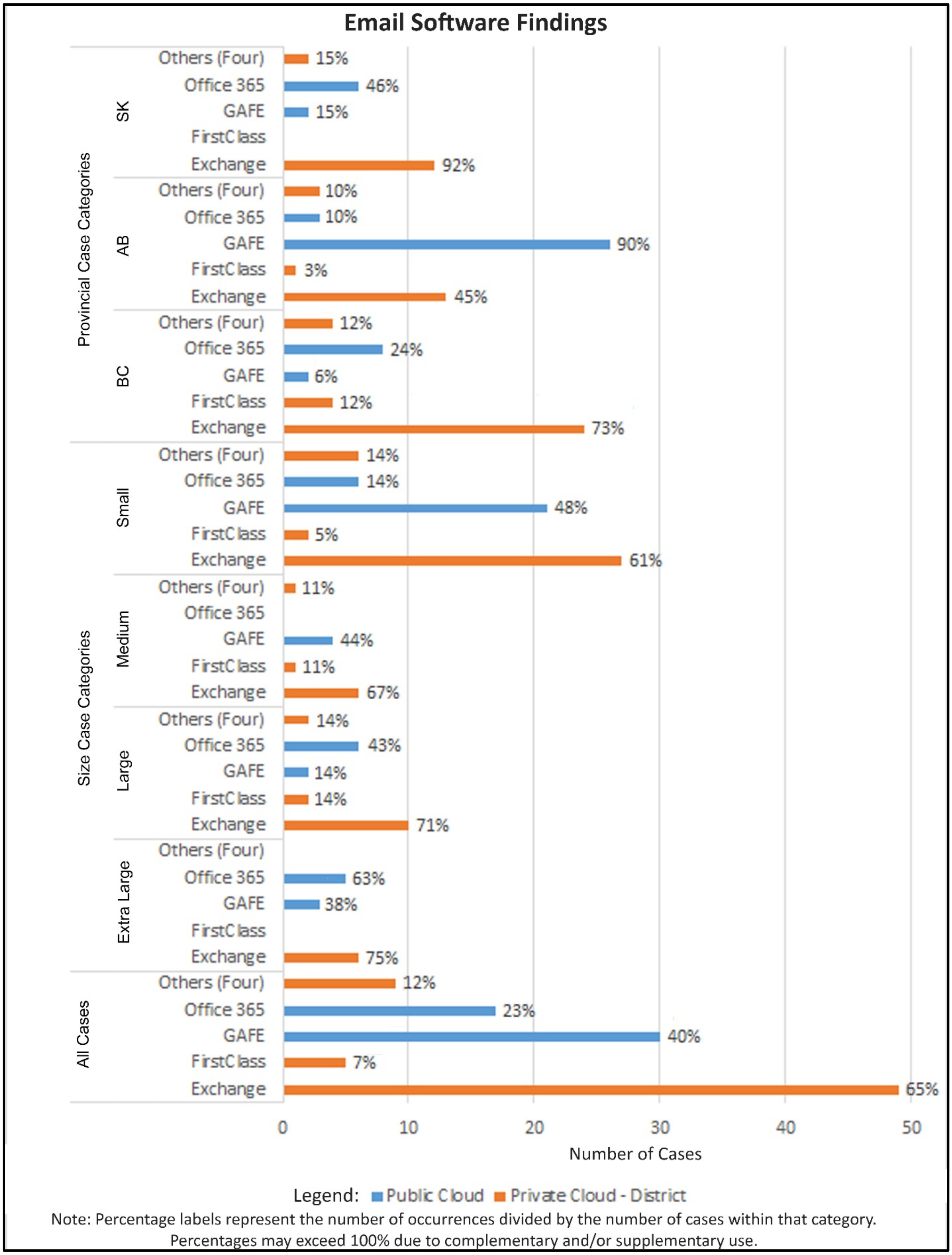


Figure 23. E-mail software findings.

The third most common e-mail software in 23% of the cases in the study was Office 365, a public cloud–only software. The greatest use of Office 365 was in Saskatchewan, where it accounted for 46% of district e-mail; it was the second most used e-mail software after Exchange. British Columbia and Alberta showed considerably less use of Office 365; 24% and 10%, respectively. In the size category, the larger cases used Office 365 the most heavily. In the largest size category, XL, 63% of the cases used Office 365, followed by the second largest category, L, which 43% of the cases used. The use of Office 365 was absent from the M size category and present in only 14% of the cases in the smallest category.

The fourth most commonly used e-mail software in 7% of the cases was FirstClass. I found FirstClass only in British Columbia (12%) and Alberta (3%); it was absent entirely from Saskatchewan. Similarly, FirstClass was absent from the largest size category (XL). The cases in the S, M, and L categories, however, used First Class, minimally; it accounted for 5%, 11%, and 14% of the cases, respectively. In all instances the cases used only the private cloud–district platform to deliver First Class.

In addition to Exchange, GAFE, Office 365, and FirstClass, I found the use of four additional software types for e-mail: DeskNow, GroupWise, IceWarp, and Zimbra. These other software types accounted for 12% of the e-mail software in the study. I found them in all provinces and all size categories, with the exception of the largest size category of XL, from which it was absent. In British Columbia, Alberta, and Saskatchewan, 12%, 10%, and 15% of the cases, respectively, used these other e-mail software types. According to district size, in the S category, 14% of the cases used other software types; in the M category, 11% did so; and in the L category, 14% did so. All of these other e-mail software types operated on the private cloud–district infrastructure platform.

Financial Systems

Financial infrastructure platforms. The cases in this study most frequently delivered financial software via a private cloud–district platform. Figure 24 shows these findings. Of all cases studied, 85% used this approach. It was most common in British Columbia, where 97% of the cases used private cloud–district to deliver financial software-related functions. In Saskatchewan and Alberta, 77% and 76% of the cases, respectively, used this infrastructure platform to support their financial operations. According to size, only the cases in the S size category partially used private cloud–district. Although 75% of cases in this category is still a large percentage, this was the only size category in which 100% of the cases did not use private cloud–district.

The second most common infrastructure platform that 21% of the cases used to deliver financial software functions was public cloud, in all provinces and all size categories, though to a relatively small extent compared to the use of private cloud–district. Alberta (31%) and Saskatchewan (23%) had the highest percentages of use, followed by British Columbia (12%). The S size category had a considerably higher rate of public cloud use (27%), compared to the larger categories of M (11%), L (14%), and XL (13%).

The third most common infrastructure platform to deliver financial software operations was the traditional on-premises infrastructure platform. This platform accounted for 5% of all cases in the study. Although absent from Alberta, 15% of the cases in Saskatchewan and 6% of those in British Columbia used traditional infrastructure for financial software delivery, though in relatively small numbers. The size categories in which this traditional infrastructure platform appeared were the S and L categories, occurring in 7% of each of those cases.

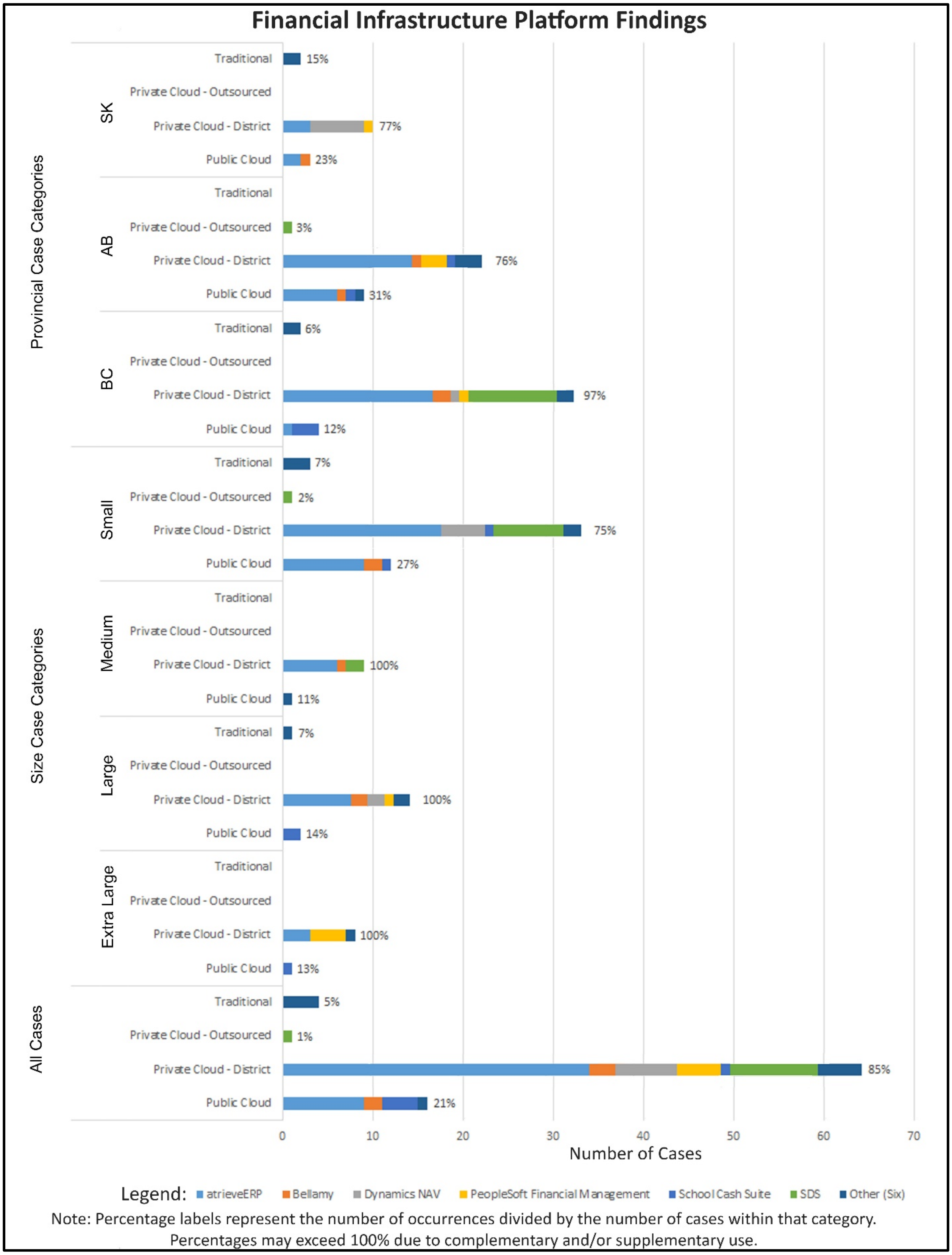


Figure 24. Financial infrastructure platform findings.

The least common infrastructure platform was private cloud–outsourced, which I found in 1% of cases in this study. This was used by only one district in Alberta, representing 3% of the provinces' cases. Similarly, this one district was found in the smallest category, representing 2% of the cases in the S size category.

Financial software. The most common financial software that 59% of all cases used was SRB atrieveERP, in all provinces and all size categories. I illustrate this finding in Figure 25. Cases in Alberta used it most heavily (72%), followed by British Columbia (55%) and Saskatchewan (38%). Cases in the smaller size categories showed higher rates of use than the larger cases. For example, 61% and 67% of the cases in the S and M size categories, respectively, used SRB atrieveERP. Of the cases in the L size category, 57% used it slightly less. Of the cases in the XL size category, however, 38% used it considerably less. SRB atrieveERP is delivered on both private cloud–district and public cloud platforms. Most commonly, SRB atrieveERP is delivered on private cloud–district. In all provinces and size categories, private cloud–district was more common than the public cloud platform. Although all provinces used public cloud to deliver SRB atrieveERP, it was only in the S size category. In all other size categories, the cases used private cloud–district to deliver SRB atrieveERP.

The second most common financial software, in 15% of all cases in the study, was SDS. Cases in British Columbia used SDS the most heavily (30%), but only 3% of the cases in Alberta used it, and none in Saskatchewan. In the size category, the smaller cases used SDS the most heavily. In the S and M categories, 20% and 22% of the cases, respectively, used SDS. SDS was absent from the larger size categories entirely. Districts used both private cloud–district and private cloud–outsourced to deliver SDS, though the latter to a very minor extent. Only in one district in the S size category in Alberta delivered SDS exclusively by using private cloud–

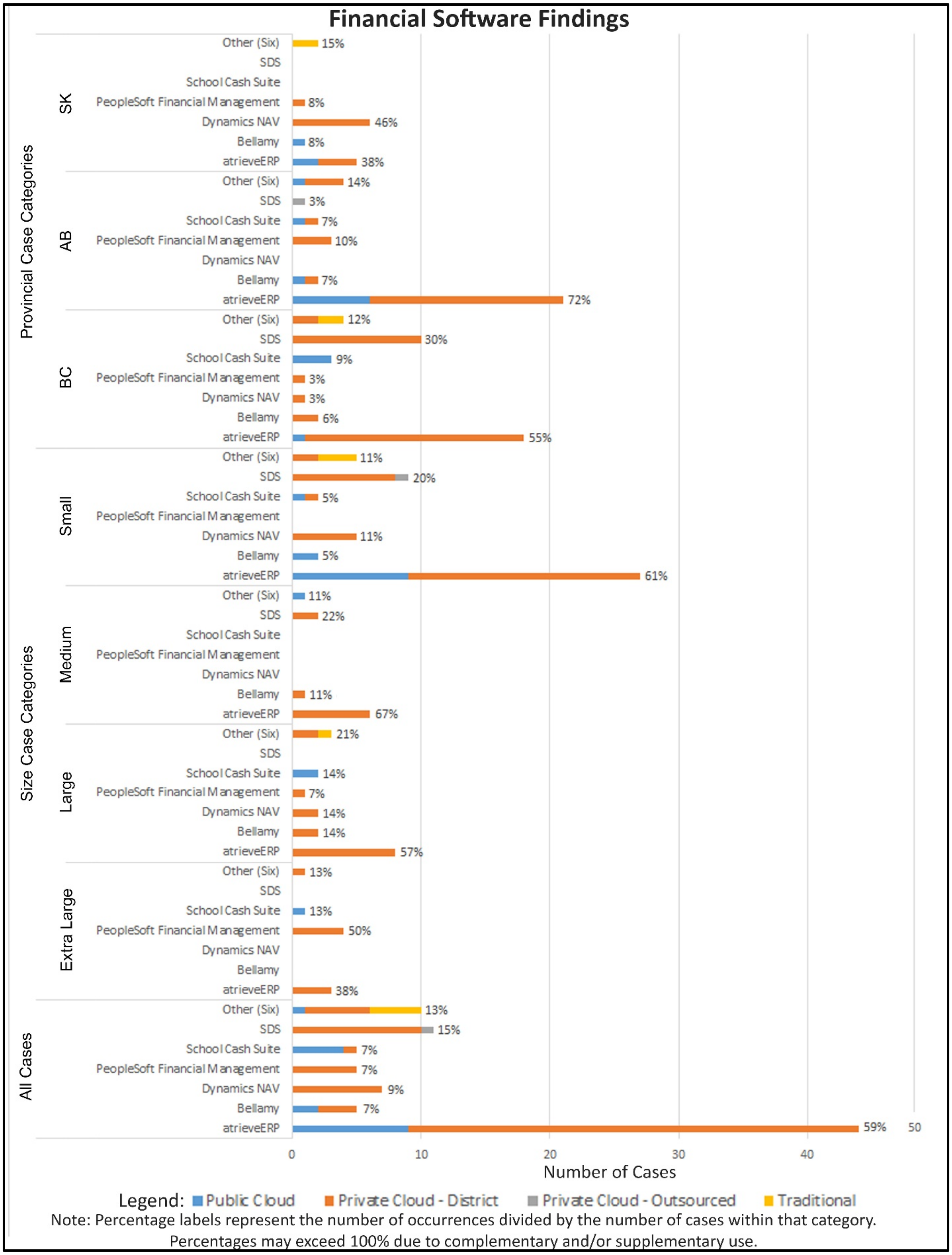


Figure 25. Financial software findings.

outsourced. The cases in British Columbia used private cloud–district infrastructure exclusively to deliver SDS.

The third most common financial software was Microsoft Dynamics NAV, which 9% of all cases in the study used. It was the most commonly used financial software in Saskatchewan, in 46% of the cases. It was, however, absent from Alberta, and only 3% of the cases in British Columbia used it. Only 11% of the cases in the S size category and 14% of the cases in the L category used Microsoft Dynamics NAV. In Saskatchewan Microsoft Dynamics NAV accounted for 50% of the financial software in the S category and 33% in the province’s largest category, L. All of the cases operated Microsoft Dynamics NAV on a private cloud–district platform.

In 7% of the study’s cases I found the following three software types: Bellamy, PeopleSoft Financial Management, and School Cash Suite. They are tied for the third most commonly used financial software. In the following paragraphs I discuss each of these software types.

I found Bellamy in use in 7% of all cases, in all provinces, and in all size categories, with the exception of the largest category, XL. Its use was relatively consistent across the provinces: Saskatchewan, 8%; Alberta, 7%; and British Columbia, 6%. In the size categories, the distribution was similarly minor and consistent: S, 5%; M, 11%; and L, 14%. Both private cloud–district and public cloud hosted Bellamy in these cases. In Saskatchewan, public cloud exclusively delivered Bellamy. The cases in Alberta used public cloud and private cloud–district in equal measure to deliver Bellamy. Those in British Columbia used private cloud–district exclusively to deliver Bellamy. In the size categories, only the smallest cases, those with S students, used public cloud for Bellamy. In all other size categories, the cases delivered Bellamy on the private cloud–district platform.

Only 7% of the cases in the study used Oracle PeopleSoft Financial Management. Its use was limited in the provincial analysis as well: British Columbia, 3%; Alberta, 10%; and Saskatchewan, 8%. Only the cases in the largest size categories used Oracle PeopleSoft Financial Management. In the largest size category, XL, 50% of the cases used it; whereas 7% of the cases in the L size category used it. It is noteworthy that the one district in the L category in Saskatchewan represents the largest size category in that province because Saskatchewan had no XL cases. Perhaps because of the cost and/or complexity of the Oracle PeopleSoft Financial Management software, only the largest cases in a province used it. These largest cases used private cloud–district exclusively to deliver the software. This is a reasonable finding as the largest cases are more likely to have large-scale IT infrastructure and necessary support staff.

KEV School Cash Suite was used in 7% of all cases: It was present in British Columbia (9%) and Alberta (7%), but absent from Saskatchewan. According to the size categories, all but the cases in the M category used KEV School Cash Suite. In the S category, 5% of the cases used it; in the L category, 14% used it; and in the XL category. 13% used it. The cases most commonly used public cloud infrastructure to deliver KEV School Cash Suite, though only cases in the smallest size category of S students in Alberta used the private cloud–district infrastructure platform. The cases in Alberta used both private cloud–district and public cloud to deliver KEV School Cash Suite. Those in British Columbia used public cloud exclusively. Similarly, cases in the L, and XL size categories used public cloud exclusively to deliver KEV School Cash Suite. The software is notable in that it is the only financial software that the cases delivered on both private cloud–district (20%) and public cloud infrastructure platforms (80%); public cloud was more common.

In addition to the six leading financial software types that discussed in this section, I found the use of six other software types; combined, 13% of all the study's cases used these types: My BudgetFile, Altus Dynamics, Cayenta, CIMS, QuickBooks, and Simply Accounting. Across the three Western provinces the distribution of these other financial software types was relatively consistent: British Columbia, 12%; Alberta, 14%; and Saskatchewan, 15%. A similar pattern existed in the size categories: 11% in the S category, 11% in the M category, 21% in the L category, and 13% in the largest category, XL. The infrastructure types that the cases used to deliver these financial software types varied. The most common was private cloud–district (50%), followed by traditional (40%) and public cloud (10%). A more detailed discussion of these other financial software types, however, is beyond the scope of this dissertation.

Websites: Website Infrastructure Platforms

I found that private cloud–district was used in 75% of the cases in this study. This was the most common approach to host websites in all case provincial and size groupings. The findings for website infrastructure are presented in Figure 26. Saskatchewan depended on this infrastructure type the most for website hosting; 100% of its cases used it. Moreover, the Saskatchewan cases used no other infrastructure platforms for website hosting. The rate of use in British Columbia was similarly high in that 88% of its cases used private cloud–district for website delivery. Alberta's rate of use was considerably lower, but still substantial at 48%. Unlike in Saskatchewan and British Columbia, where private cloud–district was the primary website infrastructure, in Alberta, private cloud–district was the second most common approach, behind private cloud–outsourced. Cases in the larger size categories used private cloud–district

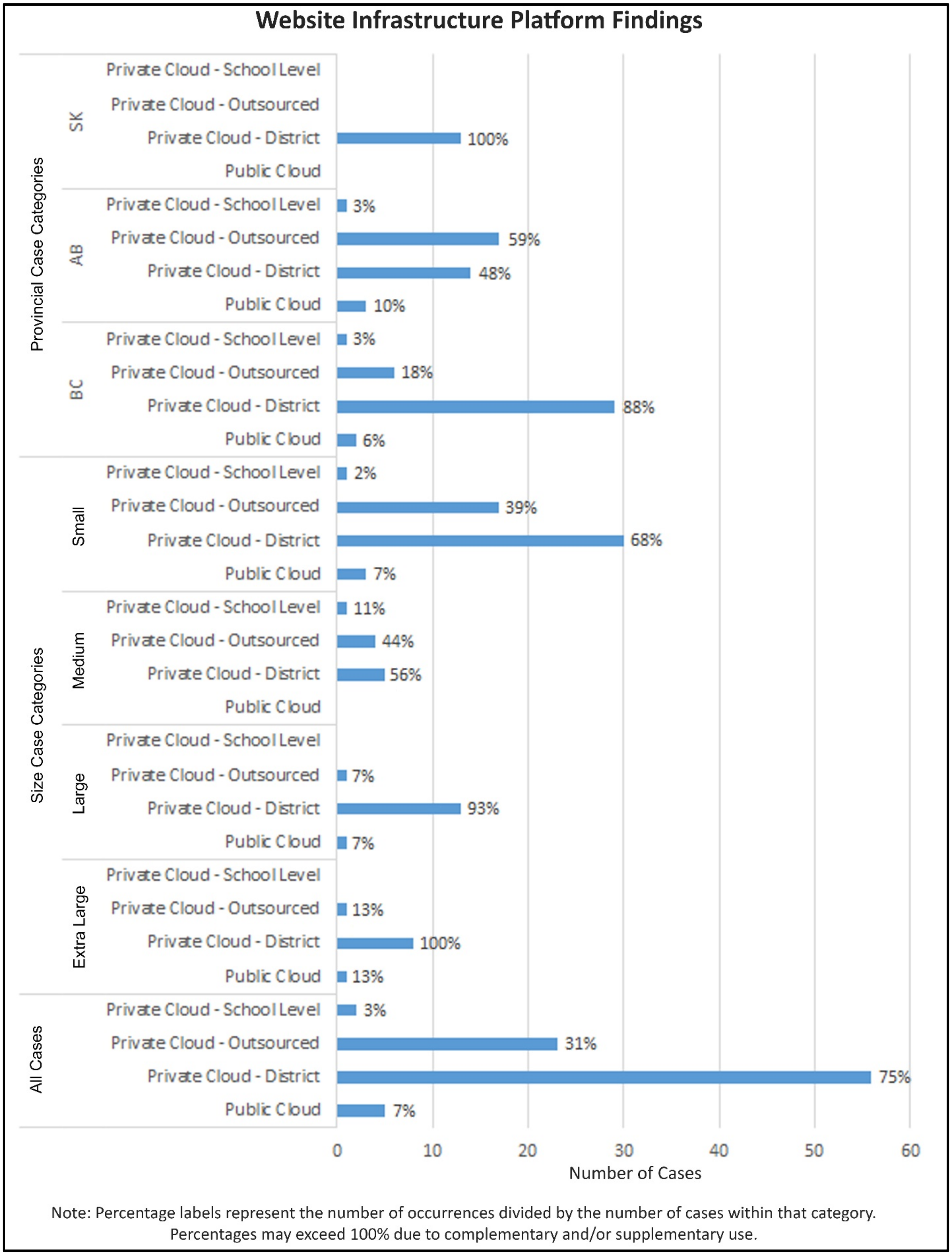


Figure 26. Website infrastructure platform findings.

the most heavily. The heaviest use was in the XL size category; 100% of the cases used private cloud–district. Cases in the second largest size category, L, also used private cloud–district infrastructure heavily for website delivery (93%). The smaller size categories had substantially reduced rates of use, but still used private cloud–district infrastructure as the dominant delivery approach to hosting district websites. The S and M categories used private cloud–district at a rate of 68% and 56%, respectively.

The second most common infrastructure platform to deliver district websites that I found in this study was private cloud–outsourced, which 31% of the cases used. Cases in Alberta were the heaviest users (59%). In British Columbia, 18% of the cases also used private cloud–outsourced for website delivery. However, the cases in Saskatchewan did not use private cloud–outsourced. With regard to size, smaller cases more commonly used private cloud–outsourced than larger cases did. In the S and M categories, 39% and 44% of the cases, respectively, used private cloud–outsourced, contrasted by 7% and 13% in the L and XL categories, respectively.

The third most common infrastructure platform to deliver websites was public cloud. Public cloud delivery for websites occurred via third-party professional website hosts such as Google sites, Weebly, and Amazon Web services, which is a professional integrated website hosting platform. In addition, 7% of the cases used public cloud, most commonly in Alberta (10%) and then in British Columbia (6%), but it was absent entirely from Saskatchewan. Cases in all size categories used public cloud in a limited way, with the exception of those with M students, from which it was absent. In the S and L categories, 7% of the cases used it. In the XL category, 13% of the cases used it. The use of public cloud complemented both private cloud–district and public cloud–outsourced. The cases also used one of these two other infrastructure types in addition to public cloud for website delivery.

The fourth most common infrastructure platform that the cases used to deliver websites was private cloud–school-based. However, they seldom used it; only 3% of the cases used this approach. It was absent entirely from Saskatchewan, but 3% of the cases in both Alberta and British Columbia used this approach. I found the private cloud–school-based platform only in the smaller size categories, and in a similarly limited way. In the S category, 2% of the cases used it. In the M category, 11% of cases used it. As with public cloud, private cloud–school-based website infrastructure complemented either private cloud–district or private cloud–outsourced infrastructure. The cases never used it without either of these other infrastructure types.

Social Media

Social media use is included in this study on IT infrastructure and cloud computing adoption by K-12 districts in Western Canada because major social media websites, such as Facebook and Twitter, are hosted exclusively on public cloud infrastructure. The findings presented in the subsections below for Facebook and Twitter therefore imply cloud computing adoption and use by districts.

Facebook. The majority of the cases in this study actively used Facebook in their district offices and/or their schools; 73% of all cases actively used Facebook. I present these findings in greater detail in Figure 27, organized by provincial and case size categories. Compared by province, the cases in Alberta most widely used Facebook (83%). British Columbia followed (70%), and Saskatchewan had the lowest level of use (62%). In the size categories, the levels of use were fairly consistent: 73% in the S category, 78% in the M category, 71% in the L category, and 75% in the XL category.

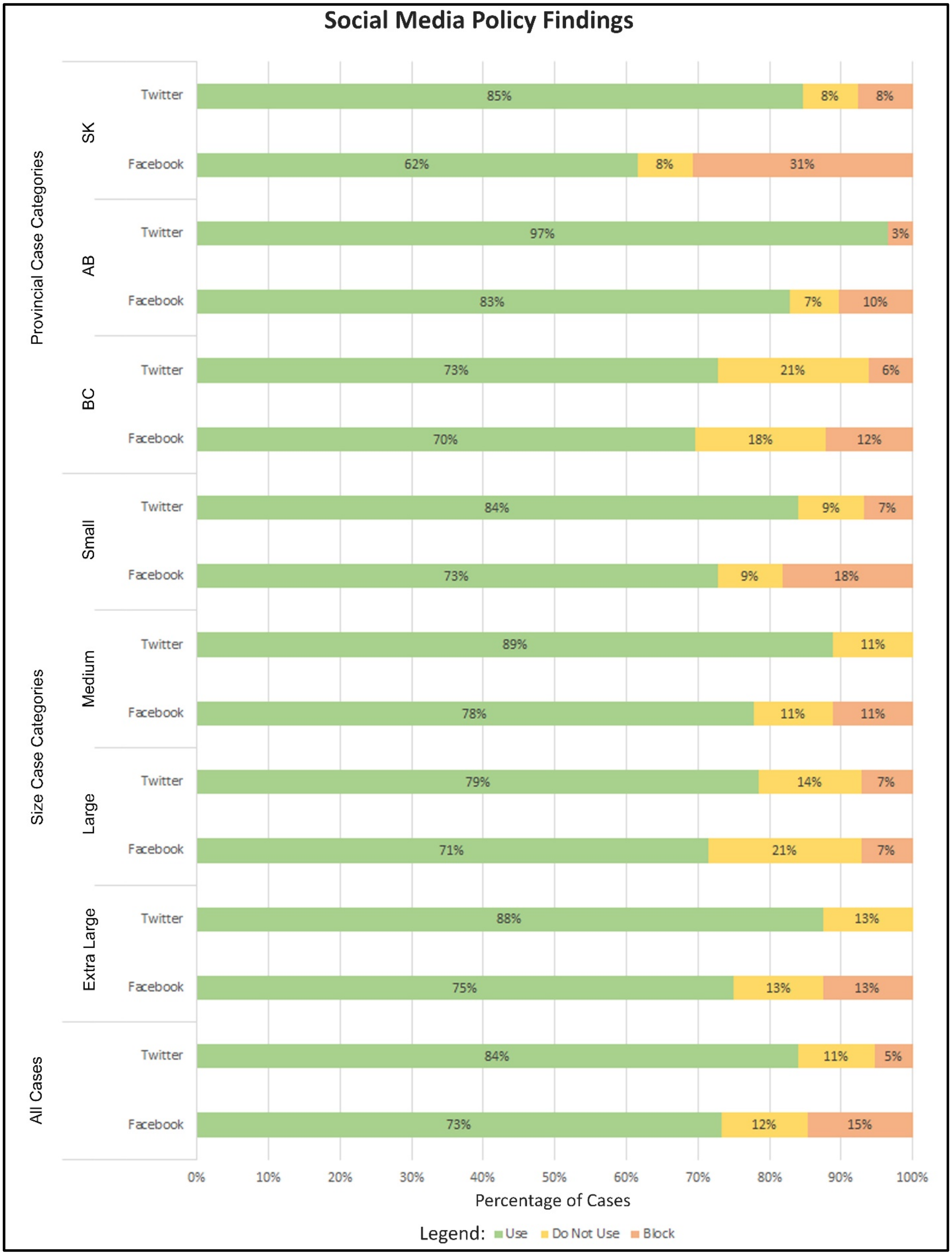


Figure 27. Social-media policy findings.

A relatively small percentage, 15%, of the cases actively blocked Facebook. The greatest opposition to Facebook was in Saskatchewan, in 31% of its cases. Alberta and British Columbia accepted Facebook considerably more: Only 10% and 12% of the cases, respectively, blocked it. According to size, the cases in the smallest size category of S were the most likely to block Facebook (18%). However, I found no apparent correlations between the blocking of Facebook and category size. In the M category, 11% of the cases blocked Facebook; in the 10-24.9K category, 7% blocked it; and in the XL category, 13% blocked it.

Across the study, 12% of the cases fit into a middle category in which they neither actively used nor actively blocked Facebook. This category was the largest in British Columbia, where 18% neither actively used nor blocked Facebook. Saskatchewan and Alberta followed, though to a lesser extent, with 8% and 7% in this category, respectively. The greatest percentage of cases (21%) in the L size category took this neutral approach. The next greatest percentage, 13%, though still low, was in the XL category. In the S and M size categories, 9% and 11% of the cases, respectively, took this neutral approach.

Twitter. The active use of Twitter was prevalent in 84% of the Western Canadian cases. The cases in Alberta actively used Twitter the most widely (97%); Saskatchewan and British Columbia followed (85% and 73%, respectively). The use of Twitter across the size categories was high and relatively consistent. In the S category, 84% of the cases actively used Twitter, and 89% in the M category. In the L size category, where active Twitter use was the lowest, the percentage was still high, at 79% of the cases. In the XL category, the active use of Twitter was again high, at 88% of the cases.

It was uncommon for the cases to actively block the use of Twitter in schools and/or at the district level. Only 5% of the cases in this study took this approach. Saskatchewan was the most likely to block Twitter, though in only 8% of its cases. British Columbia and Alberta had similarly low rates of 6% and 3%, respectively. In both the S and L size categories, 7% of the cases blocked Twitter. The cases in the other size categories, M and XL, did not block Twitter at all.

A small percentage (11%) of cases neither actively used nor actively blocked Twitter. The cases in Alberta were the most decisive in their use of Twitter; they either used it or blocked it, with no cases in the neutral category. In Saskatchewan 8% of the cases were in the neutral category. In British Columbia a comparably large percentage (21%) of its cases were in this middle category in which they neither blocked nor used Twitter. In the size categories, the neutral, middle category was relatively consistently represented: 9% of the cases in the S category, 11% of the cases in the M category, 14% in the L category, and 13% in the XL category.

Infrastructure Platform and Software Summary and Rankings

In this section on IT infrastructure and cloud computing adoption I have discussed in detail both the IT infrastructure platforms and the software that school districts used to deliver IT-enabled services to the over 1.148 million students enrolled in the 75 districts in Canada's three western-most provinces. Table 18 summarizes the infrastructure and software findings for all 75 districts. I have organized them in descending order from the greatest frequency to the lowest. Appendix H contains additional tables that summarize the remaining seven groupings, organized by province and size.

Findings Concerning Adoption Stages and Continued Infrastructure Use

In this chapter I discussed the ubiquity of cloud computing use in Western Canadian K-12 districts. A strength of Frambach and Schillewaert's (2002) framework is that, in addition

Table 18

IT Infrastructure Platform and Software Summary: All 75 Cases

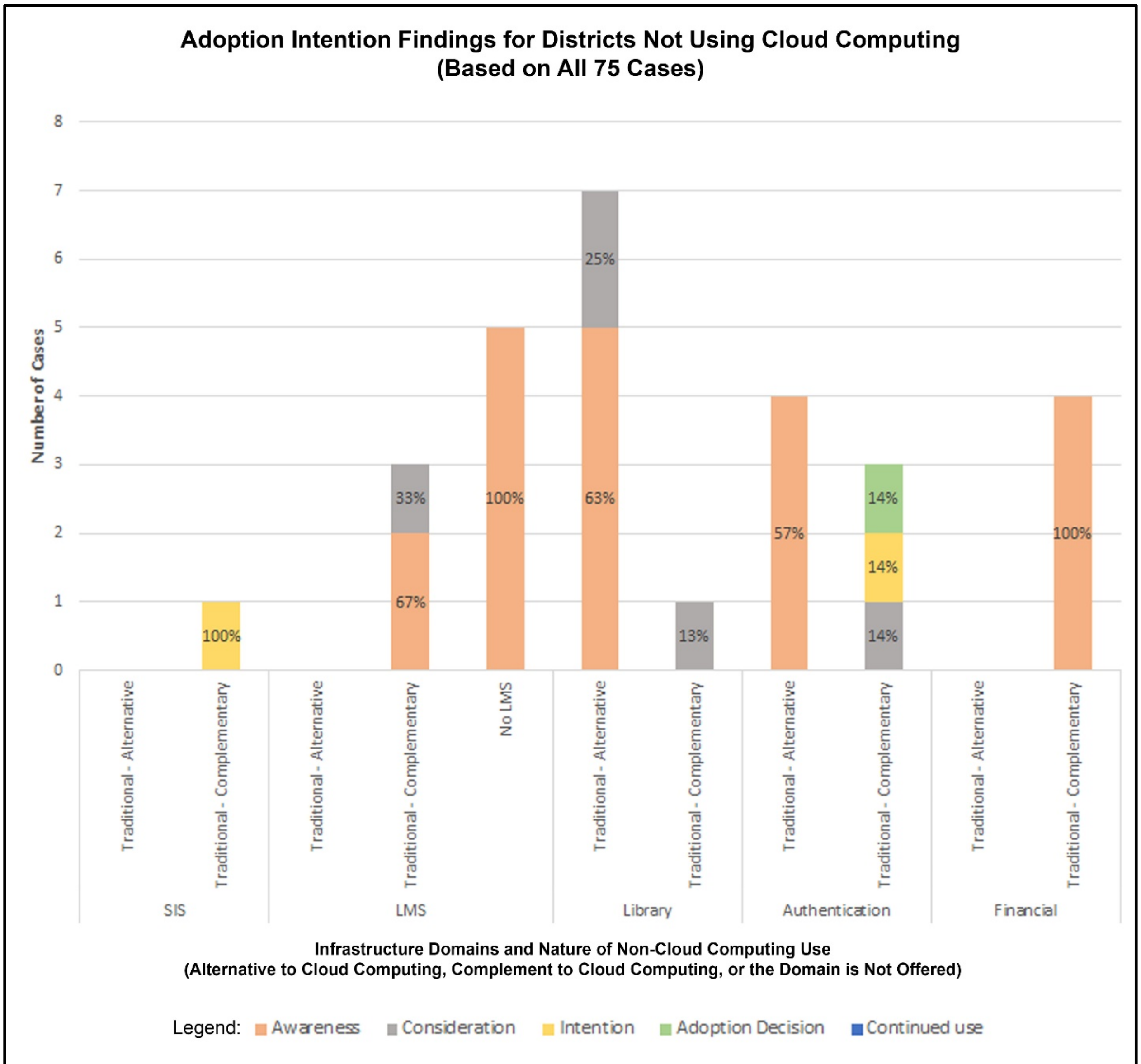
Summary of Findings: Percentage of Occurrence in All 75 Cases					
Infrastructure Domain	Rank	Infrastructure Platform		Software	
SIS	1	Private Cloud - District	51%	BCeSIS/MyEducationBC	39%
	2	Community Cloud	39%	PowerSchool	28%
	3	Public Cloud	9%	SchoolLogic	17%
	4	Outsourced & Traditional (tie)	1%	Maplewood	12%
LMS	1	Private Cloud - District	83%	Moodle	81%
	2	Public Cloud	21%	Other	20%
	3	Private Cloud - Outsourced	13%	GAFE	15%
	4	Traditional	4%	Blackboard	11%
Library	1	Private Cloud - District	68%	Destiny	48%
	2	Public Cloud	20%	L4U	23%
	3	Traditional	11%	Other	21%
	4	Private Cloud - Outsourced & Community Cloud (tie)	3%	Insignia Library System	12%
Authentication	1	Private Cloud - District	95%	Active Directory	95%
	2	Traditional	9%	OpenLDAP and other	5%
	3			eDirectory	4%
	4			GAFE portal	3%
E-mail	1	Private Cloud - District	81%	Exchange	65%
	2	Public Cloud	61%	GAFE	40%
	3			Office 365	23%
	4			Other	12%
Financial	1	Private Cloud - District	85%	atrieveERP	59%
	2	Public Cloud	21%	SDS	15%
	3	Traditional	5%	Other	13%
	4	Private Cloud - Outsourced	1%	Dynamics NAV	9%
Website	1	Private Cloud - District	75%		
	2	Private Cloud - Outsourced	31%		
	3	Public Cloud	7%		
	4	School level	3%		

Note. Due to complementary and supplementary use of infrastructure platforms and software, the percentages may not add to 100%.

to exploring the influences on an organization's adoption of technology, the framework also helps to identify an organization's stages of adoption. The five stages of adoption in Frambach and Schillewaert's (2002) organizational innovation adoption framework fall into two categories: nonadoption (awareness, consideration, and intention) and postadoption (adoption decision and continued use). In this section I present this study's findings concerning these adoption stages for cloud computing by Western Canadian K-12 districts.

Non-cloud computing infrastructure use. A recurring finding across the many sections of this chapter is the extensive use of cloud computing by K-12 districts in Western Canada. Another recurring finding is the limited use of traditional, non-cloud computing IT infrastructure. Using the Frambach and Schillewaert (2002) framework, Figure 28 shows the adoption intentions of districts that did not use cloud computing. This figure is organized by infrastructure domains. For example, in the LMS infrastructure domain, districts did not use cloud computing for LMS functions because they did not operate a LMS at all. Figure 28 also shows IT infrastructure domains that used traditional infrastructure, either as an alternative or to complement/supplement cloud computing. Lastly, in addition to depicting the reasons for the districts' lack of non-cloud computing use, Figure 28 shows districts' stages of pre-cloud computing adoption (i.e., awareness, consideration, intention, adoption decision). These stages correspond to the five stages in Frambach and Schillewaert's (2002) framework. In the following subsections I explore these non-cloud computing instances in greater detail.

Student Information System (SIS). Every school district in this study used cloud computing for SIS purposes. Only one district used traditional infrastructure to complement its SIS cloud computing infrastructure. This district used three SISs for its different school levels. The elementary and high schools used TurboSchool and Windsor, respectively, which both run



Note. Adoption stages are based on the Frambach and Schillewaert (2002) framework for organizational innovation adoption.

Figure 28. Adoption intention findings for districts not using cloud computing.

on traditional on-premises infrastructure. The district's middle schools used BCeSIS/ MyEducation BC, delivered on community cloud infrastructure. This one British Columbia district intended to abandon TurboSchool and Windsor in favour of MyEducation BC within two years (by the 2017-2018 school year).

Learning Management System (LMS). Five cases did not use cloud computing for LMS purposes because they did not run an LMS at all. The three cases that used traditional infrastructure for LMS purposes did so to complement/supplement their cloud computing LMS offerings. Specifically, they had school-based Moodle servers in addition to cloud-based Moodle servers. The rationale for these traditional, on-premises Moodle instances was to enable the teachers in these schools to have greater local control of course content and/or to remedy the connectivity issues that made centralized, private cloud–district use not viable. Of these three cases, one was actively considering moving its LMS software to a cloud platform exclusively.

Library systems. The library systems domain had the greatest use of traditional infrastructure as an alternative to cloud computing. With the exception of one case, the cases that used traditional infrastructure for library systems did not use another infrastructure platform. The one case that used both traditional and cloud computing infrastructure for library systems was considering moving to a cloud computing platform entirely. Similarly, two of the seven cases that used traditional infrastructure as an alternative were considering moving their systems to cloud computing platforms.

Authentication systems. Four cases of the 75 used traditional infrastructure for authentication purposes as an alternative to cloud computing authentication approaches. Of these four, none intended to change their use to cloud computing infrastructure. However, in cases that used both traditional and cloud computing for authentication purposes in a complementary/supplementary manner, the stages of cloud computing adoption varied. These three cases ranged from considering cloud computing to intending to adopt it to having decided to adopt it and being in the process of migrating from their traditional infrastructure to cloud computing-based authentication.

The one district in the adoption-decision stage had decided to migrate to cloud computing and was in the process of piloting and implementing cloud computing authentication infrastructure as a replacement for traditional authentication infrastructure. This district was at the beginning of this process and still had considerable traditional authentication infrastructure at the time of my data collection.

Financial systems. All of the cases in this study used cloud computing infrastructure to operate their financial systems. In addition to cloud computing, four cases used traditional infrastructure for their financial systems; they used either QuickBooks or Simply Accounting to manage small school-level financial transactions. These cases' primary financial systems were, however, on cloud computing infrastructure, they did not intend to move away from this complementary/supplementary setup.

Plans for the continued use of cloud computing infrastructure. A major finding of this study is that, once districts adopt cloud computing infrastructure, they remain with it. None of the personnel in the districts in this study expressed an interest in discontinuing cloud computing use or were even considering it. Figure 29 presents this phenomenon. In all of the infrastructure categories, 100% of the cases planned to continue their cloud computing infrastructure use. Moreover, of the small number of cases that used traditional infrastructure, a considerable percentage planned to discontinue it or were in the process of considering such a change. In the SIS and authentication categories, 100% and 29% of the cases, respectively, planned to discontinue their use of traditional infrastructure and move to cloud computing infrastructure. Similarly, in the LMS, Library Systems, and authentication categories, 33%, 38%, and 14% of the cases, respectively, were considering a move away from traditional infrastructure to cloud computing.

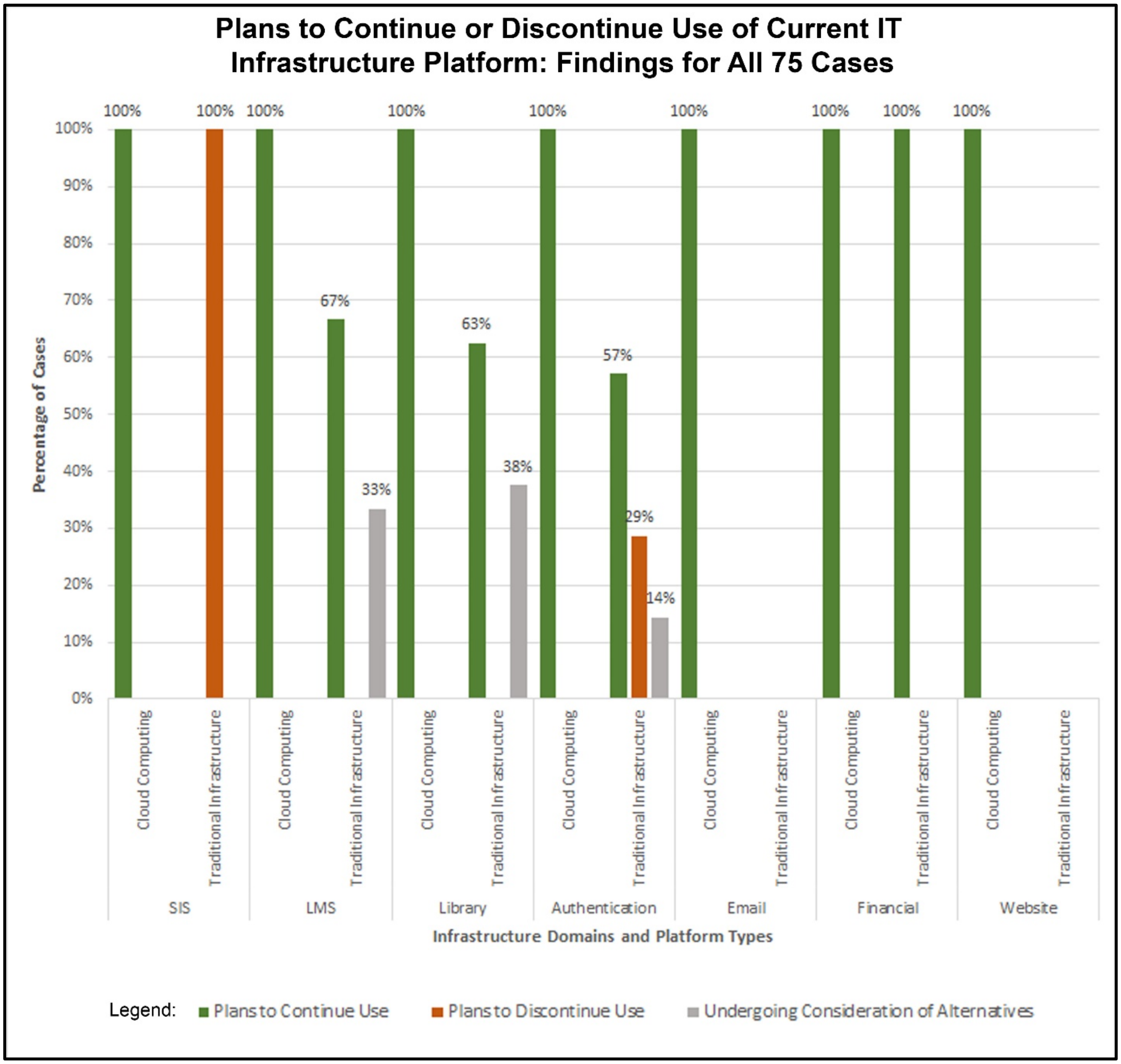


Figure 29. Plans to continue or discontinue use of current IT infrastructure platform: Findings for all 75 cases.

Summary of IT Infrastructure and Cloud Computing Adoption Findings

To answer the central research question of “What factors influence district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for district schools?” it is necessary to know the IT infrastructure of the districts being studied. This section presented the IT infrastructure, and thereby the cloud computing adoption and non-adoption findings, for the critical IT functions of Western Canadian K-12 districts. Cloud computing adoption was ubiquitous and it was rare for districts to use non-cloud computing infrastructure. In instances where districts did not use cloud computing, it was often because traditional, non-cloud computing infrastructure served to complement or supplement their cloud computing infrastructure. Figure 30 presents a summary of the infrastructure platform findings for all 75 cases that I investigated.

Another key finding in this section on IT infrastructure is that once K-12 district leaders adopt cloud computing infrastructure, they plan to continue to use cloud computing for the foreseeable future. In none of the 75 cases this research examined did any participant indicate they intended to move away from their cloud computing IT infrastructure.

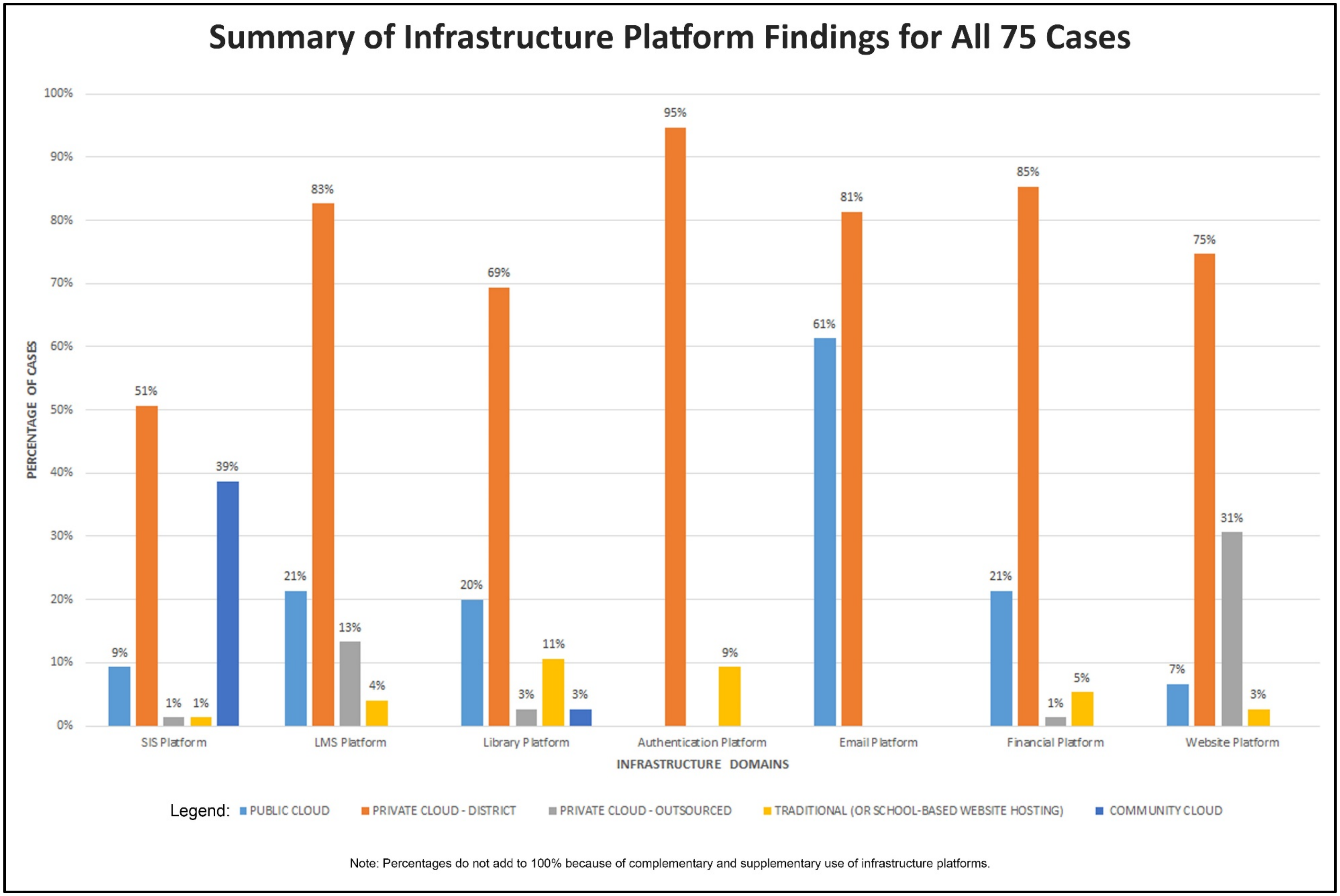


Figure 30. Summary of infrastructure platform findings for all 75 cases.

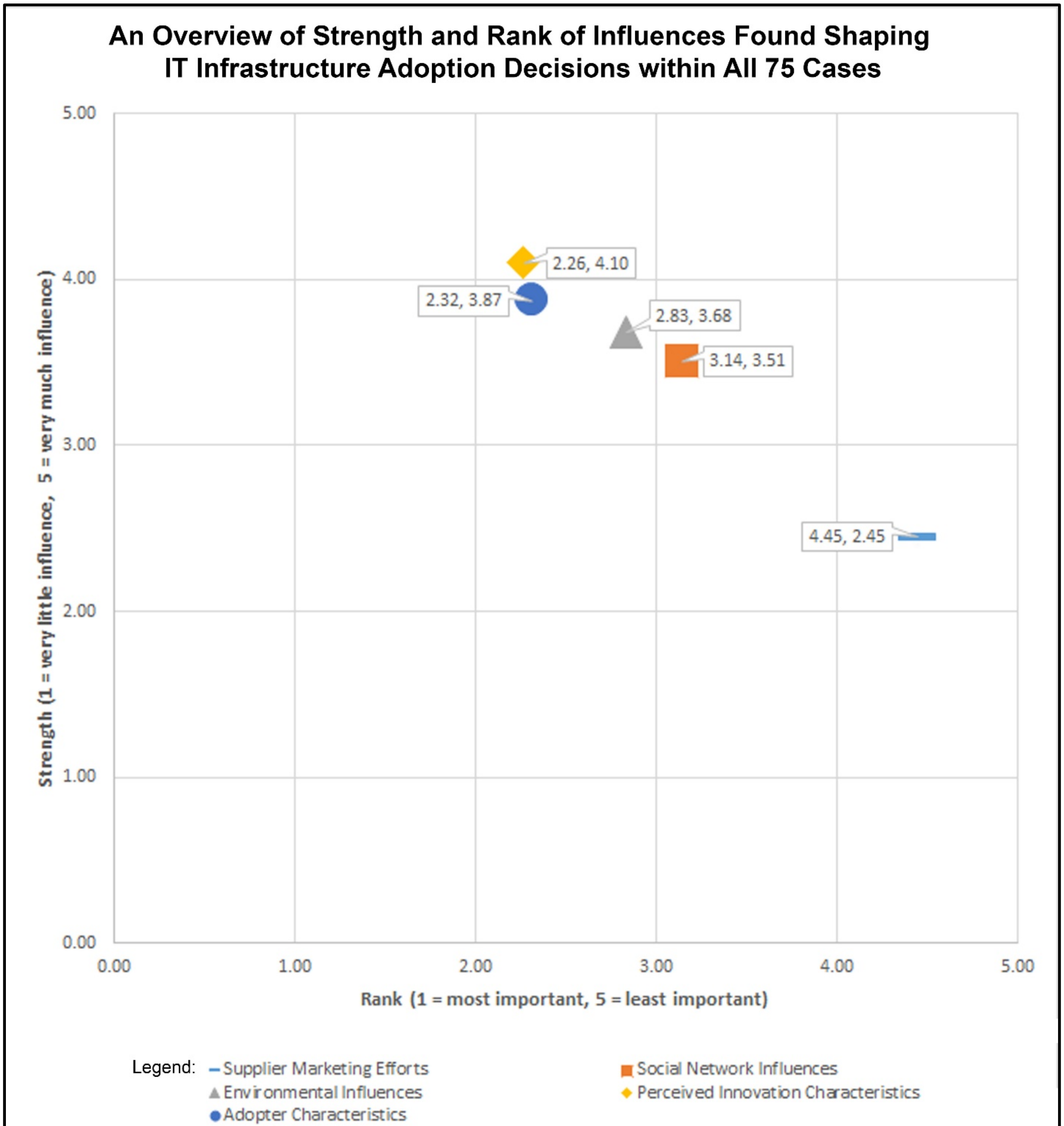
Influences on IT Infrastructure Findings

In this section I explore the findings on the five adoption factors that Frambach and Schillewaert (2002) identified in their conceptual framework: (1) supplier marketing efforts, (2) social network, (3) environmental influences, (4) perceived innovation characteristics, and (5) adopter characteristics. First, I present the findings for the strengths of these factors in absolute terms, as the study participants identified them (very little impact to very much impact on IT infrastructure decisions). Second, I present findings for the relative rank of these factors. The relative rank is beneficial because it additionally clarifies the findings when the factors are of similar strength.

The purpose of this two-part approach is not only to accurately depict how influential a factor is, but also to contextualize that influence in relation to other factors. This findings section will demonstrate that the most influential and most important factors are perceived innovation characteristics and adopter characteristics. Environmental influences and social network influences follow in strength and rank. Supplier marketing efforts is the least influential and least important factor. Figure 31 presents a high-level summary of the study's findings from all 75 cases, with the mean average strength and rank of each of the adoption factors from the Frambach and Schillewaert (2002) framework. In the following subsections I examine the five factors individually, in greater detail.

Supplier Marketing Efforts

Supplier marketing efforts was identified by the study's participants as the least important and lowest ranked organizational adoption factor. Figure 32 summarizes the study's findings on the strength and rank of supplier marketing efforts and depicts the number of times that a strength and rank combination appeared in the study. In this figure it is evident that the



Note. Adoption influences are from the Frambach and Schillewaert (2002) framework on organizational innovation adoption.

Figure 31. An overview of strength and rank of influences found shaping IT infrastructure adoption decisions within all 75 cases.

participants often considered the influence strength of supplier marketing efforts low, and they are typically ranked last/fifth. Moreover, the clustered distribution of responses in Figure 32 reveals the general consensus that supplier marketing efforts are of little influence and the least influential of the five factors in Frambach and Schillewaert’s (2002) conceptual framework. Figure 33 presents the mean averages of these strength and rank findings in greater fidelity. I have organized them for the entire study, the three provinces, and the four size groupings.

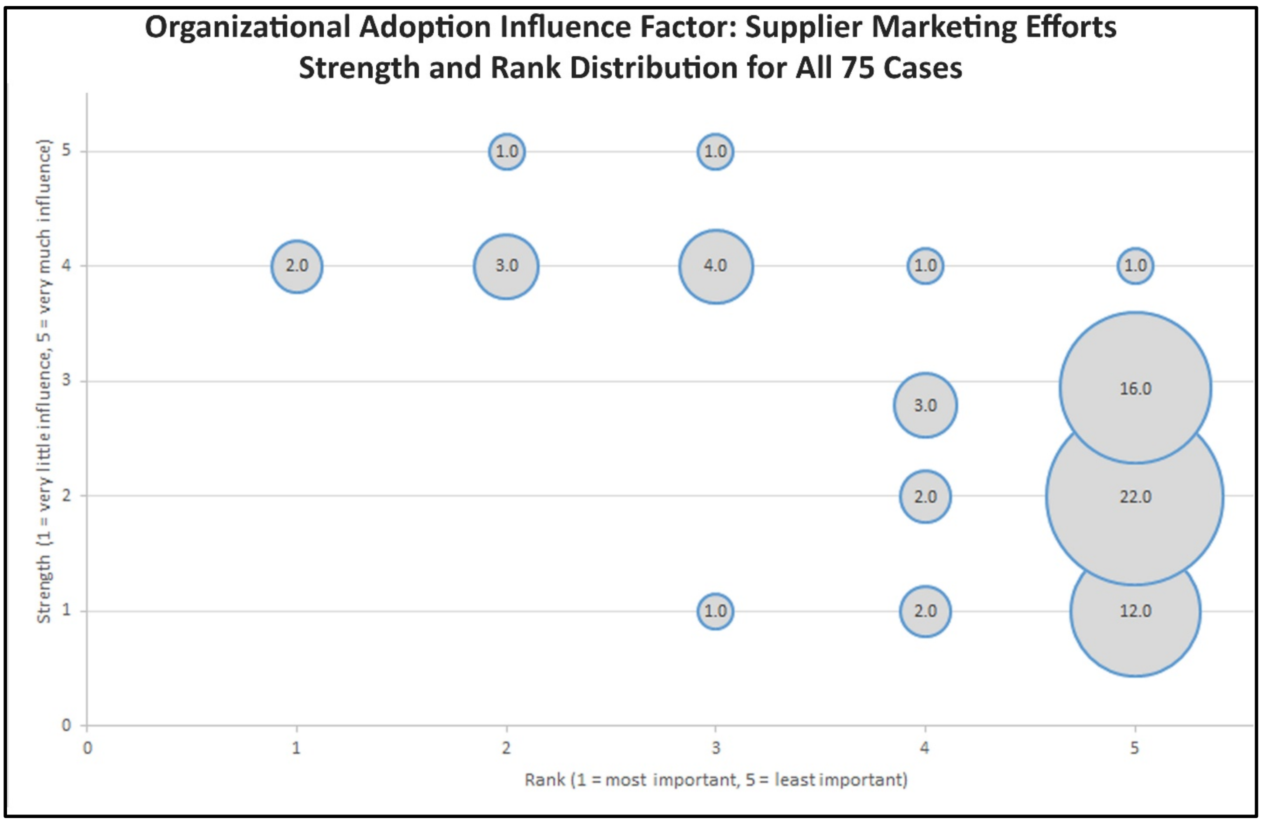


Figure 32. Supplier marketing efforts: Strength and rank distribution.

Strength of supplier marketing efforts. The participants perceived the supplier marketing efforts as having little influence on the districts’ IT infrastructure decisions. The average rating in all cases was 2.45, which corresponds to little influence on the 1 to 5 Likert scale. When I examined the provinces individually, the perceptions of the ratings of 2.40, 2.42, and 2.62 for Alberta, British Columbia, and Saskatchewan, respectively, were similar. According to size, however, the findings are more varied. The averages of the XL and the S size categories were close to the study's average of 2.44 each. The perception of the strength of supplier marketing efforts in the L size category was the highest, at 2.93. Conversely, the lowest perception of supplier marketing effort strength was in the M size category, at 1.78. This category also had the most consistent views of low supplier marketing effort strength, with a standard deviation of 0.83 (response range of 2).

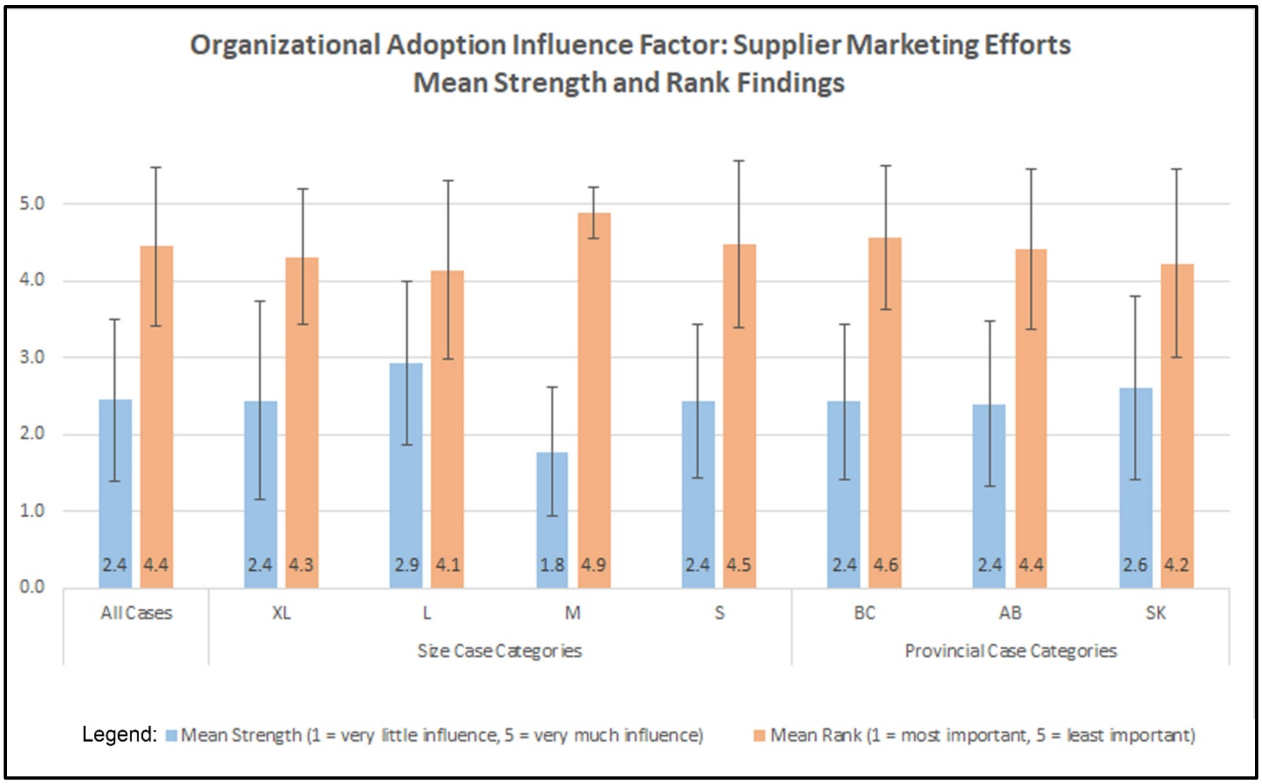


Figure 33. Supplier marketing efforts: Strength and rank mean averages.

Ranking of supplier marketing efforts. The participants in the study's 75 districts ranked the supplier marketing efforts the lowest of all five factors in Frambach and Schillewaert's (2002) conceptual framework. The average rank of supplier marketing efforts in the entire study was 4.45. Cases in British Columbia, Alberta, and Saskatchewan had similarly low perceptions of supplier marketing effort rank, with response averages of 4.56, 4.42, and 4.23, respectively. In the size categories, the district size groupings varied slightly, but the response averages still placed supplier marketing efforts in fifth place. The highest rankings of supplier marketing efforts were in the smaller cases: The scores of the M and S groupings were 4.89 and 4.48, respectively. The lowest rankings for supplier marketing efforts were in the larger cases: The rankings of XL and L were 4.31 and 4.14, respectively. The strongest agreement on supplier rankings was in the M and XL categories, where the standard deviation was 0.33 (response range of 1) and 0.88, respectively (response range of 2).

Social Network

Figure 34 summarizes the study's findings on the strength and rank of social network influences and depicts the number of times that a strength and rank combination appeared in the study. It is evident that the influence strength of social network influences was moderate and that it was in the middle rank. Although considered somewhat of an important/strong influence, the participants rarely considered it the most important factor. They did, however, consider it ahead of supplier marketing efforts in terms of both influence strength and rank. Figure 35 presents the mean averages of the findings on strength and rank in greater fidelity. I have organized them for the entire study, the three provinces, and the four size groupings.

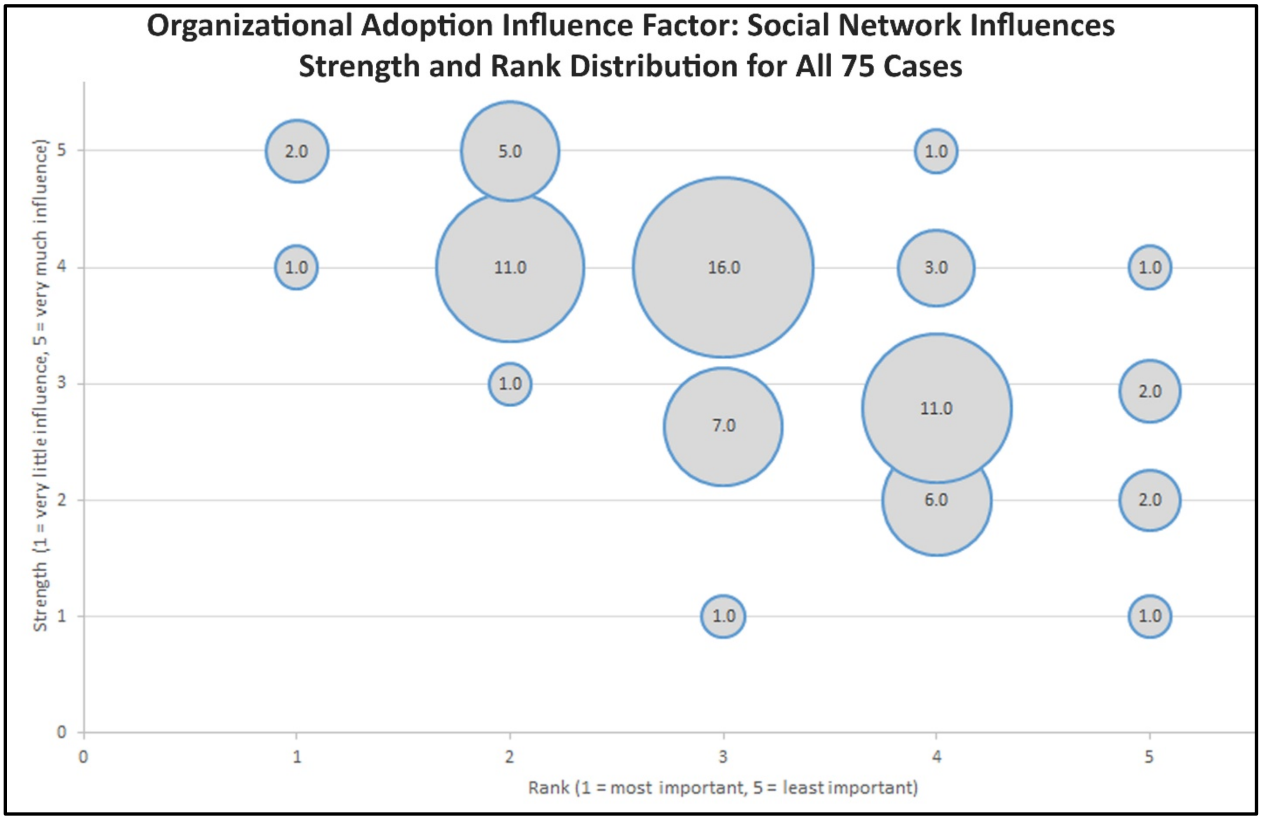


Figure 34. Social network influences: Strength and rank distribution.

Strength of social network influences. The participants perceived the social network influences as having a moderate influence on the IT infrastructure decisions of a district. The average rating in all of the cases was 3.53, which corresponds to a moderate influence on the 1 to 5 Likert scale. When I examined the provinces individually, I found similar ratings of 3.44, 3.61, and 3.46 for British Columbia, Alberta, and Saskatchewan, respectively. British Columbia had the highest rating, 3.61, for social network influence strength. This, however, was still very close to the other provincial averages and the study's average. The most consistent responses concerning strength were in Saskatchewan, where the standard deviation was 0.52 (response range of 1).

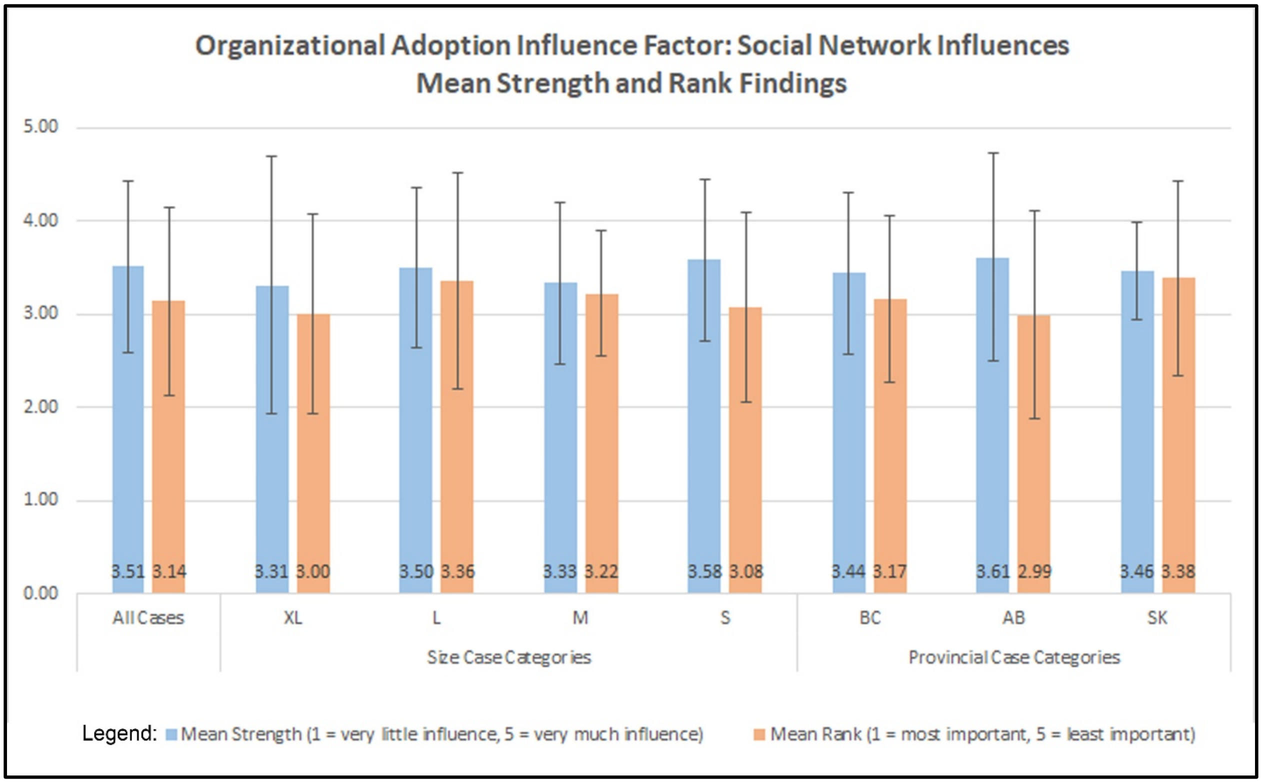


Figure 35. Social network influences: Strength and rank mean averages.

In the size categories the findings are similarly consistent. The averages in the XL and the M size categories were below the study's average: 3.31 and 3.33, respectively. The averages in the L and S size categories were slightly above the study's average: 3.50 and 3.58, respectively. The responses were consistent, and the standard deviation was 0.92 for the entire study. The XL category revealed the least agreement on the strength of social network influences; the standard deviation was 1.39 (response range of 4). Nevertheless, the standard deviation was still generally low, and the consensus on social network influence strength was that it was moderate.

Ranking of social network influences. Across the study's 75 districts, the participants ranked social network influences the fourth most important of all five factors in Frambach and Schillewaert's (2002) conceptual framework. The average rank for social network influences in the entire study was 3.14. The participants in cases in British Columbia, Alberta, and Saskatchewan expressed similar perceptions of the social network influence rank, and the response averages were 3.17, 2.99, and 3.38, respectively. Alberta ranked social network influences the highest of all three provinces, though there was the least agreement (standard deviation of 1.11, compared to BC's 0.89). Nevertheless, the mean ranking for social network influences across the three provinces was similar.

I found a slight variation across the district size groupings, but the response averages still placed social network influences fourth. The highest rankings of social network influences were in the middle size groupings; the scores of the L and M groupings were 3.36 and 3.22, respectively. The lowest rankings for social network influences were in the largest and smallest size categories: In the XL category the average ranking score was 3.00, and in the S size category, it was 3.08. The strongest agreement on social network influence rank was in the M category, where the standard deviation was 0.67 (response range of 2). Nevertheless, the mean ranking of social network influences across the size grouping was 1.00, which indicates general agreement.

Environmental Influences

The influence and strength of environmental influences vary across the entire study. The wide distribution of strength and rank combinations evident in Figure 36 illustrates this finding from 75 cases. Unlike other factors, such as supplier marketing efforts or social network influences, where there is a greater consensus on the strength and rank of influences, the responses concerning environmental influences varied considerably. For example, in 10 cases the environmental influences are the strongest (5) and the highest ranked (1). On the other hand, in 11 cases the environmental influences are of moderate strength (3) and ranked the second

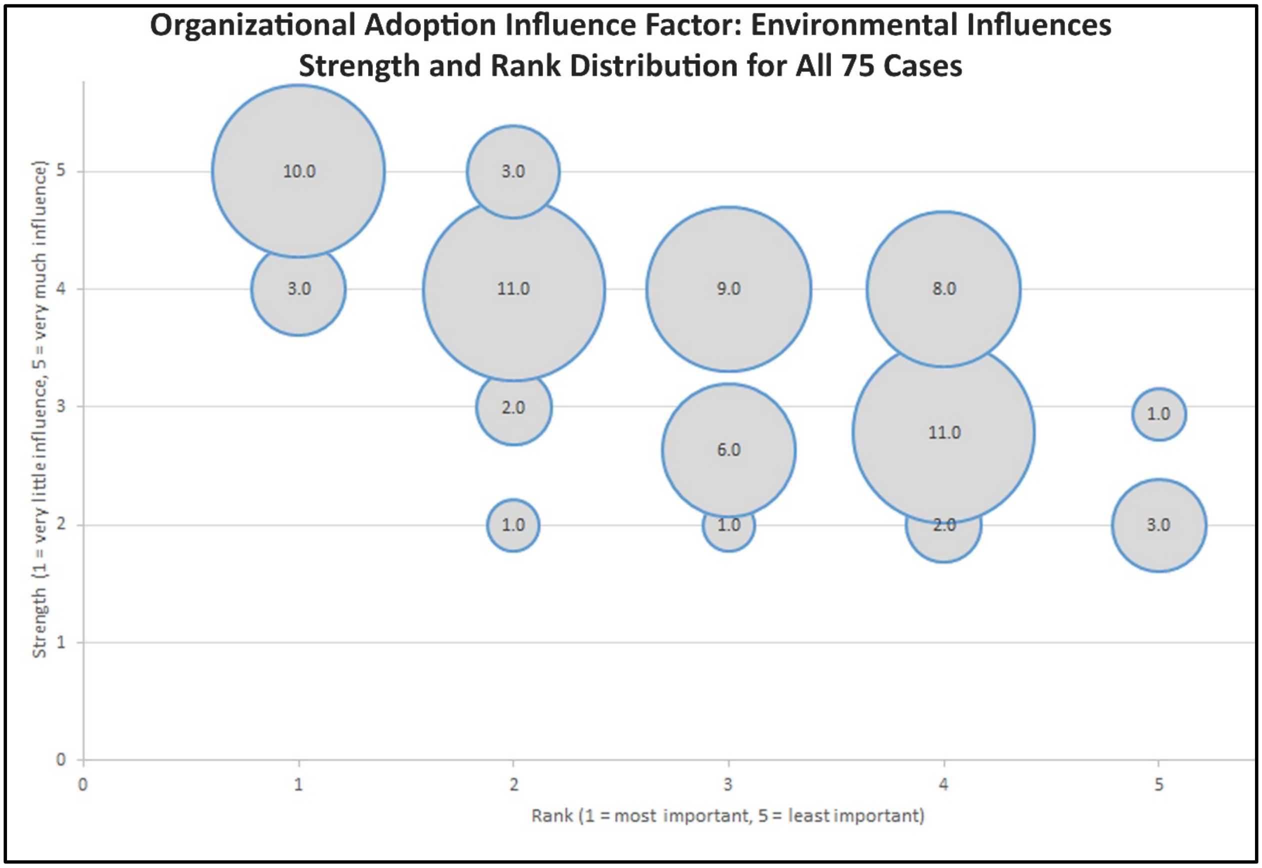


Figure 36. Environmental influences: Strength and rank distribution.

lowest (4). This range of responses is perhaps a result of the dichotomy found in the participants' responses with regard to environmental influences. For example, some participants replied that the actions of other districts had little influence on their adoption decisions, but government policies—namely, privacy legislation—had a considerable impact on their adoption decisions. This is a limitation of Frambach and Schillewaert's (2002) framework because it collapses large factors such as environmental influences, but in the process loses some fidelity.

This difficulty is particularly pronounced when a strong factor such as a government privacy policy and a weak factor such as the actions of other districts are combined under one larger heading. This is supported by the comments from the study participants. When asked about the influence of environmental influences, Anstice replied: "More so on the government side… that influence would be exclusively government, not, not by… peers around." (p. 17). Other participants also expressed this difficulty, where legislative influences are considerable on a K-12 district, but the actions of other districts are much less influential:

> We're definitely willing to learn from others, but we won't… chase something just because somebody else is doing it… again, back to, if the government flat out, you know, legislates that we can't, well that's going to influence our decisions, right. (Adrian, p. 12)

Appendix Table F5 presents this dichotomy further, illustrating importance of government privacy policy in each province on IT infrastructure decisions for Western Canadian K-12 districts. Some of the quotations in Appendix Table F5 also further express the limited impact of the actions of surrounding districts. When Figure 36 is informed by the corroborating quotations of Appendix Table F5, it becomes clear that the distribution of the participants' responses concerning environmental influences is the result of this dichotomy. In the seventh and final chapter, I propose a modification to the Frambach and Schillewaert framework to better handle this dichotomy in future research.

Strength of environmental influences. Figure 37 shows that the participants perceived environmental influences as having a moderate influence on the IT infrastructure decisions of their districts. The average rating in all of the cases in the study was 3.68, which corresponds to a moderate influence on the 1 to 5 Likert scale. When I examined the provinces individually, I found that the perceptions, with ratings of 3.73, 3.52, and 3.92 for British Columbia, Alberta, and Saskatchewan, respectively, were similar. Saskatchewan rated environmental influence strength the highest at 3.92. This, however, was still very close to the other provincial averages and the study's average. The most consistent responses concerning strength were in the cases in Saskatchewan, where the standard deviation was 0.76 (response range of 2).

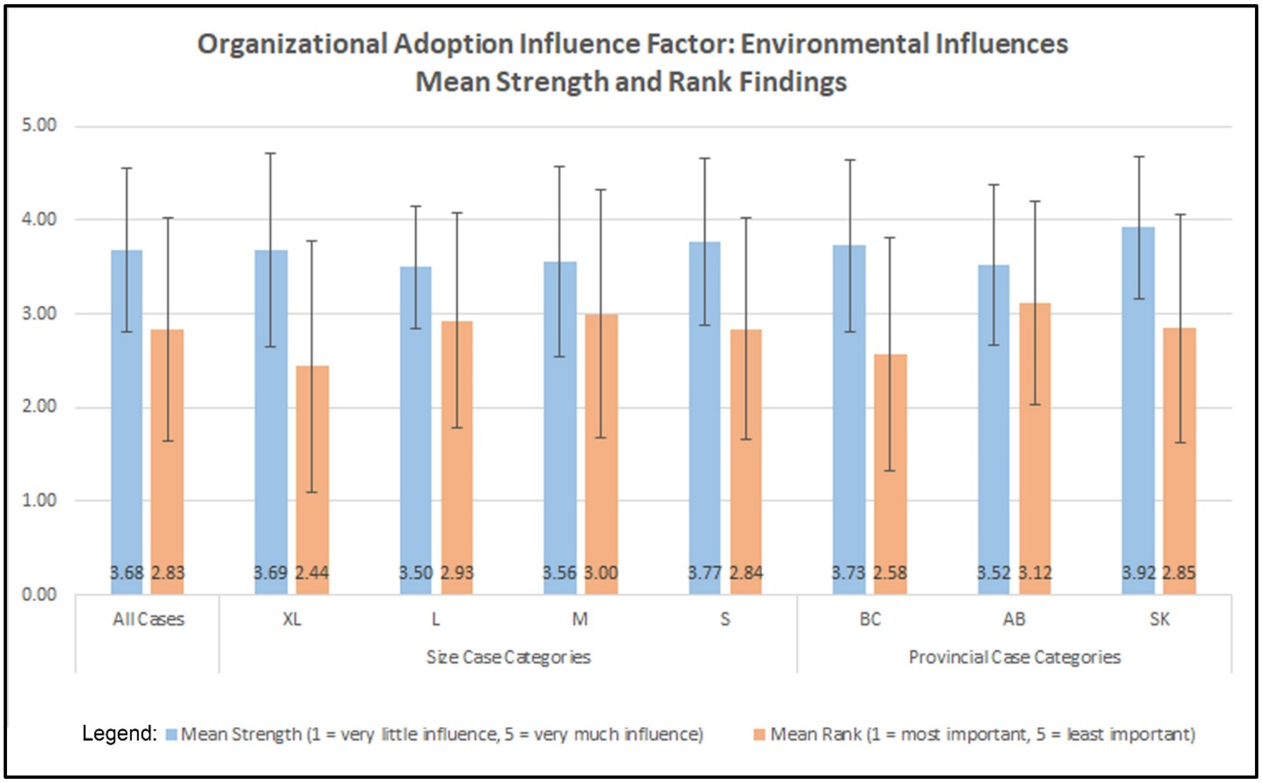


Figure 37. Environmental influences: Strength and rank mean averages.

The findings in the size categories were similarly consistent. The highest averages were in the XL and the S size categories, at 3.69 and 3.77, respectively. The lowest averages were in the L and M size categories, at 3.50 and 3.56, respectively. The strongest agreement on the strength of environmental influences was in the L category, with a standard deviation of 0.65 (response range of 2).

Ranking of environmental influences. In the study's 75 districts, the participants ranked environmental influences the third most important of all five factors in Frambach and Schillewaert's (2002) conceptual framework. The average rank of environmental influences for the entire study was 2.83. The participants in the British Columbia, Alberta, and Saskatchewan cases had similar perceptions of environmental influences; the response averages for rank were 1.24, 1.08, and 1.21, respectively. Alberta, compared to the other provinces, ranked environmental influences the highest and had the least variation (standard deviation of 1.08). Nevertheless, the mean ranking and standard deviation for environmental influence rank across the three provinces was similar.

The district size groupings varied slightly, but the response averages still placed environmental influences third. The highest rankings of environmental influences were in the largest size grouping: The average in the XL size category was 2.44. The ranking in the other size categories was similar; however, in the L, M, and S categories, the rankings were 2.93, 3.00, and 2.84, respectively. As with the provincial groupings, the rankings and standard deviations across the size categories for environmental influences were similar.

Perceived Innovation Characteristics

Figure 38 summarizes the findings on the strength and rank of perceived innovation characteristics and depicts the number of times that a strength and rank combination appeared in the study. It is evident that the influence strength of perceived innovation characteristics is high to very high. The majority of the respondents rated perceived innovation characteristics as influential (4) or very influential (5). Similarly, the participants ranked perceived innovation characteristics highly as well. Figure 38 shows that perceived innovation characteristics were most often the top or second highest ranked priority in the districts that adopted new infrastructure technology. Across the entire study, these characteristics had the highest mean average for both strength and rank, at 4.10 and 2.26, respectively.

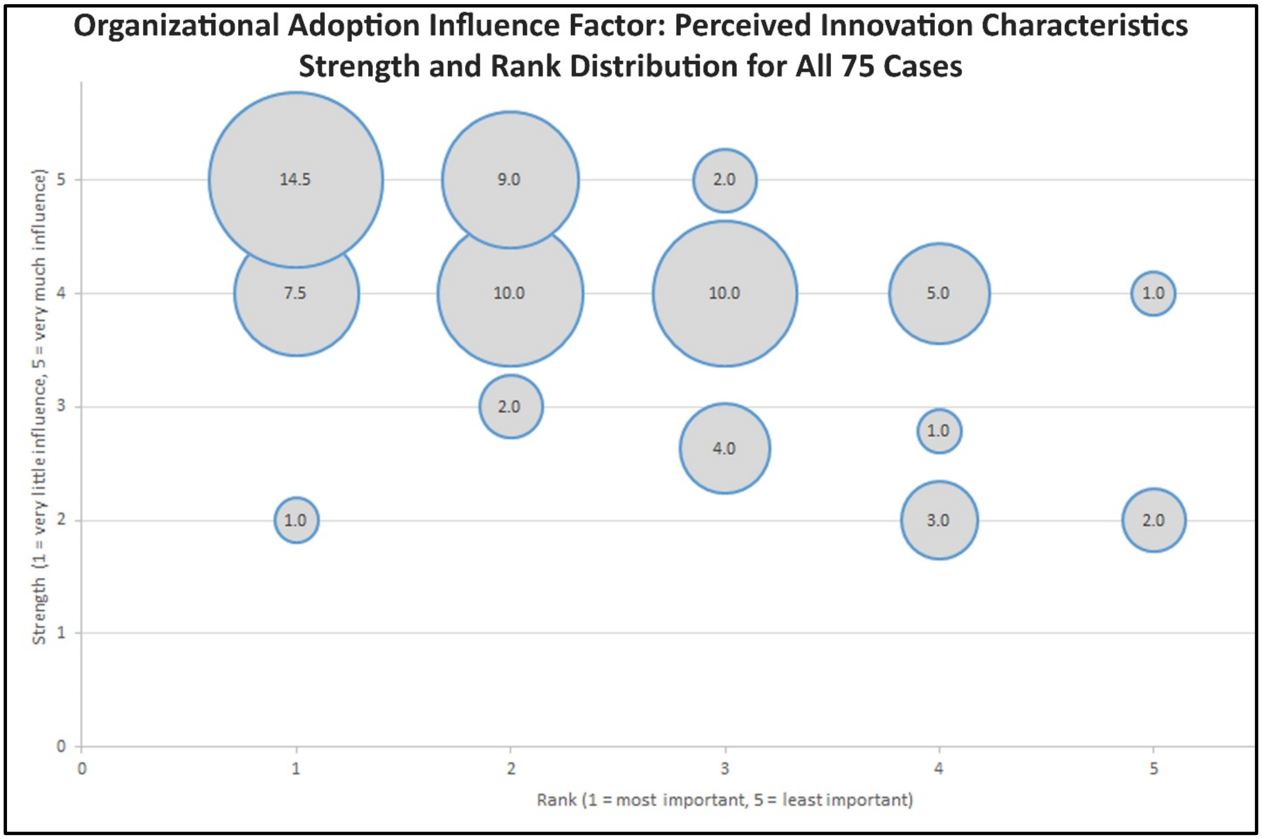


Figure 38. Perceived innovation characteristics: Strength and rank distribution.

Strength of perceived innovation characteristics. Figure 39 illustrates that the participants perceived that the innovation characteristics had a very high influence on IT infrastructure decisions in the districts. Across all cases in the study, the average rating was 4.10, which corresponds to a very high influence on the 1 to 5 Likert scale. Individually, the perceptions in the provinces rated similarly: 4.15, 4.11, and 3.92 for British Columbia, Alberta, and Saskatchewan, respectively. British Columbia had the highest rating for perceived innovation characteristic strength, though all provinces had similarly high values. The standard deviation for all provinces ranged from 0.95 to 0.93, which reveals a consensus on the importance of perceived innovation characteristics.

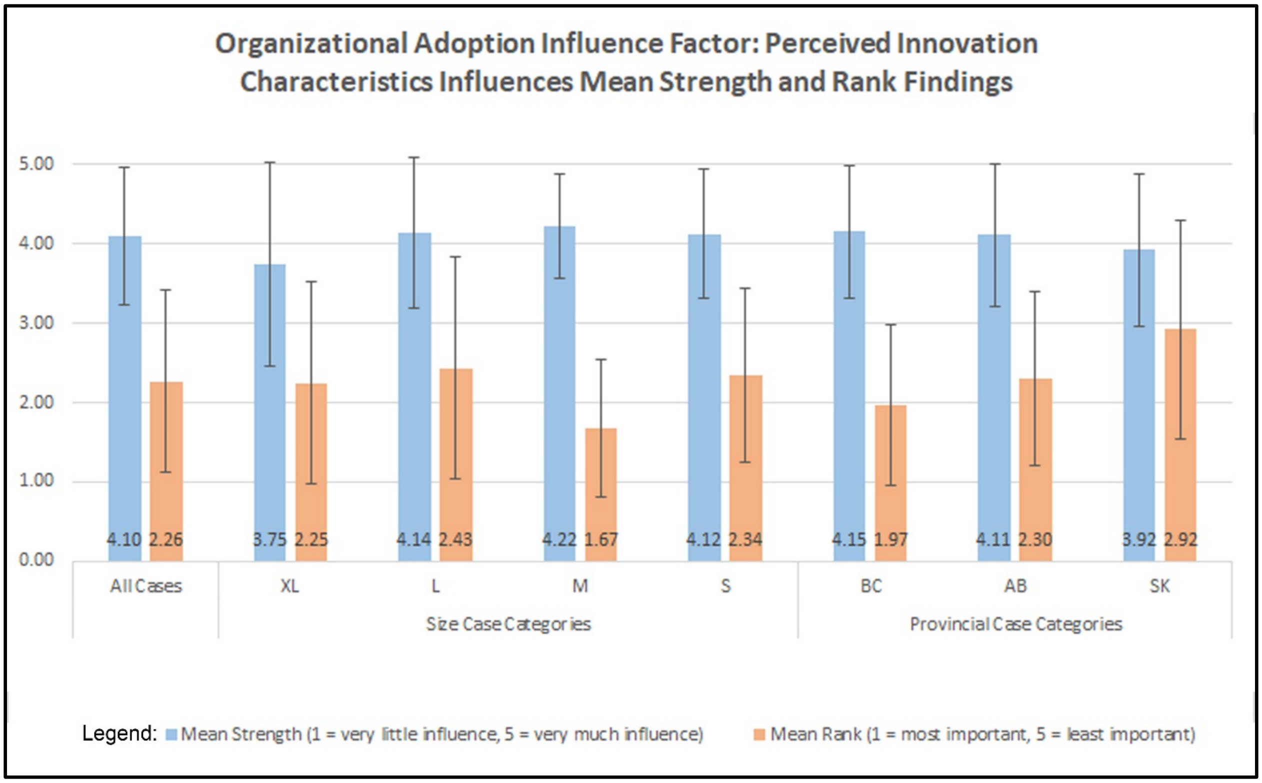


Figure 39. Perceived innovation characteristics: Strength and rank mean averages.

The findings were similarly consistent in the size categories. The strength ratings for the size categories were as follow: The corresponding averages in the L, M, and S categories were 4.14, 4.22, and 4.12, respectively. The lowest rating, in the largest size category of XL, was 3.75, which perhaps reflects the increased complexity of the large districts. The responses were consistent in the entire study: The standard deviation was 0.87. The greatest agreement was in the M category, in which the standard deviation was 0.67 (response range of 2). The least agreement on the strengths of the perceived innovation characteristics was in the XL category, in which the standard deviation was 1.28 (response range of 4). Nevertheless, the standard deviation was still generally low, and the consensus on the perceived innovation characteristic influence strength was that it was very strong.

Ranking of perceived innovation characteristics. Across the study's 75 cases, the participants ranked the perceived innovation characteristics as the most important of all five factors in Frambach and Schillewaert's (2002) conceptual framework. The average rank of perceived innovation characteristics in the entire study was 2.26, which was the highest mean average of the five factors. British Columbia had the highest ranking of perceived innovation characteristics, with a mean average of 1.97. Alberta followed with 2.30, and then Saskatchewan with a mean average ranking of 2.92. The level of agreement/standard deviation was comparable: from 1.02 to 1.10 to 1.38, respectively.

I found a slight variation across the district size groupings, but the response averages still indicated the prominence of perceived innovation characteristics as a leading factor in IT infrastructure adoption decisions. The highest rankings of perceived innovation characteristics were in the M size category, where the rank average of 1.67 was notably higher than the overall average of 2.26. The participants in the other size categories expressed similar views, and the rankings were 2.25, 2.43, and 2.34 in the XL, L, and S categories, respectively. Agreement on the rank of perceived innovation characteristics was also highest in the M size category, where the standard deviation was 0.87 (response range of 2). The participants in the other size categories shared consistent views as well, with a low overall standard deviation of 1.15, but not to the extent of the M category.

Adopter Characteristics

Figure 40 summarizes the findings on the strength and rank of adopter characteristics and depicts the number of times that a strength and rank combination appeared. It is evident that the influence strength of adopter characteristics was often high and most often ranked first or second of the five factors. The clustered distribution of the responses in Figure 40 reveals the consensus

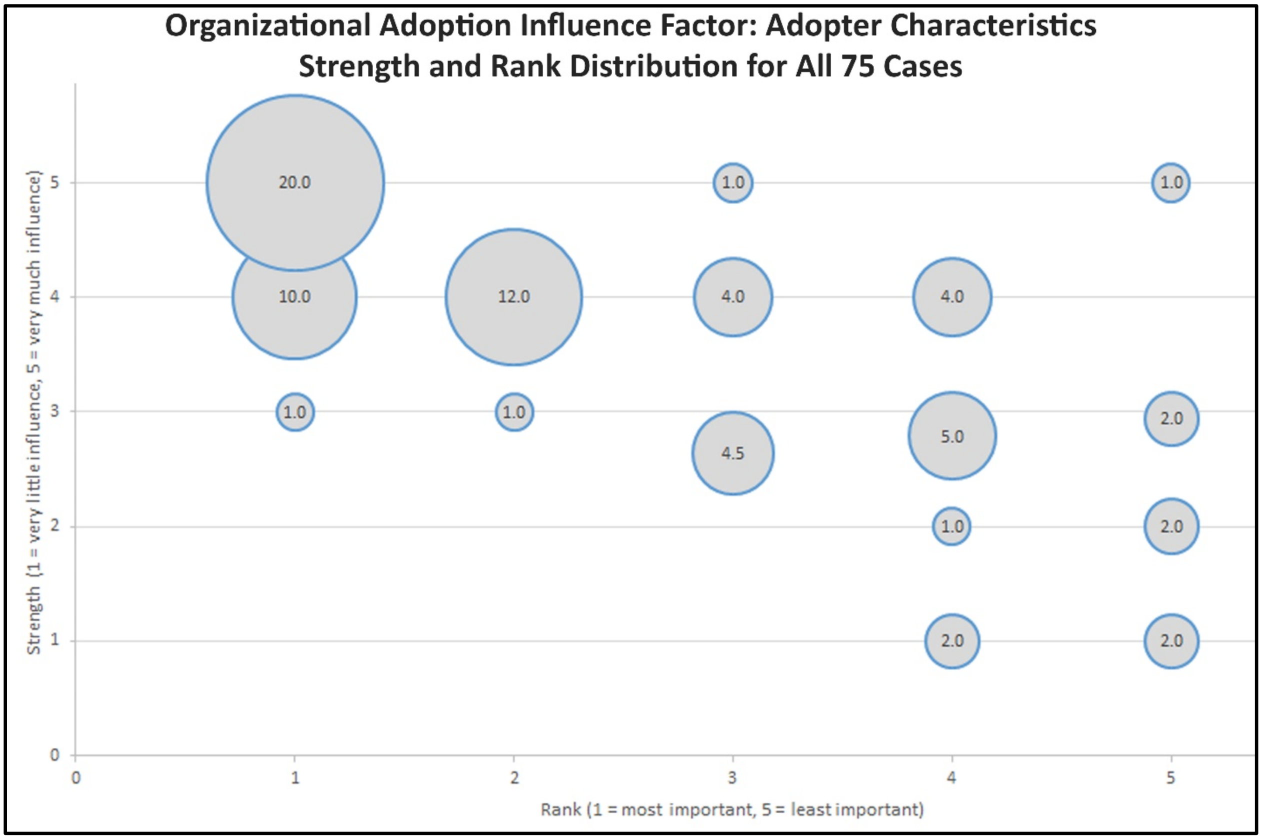


Figure 40. Adopter characteristics: Strength and rank distribution.

that the adopter characteristics had a high influence and were among the most influential of the five factors in Frambach and Schillewaert's (2002) conceptual framework. Figure 41 presents the mean averages of these strength and rank findings in greater fidelity.

Strength of adopter characteristics. Figure 41 shows that the participants perceived the adopter characteristics as having a great influence on the IT infrastructure decisions in their districts. Across all cases in the study, the average influence strength rating was 3.87, which corresponds to a strong influence on the 1 to 5 Likert scale. Individually, the provinces' ratings varied slightly, though they were still high. Adopter strength had the lowest rating, 3.52, in British Columbia. Saskatchewan followed, with a rating of 4.08; and Alberta had the highest rating, 4.18. Despite these slight differences, the rating of adopter characteristics was of

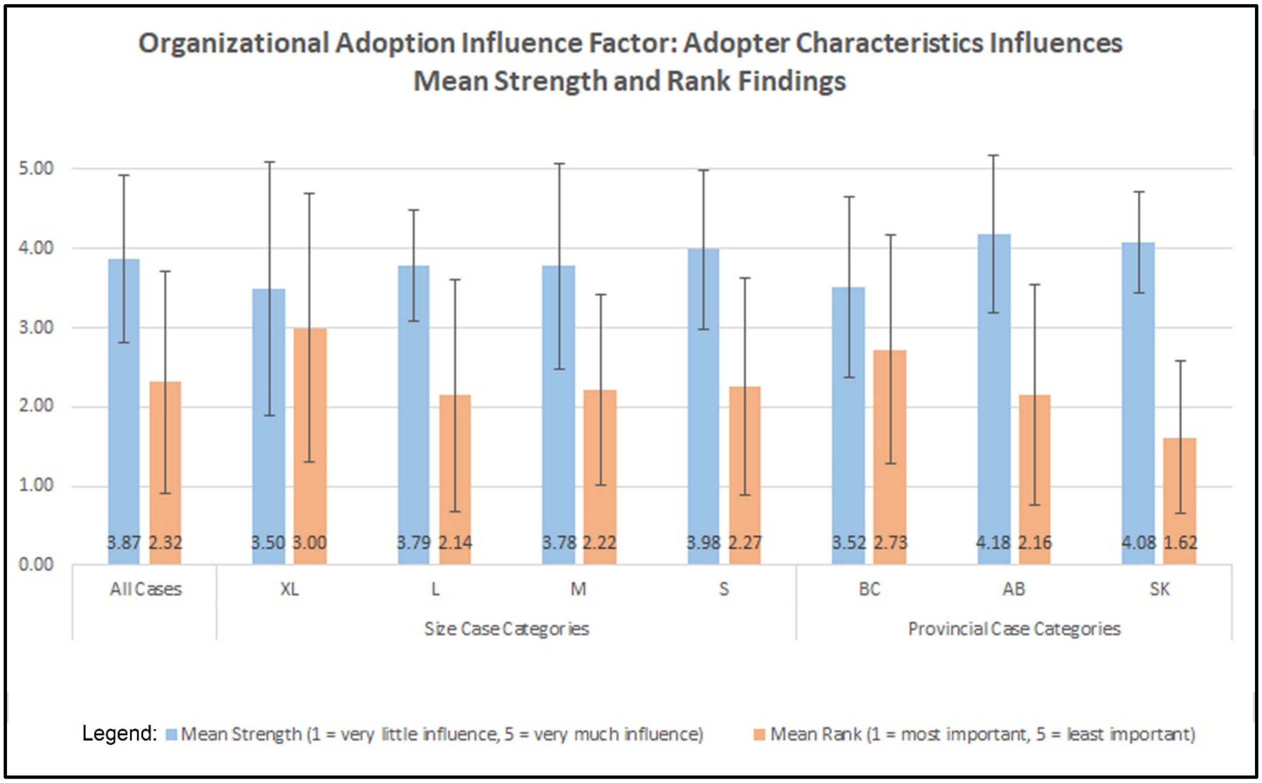


Figure 41. Adopter characteristics: Strength and rank mean averages.

moderate strength. The low standard deviation across provinces supports this consensus: British Columbia at 1.15; Alberta at 1.00; and Saskatchewan, the lowest at 0.64 (response range of 2).

The findings in the size categories revealed similarly slight variations. The XL size category had the lowest strength rating, 3.50, for adopter characteristics. However, the highest standard deviation, 1.69 (response range of 4) accompanied this rating, which indicates a range of opinions on adopter characteristics as an influence on adoption in this largest size category. The remaining size categories had more uniform responses and slightly lower standard deviations. The averages in the L, M, and S size categories were 3.79, 3.78, and 3.98, respectively. The greatest agreement was in the L size grouping, where the standard deviation was 0.70 (response range of 2).

Ranking of adopter characteristics. Across the study's 75 districts, the participants ranked the adopter characteristics second of all five factors in Frambach and Schillewaert's (2002) conceptual framework, behind only technology characteristics. The average rank of adopter characteristics in the entire study was 2.32. Saskatchewan had the highest ranking at 1.62, followed by Alberta at 2.16 and British Columbia at 2.73. The level of agreement on the importance of adopter characteristics was also the highest in Saskatchewan, with a standard deviation of 0.96, compared to 1.44 and 1.39 for British Columbia and Alberta, respectively. Nevertheless, the standard deviation is reasonably small, which supports the consensus on the importance of adopter characteristics.

I found a slight variation across the district size groupings, but the response averages still placed adopter characteristics near the top of adoption priorities. In the XL size category, the adopter characteristics ranked the lowest for adopter characteristics with an average of 3.00. However, a relatively high standard deviation of 1.69 (the highest standard deviation of all categories in this study) accompanied this, which indicates that the views on it were mixed. The averages in the remaining size categories were more consistent: The averages in the L, M, and S size categories were 2.14, 2.22, and 2.27, respectively. It is noteworthy that the adopter characteristics showed the greatest variance/standard deviation of all of the factors. Although the adopter characteristics overall had a relatively low standard deviation of 1.40, it was the highest in the study, which indicates that the participants had much more diverse views on the rank (and strength) of adopter characteristics than they did on factors such as supplier marketing efforts, which received consistent responses (standard deviation of 1.03).

Summary of Influences on IT Infrastructure Findings

The findings of this study concerning the influences/priorities that shape IT infrastructure in Western Canadian K-12 districts reveal that the most influential factors are perceived innovation characteristics and adopter characteristics. These are followed by environmental influences, social network influences, and, lastly, supplier marketing efforts. An interesting finding from the 75 cases in this study is that, regardless of the size or province, the priorities that shape IT infrastructure in Western Canadian K-12 districts are often very similar.
Figures 33, 35, 37, 39, and 41 present the mean strength and rank of influences from Frambach and Schillewaert's (2002) framework across the entire study, the three provinces, and the four size categories. These visual representations show that, with minor variations, the priorities of and influences on K-12 districts in terms of IT infrastructure are consistent, regardless of size or province/location.

Summary of Findings Chapter

In this chapter I presented the findings from 75 cases from Western Canada in order to more fully understand cloud computing adoption in K-12 district schools. These findings were in three areas: (1) IT leadership in K-12 district, (2) IT infrastructure platforms and software used by K-12 districts, and (3) the influences that shape the IT infrastructure decisions by district leaders. In the following chapter, using correlation analysis, I explore the relationships that influence the adoption (and nonadoption) of cloud computing by K-12 districts.

CHAPTER 5: ANALYSIS

Overview

I continue to answer the central research question of "What factors influence district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for district schools?" by statistically analyzing the relationships among the study's many findings. In the previous chapter I presented the study's findings on leadership structures, decision-making processes, IT infrastructure, and the priorities that shape IT infrastructure. These findings were detailed, across the entire study, and in categories based on province and size. They serve as the foundation for my analysis of the statistically significant relationships among these factors that answer the third research question "What is the interplay of human and nonhuman factors that influence infrastructure decisions by district-level IT leadership in K-12?"

As discussed in the correlation analysis section of chapter 3, this analysis of statistically significant relationships ($\alpha = 0.05$) between variables will contain both objective and subjective findings. For this reason, this chapter is organized into two major sections: objective findings and subjective findings. Recalling Table 11, these objective and subjective relationships are as follow:

1. Objective variables relating to IT infrastructure
    a. Demographics (location/province and size)
    b. Leadership structures (branches and hierarchy levels)
    c. Infrastructure (platforms and software)
2. Subjective variables relating to IT infrastructure
    a. Decision models
    b. Priorities/influences

Challenges Concerning the Volume of Statistically Significant Relationships

The volume of statistically significant relationships that I found in this study created challenges for the presentation of this chapter. From these 895,122 possible variable combinations, described in chapter 3, only approximately 0.26% were found to be statistically significant relationships. Despite the rarity of statistically significant findings, in terms of a percentage, the total volume of findings in this study is over 2,000. This makes an extensive individual examination of each of these findings impossible in a dissertation such as this. To address the challenge of presenting such a large volume of findings, I made several design decisions about the contents of this chapter. I present these decisions in the following section.

The Presentation of Statistically Significant Relationships

The presentation of objective relationships. With the exception of software to platform and software to software relationships, I presented both positive and negative phi coefficient relationships in the objective relationships section. Software relationship findings required that I use a modified approach in my presentation of statistically significant relationships given the volume of findings that would have resulted otherwise.

The infrastructure software findings, presented in chapter 4, revealed that districts typically used one software type on a single platform. For example, when a district used Microsoft Exchange on a private cloud platform, it did not use another e-mail software on their private cloud platform as well. Consequently, the inclusion of the very large number of negative phi coefficient relationships for software would obscure the more important positive phi coefficient relationship findings. This is because many negative phi coefficient relationships were redundant, expressing findings already evident in positive phi coefficient relationships.

The presentation of subjective relationships. In this chapter's section on subjective relationships, I present both positive and negative statistically significant phi coefficient relationships. As with the objective relationships discussed earlier, I structured this chapter to reduce redundant relationships and to highlight the most important findings. For this purpose, I present only the relationships between the Frambach and Schillewaert (2002) organizational innovation adoption factors that were ranked first in importance. In many instance this ranking implies a very important strength rating. The priority and strength relationships were numerous and therefore such a reductive strategy was required to facilitate a focused discussion.

My analysis of relationships with subjective variables also resulted in negligible findings that are not included in this chapter. These omitted subjective relationship categories are:

- Demographic relationships with decision models
- Leadership relationships with decision models
- Relationships between influences/priorities and decision models
- Demographic relationships with influences/priorities
- Leadership relationships with influences/priorities

The rationale for omitting these subjective relationship categories from discussion is that neither K-12 districts' decision models nor their influences/priorities were found to be major determinants of cloud computing adoption or IT infrastructure. As the subjective relationship categories listed here are subsets of these, they should be omitted. Moreover, these subjective relationship categories in themselves did not offer any deeper insights into why decision models nor influences/priorities were not more important in shaping districts' IT infrastructure or cloud computing adoption.

Objective Relationships

Overview

The objective relationships presented in this section reveal the study's two most important findings:

1. Demographic factors, namely a district's location/province and then size, have the greatest impact on the IT infrastructure of that district.
2. A district's existing IT infrastructure, including both platform and software, is a major determinant of other elements of that district's IT infrastructure.

These two factors have the greatest influence on district-level K-12 IT leadership on their adoption of cloud computing. The following subsections will present support for these two main findings.

Conversely, a district's leadership structure, such as the organizational branch and/or hierarchy level responsible for IT infrastructure decision making was found to have a negligible impact on a district's IT infrastructure. Evidence of this is also presented in the following subsections.

Demographic Relationships

Overview. A key finding of this study is the importance of location and size to the infrastructure decisions of K-12 districts in Western Canada. In this section I present the demographic findings that were statistically significant to a *p*-value of 5%. Figures 42 to 45 present statistically significant relationships based on province and size groupings. The demographic relationships that these figures describe are the foundation for my discussion of the provincial and size influences on the leadership and infrastructure domains that I discuss in this study. Though the provincial and size differences in these figures create interesting demographic insights on their own, the comparison between provinces and then between size categories adds further insights to the analysis. This is particularly true in instances in which a positive relationship exists in one province/size grouping and a negative relationship for the same platform/software exists in another province/size grouping (e.g., the use of PeopleSoft Financial Management by large XL cases, and its lack of use by S cases). This is the reason for the relationship findings' presentation in this section.

		Relationship Item							
British Columbia (n=33)	Leadership	Leadership-Level3-Branch-Financial (19)				0.29			
	SIS	SIS-CommunityCloud (38)	0.90						
		SIS-District- (38)							-0.68
		SIS-PublicCloud (7)					-0.28		
		SIS-CommunityCloud-BCeSISMyEducationBC (38)	0.90						
		SIS-District-CIMS (4)				0.27			
		SIS-District-PowerSchool (19)							-0.52
		SIS-District-SchoolLogic (12)						-0.39	
		SIS-Combined-Maplewood (9)						-0.33	
		SIS-Combined-PowerSchool (21)							-0.55
		SIS-Combined-SchoolLogic (13)						-0.41	
	LMS	LMS-PublicCloud (16)					-0.26		
		LMS-PublicCloud-GAFE (11)						-0.37	
	Financial	Financial-District (64)				0.29			
		Financial-District-SDS (10)			0.44				
		Financial-Combined-SDS (11)			0.39				
	E-mail	E-mail-District (61)			0.36				
		E-mail-PublicCloud (46)							-0.56
		E-mail-PublicCloud-GAFE (30)							-0.61
	Website	Website-District (56)				0.27			
		Website-Outsourced (23)					-0.24		
	Social Media	Social-Twitter-DoNotUse (8)			0.30				
		Social-Twitter-Use (63)					-0.27		

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure 42. British Columbia demographic relationships.

		Relationship Item							
Alberta (n=29)	Leadership	Leadership-Branch-Financial (26)					-0.23		
		Leadership-Level3-Branch-Financial (19)						-0.34	
	SIS	SIS-CommunityCloud (38)							-0.63
		SIS-District- (38)		0.51					
		SIS-CommunityCloud-BCeSISMyEducationBC (38)							-0.63
		SIS-District-PowerSchool (19)		0.67					
		SIS-Combined-PowerSchool (21)		0.66					
	LMS	LMS-PublicCloud (16)			0.32				
		LMS-District-Moodle (47)					-0.24		
		LMS-District-PowerSchool (3)				0.26			
		LMS-PublicCloud-GAFE (11)			0.44				
	Financial	Financial-District-DynamicsNAV (7)					-0.25		
		Financial-District-SDS (10)						-0.31	
		Financial-Combined-SDS (11)					-0.25		
	E-mail-	E-mail-District (61)							-0.53
		E-mail-PublicCloud (46)		0.57					
		E-mail-PublicCloud-GAFE (30)	0.80						
		E-mail-PublicCloud-Office365 (17)					-0.23		
		E-mail-Combined-ExchangeAll (49)						-0.34	
		E-mail-Combined-MicrosoftExchangeO365 (50)						-0.31	
	Website	Website-District (56)						-0.48	
		Website-Outsourced (23)			0.48				
	Social Media	Social-Twitter-DoNotUse (8)					-0.27		
		Social-Twitter-Use (63)				0.27			

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure 43. Alberta demographic relationships.

		Relationship Item							
Saskatchewan (n=13)	SIS	SIS-CommunityCloud (38)						-0.36	
		SIS-District- (38)				0.24			
		SIS-CommunityCloud-BCeSISMyEducationBC (38)						-0.36	
		SIS-District-MaplewoodStudentInformationSystem (4)		0.52					
		SIS-District-SchoolLogic (12)				0.28			
		SIS-Combined-Maplewood (9)			0.48				
		SIS-Combined-SchoolLogic (13)				0.26			
	LMS	LMS-District-Blackboard (6)			0.38				
		LMS-Combined-Blackboard (7)			0.34				
	Financial	Financial-District-DynamicsNAV (7)		0.58					
	E-mail	E-mail-District-Exchange2013 (16)			0.36				
		E-mail-PublicCloud-GAFE (30)					-0.23		
		E-mail-Combined-ExchangeAll (49)				0.26			
		E-mail-Combined-MicrosoftExchangeO365 (50)				0.25			
	Website	Website-District (56)				0.27			
		Website-Outsourced (23)						-0.30	

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure 44. Saskatchewan demographic relationships.

	Relationship Item							
L (n=14)	Leadership-Level2 (28)					-0.23		
	E-mail-PublicCloud-GAFE (30)					-0.25		
	Website-Outsourced (23)					-0.24		
XL (n=8)	LMS-Traditional (3)			0.37				
	LMS-District-Desire2Learn (2) (2)			0.48				
	LMS-District-Moodle (47)						-0.36	
	LMS-Traditional-Moodle (3)			0.37				
	LMS-Combined-Desire2Learn (4)			0.30				
	Financial-District-PeopleSoftFinancialManagement (5)		0.60					
	E-mail-PublicCloud-Office365 (17)			0.33				
	Library-District-Symphony (6)			0.38				
	Library-Combined-Symphony (7)			0.38				
S (n=44)	Leadership-Level2 (28)				0.26			
	SIS-CommunityCloud (38)						-0.33	
	SIS-PublicCloud (7)				0.27			
	SIS-CommunityCloud-BCeSISMyEducationBC (38)						-0.33	
	SIS-District-SchoolLogic (12)				0.29			
	SIS-Combined-SchoolLogic (13)			0.31				
	LMS-Combined-Desire2Learn (4)					-0.28		
	Financial-District (64)						-0.35	
	Financial-District-PeopleSoftFinancialManagement (5)						-0.32	
	Financial-PublicCloud-atrieveERP (9)			0.31				
	E-mail-PublicCloud-Office365 (17)					-0.26		
	Library-District-Symphony (6)						-0.35	
	Library-Combined-Destiny (37)					-0.25		
	Library-Combined-Symphony (7)						-0.35	

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure 45. Demographic size relationships.

The importance of location over size. A finding of this study is that districts have more in common based on location/province than they do based on size. This finding is somewhat counterintuitive because one might anticipate that district infrastructure solutions for large districts would differ from those of smaller districts. Though I found multiple size-based relationships, which are evident in Figure 45, the greater volume of provincial/regional-based relationships underscores the influence of provincial legislation on K-12 districts in Western Canada. This is particularly prevalent in the areas of privacy legislation (e.g., public cloud use in Alberta in the form of GAFE), as well as the government's encouragement of districts to use community cloud platforms (e.g., BCeSIS/MyEducation BC in British Columbia).

Beyond provincial legislation, another, and perhaps parallel, explanation of this phenomenon is the improved scalability of contemporary IT solutions, especially cloud computing solutions (Purohit, Apoorva, & Lathashree, 2017). This reduces the importance of a district's size in terms of that district's leadership selecting an appropriate software. This means that the same software can be used by both the smallest and the largest districts. An example of this is the financial software atrieveERP, which is most heavily used by districts in the smallest case size category of S. However, atrieveERP is also used by districts in the XL size category (Figure 25).

Demographic effect on leadership.

***Leadership provincial relationships*.** I found only a small number of statistically significant relationships, positive or negative, among the demographic and leadership factors. Though I found no significant relationships for Saskatchewan, I did for the cases in Alberta and British Columbia. British Columbia shows a low positive relationship among the decisions made in the Leadership-Level3-Branch-Financial branch of a district. This relationship differentiates British Columbia from Alberta in that Alberta had corresponding low negative and moderate negative relationships, respectively, between Leadership-Branch-Financial and Leadership-Level3-Branch-Financial. The implication of these relationships is that there is less financial branch involvement in IT decision making for K-12 districts in Alberta than in British Columbia or Saskatchewan.

Leadership size relationships. When I examined the districts by size, I found only two statistically significant relationships that pertained to districts' IT leadership. One finding is that the smallest districts, those in the S size case category, had a tendency to make decisions on a higher vertical hierarchy level, such as Leadership-Level2, than in larger districts. This is supported by the low positive and low negative relationships for Leadership-Level2, found in the S and L categories. The presence of a positive relationship for Leadership-Level2 and the absence of positive relationships in the other larger size categories further supports this finding. This finding is intuitive because smaller districts have fewer vertical differentiation/hierarchy levels.

Demographic effect on SIS.

SIS provincial relationships. I found the largest demographic-based relationship differences in the SIS domain, both in terms of the volume of the findings and the magnitude. In 29 of the 33 cases in British Columbia, SIS community cloud was in the form of BCeSIS/MyEducation BC. BCeSIS/MyEducation BC was the only SIS community cloud offering in the study, and exclusively available in British Columbia. I found very strong positive relationships between SIS community cloud and BCeSIS/MyEducation BC use and British Columbia. Because I did not find BCeSIS/MyEducation BC outside British Columbia, I found corresponding substantial and moderate negative relationships in Alberta and Saskatchewan, respectively.

Whereas British Columbia had predominantly SIS community cloud, Alberta and Saskatchewan preferred private cloud district for SIS. This is supported by the substantial positive relationships with SIS-District that I found in Alberta and Saskatchewan and the substantial negative relationship in British Columbia. In Alberta and Saskatchewan, provincial differences in software preferences emerged in their use of private cloud-district. Cases in Alberta preferred to use PowerSchool, which corresponded to substantial positive relationships. In Saskatchewan I found the strongest positive relationships between Maplewood, followed by SchoolLogic.

SIS size relationships. I found SIS relationships based on size solely in the smallest, S category. Though I found moderate negative relationships between SIS Community Cloud and BCeSIS/MyEducation BC, they were by-products of the fact that 14 of the 44 cases in the S size category were from British Columbia. Size did not truly influence these relationships.

I found a low positive relationship between the S category and SIS public cloud use. This is intuitive because smaller districts are less likely to have the resources for a robust data centre. These smaller districts benefit from the use of a public cloud solution hosted by the vendor where the management of the SIS software and hardware is included in the SIS subscription cost. The low positive relationship between the S category and SIS Public Cloud is linked to the fact that 57% of these smaller cases used a district-based private cloud platform for SIS purposes; otherwise, a stronger positive relationship might be expected.

I found positive relationships between the S category and the use of SchoolLogic for SIS, which districts operated primarily by using a district-based private cloud platform, though it is also available on a public cloud platform. The positive relationships for SchoolLogic were for both the district-based private cloud platform School Logic instances and the total occurrences of SchoolLogic, independent of platform.

Demographic effect on LMS.

LMS provincial relationships. A recurring finding from this study is the greater use of public cloud in Alberta than in British Columbia and Saskatchewan. This finding is reinforced by the LMS relationships, because LMS public cloud and LMS-PublicCloud-GAFE had moderate positive relationships with Alberta, but negative relationships with British Columbia. Saskatchewan had neither positive nor negative statistically significant relationships with public cloud use. The LMS positive relationships with public cloud in Alberta and the negative and nonexistent relationships in British Columbia and Saskatchewan, respectively, underscore the finding that Alberta is the Western Canadian province most open to public cloud use.

I also found that Alberta and Saskatchewan had differing positive relationships concerning their software choices for instances in which the districts delivered LMS from their private cloud data centres. Saskatchewan had moderate positive relationships with the use of Blackboard, which was predominantly delivered by a district-based private cloud platform. Alberta, on the other hand, had a low positive relationship with an LMS-District-PowerSchool and a low negative relationship with an LMS-District-Moodle. More simply put, districts that ran an LMS in their data centres preferred Blackboard in Saskatchewan and PowerSchool in Alberta.

LMS size relationships. I found size-related LMS relationships primarily in the largest, XL size category, which suggests that large district LMS needs might differ slightly from those of smaller districts. The only relationship outside this size grouping was a low negative relationship in the S size category for LMS-Desire2Learn. This negative S size category finding, placed in the context of the moderate positive LMS-District-Desire2Learn findings of the XL size category, suggests that the Desire2Learn software might have characteristics that best align it with the resources or needs of large districts.

The unique needs of the districts in the largest XL size category with regard to LMS are further evident in the negative and positive relationships with the Moodle LMS software.

Moodle was delivered out of the data centres of 47 of the 75 cases in this study. However, in the XL size category, a moderate negative relationship exists with LMS-District-Moodle in the largest cases. The implication of this is that in the largest school districts, Moodle is not the primary LMS. This sets apart the largest school districts from all other districts in the LMS domain. Rather, in the XL size category, Moodle complemented another LMS solution. This was particularly true when Moodle was delivered on a traditional in-school platform and the other LMS software was delivered on a cloud platform (district-based private cloud platform, an outsourced private cloud platform private, or a public cloud platform).

Demographic effect on library.

Library provincial relationships. In the library domain I found no statistically significant relationships among the provinces. This implies that the location/province of a district did not affect its use of library software.

Library size relationships. I found statistically significant relationships pertaining to the library domain only in the XL and the S size categories. These relationships pertained only to the software that they used and not to the infrastructure platforms. These relationships were mainly mirror relationships in which a positive relationship in one size category was matched by a negative relationship in the other. This was the case with Library-District-Symphony, where I found positive relationships for the largest, XL size category and negative relationships for the smallest, S size category. The implications of these relationships are that the Symphony library software package might be best suited to larger districts, but that they perhaps have characteristics that make it unattractive to smaller districts.

A similar conclusion can be inferred for the Destiny library software package, for which I found a low negative relationship in the S size category. The implication for the Destiny library software package, based on the lack of negative relationships in other size categories, is that it is better suited to districts with 10,000 students or more.

Demographic effect on financial systems.

Financial provincial relationships. In all provinces a district-based private cloud platform was the most commonly used for financial software. This is supported by the low positive relationship that I found between British Columbia and Financial-District and the lack of other platform relationships, positive or negative, in other provinces.

The statistically significant relationships in the financial domain illustrate the impact of location/province on a district's choice of financial software. I found the strongest relationship, a substantial positive relationship, between Saskatchewan and Financial-District-DynamicsNAV. I found other positive relationships—moderate positive—between British Columbia and Financial-District-SDS. Alberta, on the other hand, did not have any positive statistically significant relationships, but did have negative relationships with both Financial-District-DynamicsNAV and Financial-District-SDS.

Financial size relationships. An infrastructure platform finding in the financial domain is that the smallest districts might not have the resources or need for centralized accounting systems based in a data centre in the district. Rather, these smaller districts might use other alternatives, such as public cloud or an outsourced private cloud infrastructure platform, or they might choose to run more basic accounting suites at the school level (the traditional infrastructure platform). The moderate negative relationship with Financial-District in the smallest, S size category and the moderate positive relationship that I found for the use of Financial-PublicCloud-atrieveERP in the S category are evidence of this.

Beyond the negative relationships pertaining to the smallest, S size category cases, I found no other platform relationships, positive or negative, for the financial domain. This suggests that the infrastructure platforms used for financial functions, particularly those that districts with 10,000 or more students use, are scalable.

Software relationships in the financial domain echo the infrastructure platform dichotomy between the largest and smallest districts. Financial-District-PeopleSoftFinancialManagement had a substantial positive relationship in the largest, XL size category and a moderate negative relationship in the smallest, S category. This suggests that PeopleSoft Financial Management software might have characteristics that best align it with the resources/needs of larger districts, but not those of smaller districts.

Demographic effect on the website hosting.

Website provincial relationships. The statistically significant relationships illustrate the provincial differences between how websites are delivered in Western Canadian K-12 districts. The prevalence of Website-Outsourced by Alberta makes it unique. Alberta's moderate positive and moderate negative relationships with Website-Outsourced and Website-District, respectively, are evidence of this. In Saskatchewan and British Columbia, I found opposite relationships because these two provinces used mainly district-based private cloud platforms for either website.

Website size relationships. I found only one statistically significant size relationship for the website infrastructure domain. It was a low negative relationship between the L size category and Website-Outsourced, which indicates the greater use of other website platforms such as district-based private cloud, school-based hosting, or public cloud platforms. This corresponds to the findings in the previous chapter on website infrastructure that 75% of the cases used a district-based private cloud platform, and 31% of the cases used an outsourced private cloud platform. It should also be noted, however, that this one statistically significant relationship is most likely a by-product of the provincial relationships that I discussed in the previous subsection. The 12 of the 14 cases in the L size category are in British Columbia and Saskatchewan, which I found had negative relationships with Website-Outsourced and positive relationships with Website-District.

Demographic effect on e-mail.

***E-mail provincial relationships*.** Province was a strong influence on a district's e-mail platform choice. Statistically significant relationships were both greatest in number and strength in Alberta, which had a more public cloud-focused approach to e-mail than British Columbia and Saskatchewan did. I found the strongest relationships for e-mail in Alberta, with a very strong positive and a substantial positive relationship for E-mail-PublicCloud-GAFE and E-mail-PublicCloud, respectively. Because GAFE is a competing product and alternative to Microsoft's Exchange and Office 365 products, Alberta had corresponding negative relationships with Microsoft Exchange and Office 365. Moreover, Alberta had a substantial negative relationship for E-mail-District, which indicates that the districts used public cloud heavily without the use of a parallel district-based private cloud platform.

In contrast to Alberta, British Columbia had a moderate positive relationship with E-mail-District and substantial negative relationships with both E-mail-PublicCloud and E-mail-PublicCloud-GAFE. This shows that British Columbia had a data centre-first approach, whereas Alberta had a public cloud-first approach to e-mail.

Saskatchewan's e-mail approach falls between Alberta's and BC's approaches. Saskatchewan cases tended to use Microsoft Exchange for e-mail and supplemented their district-based private cloud platform use with Office 365, a public cloud solution. This is reflected in the positive relationships between Microsoft Exchange and Office 365. Because Microsoft is a competitor of Google, I found a low negative relationship in Saskatchewan for E-mail-PublicCloud-GAFE.

E-mail size relationships. One of the more interesting relationship groups in this section pertains to the use of e-mail in relation to district size. I found statistically significant relationships related to size only for public cloud software. These relationships were unlike those for financial software, where smaller cases used public cloud and larger cases used a district-based private cloud platform. In the financial software domain, this was probably attributable to the greater resources available to larger cases. Instead, in the e-mail domain, the only positive relationship to public cloud was in the XL size category, where E-mail-PublicCloud-Office365 use had a moderate positive relationship. The smallest cases, those in the S category, had a low negative relationship to E-mail-PublicCloud-Office365. Even the medium-sized, L category had a low negative relationship with E-mail-PublicCloud-GAFE. These findings are very interesting because they do not follow the trend in other domains of this study in which larger cases used a district-based private cloud platform, whereas smaller cases used infrastructure platforms outside their district data centres (e.g., a public cloud platform, an outsourced private cloud platform, or a traditional, school-based platform).

One possible explanation for this phenomenon pertaining to public cloud use is that perhaps in smaller districts, a district-based private cloud platform e-mail solution is sufficient to meet their needs. One finding is that many districts, especially those that use public cloud-based Office 365, used district data centre-based Microsoft Exchange for their staff e-mails. These same districts used Office 365 for their student e-mails. Perhaps, as the number of students increases, districts move to Office 365, away from their exclusively district-based private cloud platform. In smaller districts this move is not yet necessary.

Demographic effect on social media. A districts' location/province influenced social media use; namely, Facebook and Twitter. Although I found no statistically significant relationships for Saskatchewan pertaining to Twitter or Facebook, I found statistically significant relationships and differences between Alberta and British Columbia. British Columbia had a moderate positive relationship between Social-Twitter-DoNotUse and a low negative relationship with Social-Twitter-Use. Alberta, in contrast, had a low positive relationship with Social-Twitter-Use and a low negative relationship with Social-Twitter-DoNotUse. The implication of these relationships is that cases in Alberta were more active Twitter users than cases in British Columbia or Saskatchewan. These social media relationships further underscore Alberta districts' greater comfort with the use of the public cloud platform than its neighbouring provinces because social media is delivered exclusively using the public cloud.

Leadership Relationships

Overview. An important finding of this study is that that the leadership structures of a district have relatively little impact on the IT infrastructure of a district. Appendix K presents the relationships among leadership levels, leadership branches, and IT infrastructure. Decisions that the financial branch makes are slightly different from the decisions of other branches, such as instructional, services, and/or technology. This is evident in the large volume of findings for the financial branch, presented in Figures N2 and N3 of the appendix, especially compared to the volume of findings for other organizational branches. I describe the statistically significant relationships in IT infrastructure between the different leadership branches and levels in the section below. The influence of IT leadership structures on IT infrastructure is negligible, especially compared to more prominent factors such as a district's province and size. Nevertheless, I outline the most notable of these leadership relationships below.

Leadership hierarchy level to leadership branch relationships. Figure K1 illustrates the relationships between a district's branches and the leadership level responsible for IT infrastructure decisions. The positive relationships between L2 and BR technology show that IT leadership has the greatest influence on IT infrastructure decision making when it is its own branch within a district. In contrast are the positive relationships between Leadership-Level3 and Leadership-Level4 with Leadership-Branch-Financial and Leadership-Branch-Services, respectively. In these latter examples, IT infrastructure is a subfunction of broader, more inclusive branches that are not focused solely on IT.

Leadership effect on SIS. Several positive relationships among leadership levels, branches, and combination of leadership levels and branches illustrate the impact of a district's organization on its SIS. A finding of these statistically significant relationships is that the leadership branch and level influences the SIS decision for a district. When IT decisions are made at the most senior branch level, often by a dedicated technology branch of a K-12 district, very strong positive relationships are evident with the use of PowerSchool. Conversely, when the financial branch made the decisions, I found low negative relationships to PowerSchool. Similarly, when the services/infrastructure and instructional branches made the decisions, SIS-District-SchoolLogic and Maplewood had low and moderate positive relationships, respectively.

All of the aforementioned SIS relationships were on a district-based private cloud platform. Although I found statistically significant SIS relationships for community cloud in the Leadership-Level3 and financial branches, these community cloud relationships were most likely by-products of the distribution of Leadership-Level3 and financial branch in British Columbia.

British Columbia was the only province in which I found community cloud computing for SIS use; this platform was present in 88% of the province's cases. Therefore, these British Columbia leadership relationships concerning cloud computing are not in themselves insightful relationships, but rather reflections of British Columbia's heavy use of the community cloud platform for SIS.

Leadership effect on LMS. Unlike in the SIS domain, the impact of a district's IT leadership is relatively low in the LMS domain. Although multiple relationships exist for LMS software in this domain, they are frequently among factors that occur once or twice. The low frequency of occurrence of these factors makes broader inferences problematic.

Of the more prevalent relationships in the LMS domain was a positive relationship between LMS-PublicCloud and Leadership-Branch-Services in both Alberta and the largest, XL size category. This contrasts Leadership-Branch-Instructional, which had a moderate negative relationship with LMS-PublicCloud in Alberta. The financial branch, on the other hand, had negative relationships with LMS-District.

Leadership effect on library. I found moderate and low positive relationships between Leadership-Branch-Technology and Leadership-Level2-Branch-Technology and Library-District-InsigniaLibrarySystem. This contrasts the moderate positive relationships between Leadership-Level3-Branch-Services and Library-PublicCloud. These findings present a slight difference in the library system preferences of districts led by the technology branch and the preferences of districts led by the services branch. However, beyond these findings, the library platform and library software of a K-12 district appear to have been unaffected by the organization of its IT leadership.

Leadership effect on authentication. I found no relationships that identified a broad connection between the leadership levels or branches of a district and the authentication platform or software used. The districts throughout Western Canada predominantly used Active Directory, which is reflected in its occurrence in 66 of the 75 cases, on either a traditional or a district-based private cloud platform.

An interesting finding that emerged was the very strong negative relationships between Leadership-Branch-Financial and Authentication-ActiveDirectory, particularly for a district-based private cloud platform in AB-S. This, however, resulted from the occurrence of four non-Active Directory authentication solutions in this 20-district size category, along with an overlapping tendency in these cases for the financial branch to make IT infrastructure decisions. Moreover, in the AB-S category, Authentication-Traditional-ActiveDirectory and Authentication-Traditional-GAFEportal were present. Broader interpretations are difficult from this one relationship pair, but an implication is that decisions that the financial branch makes often result in less-mainstream authentication infrastructure.

Leadership effect on e-mail. The e-mail domain is another example of how IT infrastructure decisions that the financial branch of a district makes have a tendency to differ from decisions that instructional or technology branches make in other districts. The financial branch's decisions on e-mail infrastructure tend to favour a district-based private cloud platform. This is supported by the low negative relationship between Leadership-Level3-Branch-Financial and E-mail-PublicCloud-GAFE.

In addition to the financial branch, the services branch also tends to make decisions at the lower hierarchy level compared to the instructional or technology branches. The technology and instructional branches typically make decisions at Leadership-Level2, whereas the financial and service branches tend to make decisions at Leadership-Level3. These differences in leadership structures manifest in the e-mail domain because Leadership-Level3 districts have a tendency to use a district-based private cloud platform. The low positive relationship between Leadership-Level3 and E-mail-District and the very strong positive relationship between Leadership-Branch-Services and E-mail-Combined-MicrosoftExchangeO365 are evidence of this.

Leadership effect on financial systems. The impact of leadership structures on financial IT infrastructure is evident in the software differences among the cases in which the financial branch and the services branch make the decisions. I found a moderate positive relationship with Leadership-Level2-Branch-Financial and Financial-District-PeopleSoftFinancialManagement. In contrast is the moderate positive relationship between Leadership-Level3-Branch-Services and Financial-District-DynamicsNav.

Other examples of leadership's impact on financial IT infrastructure are the platform relationships, particularly those that pertain to public cloud use. When the instructional branch made the decisions, they preferred public cloud, which is supported by the instructional branch's positive relationships with Financial-PublicCloud and negative relationships with Financial-District. I found these relationships in Saskatchewan and in the SK-S category. This echoes a similar finding from the SIS domain that the instructional branch's IT leadership results in a preference for public cloud.

Leadership effect on website hosting. The organizational branch and level of a district's decision-making impact the Website hosting decisions. When the financial branch makes IT decisions, websites tend to be hosted on district-based private cloud infrastructure. In contrast, when the instructional or technology branches make such decisions, websites tend to be hosted on outsourced private cloud infrastructure. Corresponding leadership-level findings echo these leadership branch findings.

Leadership-Level2 relates to branches, such as the technology branch, that made decisions at the top level of that organizational branch (contrasting with IT decisions made under the lower Leadership-Level3 or Leadership-Level4 of the financial or service branches). A finding of this study is that when IT infrastructure decisions are made at Leadership-Level2, districts are less likely to host websites within the district. This is evident in the positive relationships between Website-Outsourced and the moderate negative relationships between Website-District and further supported by the Leadership-Level3 positive relationships between Website-District and the negative relationships between Website-Outsourced. I found additional support in the Leadership-Branch-Financial low positive relationship with Website-District and the negative relationships with Website-Outsourced.

Leadership effect on social media. The impact of leadership structures on IT infrastructure is evident in the tendency toward more restrictive use of social media by districts, where their financial or their instructional branches make the IT decisions. This is evident in the very strong positive relationships between Leadership-Branch-Financial and Social-Facebook-Block in Saskatchewan and SK-S. I found similar restrictive policies for Twitter in these demographic categories. In the smallest, S size category, Leadership-Level3-Branch-Financial had moderate positive and moderate negative relationships with Social-Twitter-DoNotUse and Social-Twitter-Use, respectively. Leadership-Branch-Instructional had a moderate negative relationship with Social-Facebook-Use in Alberta and a very strong negative relationship in the largest, XL size category. Leadership-Level2-Branch-Instructional echoed these relationships in

Alberta, with a moderate positive relationship with Social-Facebook-DoNotUse and a substantial negative relationship with Social-Facebook-Use.

Infrastructure Platform Relationships

Overview: A theme of data centre use inertia. I have identified five infrastructure platform types in this study: public cloud infrastructure; district-based private cloud infrastructure; outsourced private cloud infrastructure; traditional, school-based infrastructure; and community cloud infrastructure. These categories can be simplified into two categories, the first of which is IT services located in a district's data centre; namely, district-based private cloud infrastructure. The second is all other infrastructure platforms where IT services are not located at the district data centre. This second category includes public cloud infrastructure; outsourced private cloud infrastructure; traditional, school-based infrastructure; and community cloud infrastructure. This dichotomy is present throughout all of the domains in this study and is a recurring theme in the following subsections on infrastructure platform relationships.

A key finding of this study is that districts that provide IT services by using platforms outside their data centres tend to do so across multiple domains of their IT infrastructure. Similarly, districts that deliver IT services out of their district-based data centres tend to deliver multiple IT services. This tendency I refer to as *data centre use inertia*. This tendency, which I will illustrate in detail in the coming sections, is a major determinant of the type of cloud computing that districts adopt, inclusive of and extending beyond the mere adoption or nonadoption decision for cloud computing.

SIS platform relationships.

Figure 46 presents the study's findings concerning SIS platform relationships.

	Relationship Item								
SIS-Community Cloud (29)	E-mail-District (61)			All (0.31)					
	E-mail-PublicCloud (46)						All (-0.44)	S (-0.62)	M (-0.79)
	Financial-District (64)				All (0.25)				
	LMS-PublicCloud (16)						S (-0.31)		
	SIS-District- (38)							S (-0.62)	All (-0.80), BC (-1), BC-S (-1), M (-1), L (-1), XL (-1), BC-S (-1)
	SIS-PublicCloud (7)					All (-0.26)			
	Social-Twitter-DoNotUse (8)			S (0.36)	All (0.25)				
	Social-Twitter-Use (63)						S (-0.32)		
	Website-District (56)	M (0.79)							
	Website-Outsourced (23)					All (-0.23)			M (-0.79)
SIS-District (38)	E-mail-District (61)					All (-0.27)			
	E-mail-PublicCloud (46)	M (0.79)		S (0.43), All (0.36)					
	Financial-District (64)	SK (1), SK-S (1)							
	Financial-PublicCloud (16)								SK (-1), SK-S (-1)
	SIS-CommunityCloud (29)							S (-0.66)	All (-0.80), BC-S (-1), BC (-1), M (-1), L (-1), XL (-1)
	SIS-PublicCloud (7)						All (-0.33)	S (-0.50)	AB-S (-0.87), AB (-0.88), SK (-1), SK-S (-1)
	Website-District (56)								M (-0.79)
	Website-Outsourced (23)	M (0.79)			All (0.25)				
SIS-Outsourced (1)	E-mail-PublicCloud (46)								AB (-1), AB-S (-1)
	Social-Facebook-DoNotUse (9)	AB-S (1)							
SIS-PublicCloud (7)	Authentication-District (71)						All (-0.33)		
	Financial-District (64)						S (-0.47)	All (-0.51)	SK (-1), SK-S (-1)
	Financial-PublicCloud (16)	SK (1), SK-S (1)		S (0.43), All (0.39)					
	SIS-CommunityCloud (29)					All (-0.25)			
	SIS-District- (38)						All (-0.33)	S (-0.50)	AB-S (-0.87), AB (-0.88), SK (-1), SK-S (-1)

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure 46. SIS platform relationships.

SIS exclusivity as the cause of negative SIS to SIS relationships. With the exception of one case in British Columbia and two cases in Alberta, all other cases used only one SIS product or platform. Consequently, all statistically significant SIS platform to SIS platform relationships were negative. This is an advantageous design in that working within a single SIS helps districts to streamline student-records management.

SIS community cloud. The use of a community cloud platform in the SIS domain is exclusively a British Columbia phenomenon. The software that the districts use on this community cloud platform, not found on any other platform or in any other province, is BCeSIS/MyEducation BC. Consequently, the relationships that I found for SIS-CommunityCloud and SIS-CommunityCloud- BCeSIS/MyEducation BC reflect trends within one province rather than trends across all of Western Canada. This provincial phenomenon is particularly evident in the relationships between British Columbia's SIS and e-mail systems. British Columbia, which has the strictest privacy and data residency policies in the Western provinces, had the lowest occurrence of public cloud platform use for e-mail of the three provinces in the study: 30% in British Columbia versus 97% in Alberta and 62% in Saskatchewan (TriNimbus, 2018). Consequently, I found a moderate positive relationship between E-mail-District and SIS-CommunityCloud across the study. Similarly, I found negative relationships between SIS-CommunityCloud and E-mail-PublicCloud. The positive link between SIS-CommunityCloud and the use of district-based private cloud platforms is also evident in the LMS and financial domains.

Four of the 33 British Columbia cases used CIMS, a district-based private cloud platform SIS solution, as an alternative to community cloud-based BCeSIS/MyEducation BC. This use of a district-based private cloud platform reflects the tendency of British Columbia districts to operate their IT infrastructure within their district data centres.

SIS district-based private cloud. The SIS-District relationships strongly support the finding of this study that a district's province/location has the greatest impact on its IT infrastructure. Though SIS District relationships reflect the findings from the entire study of British Columbia, Alberta, and Saskatchewan, the heavy presence of SIS-CommunityCloud in

British Columbia makes the SIS-District findings largely descriptive of Alberta and Saskatchewan. Furthermore, the provincial differences in infrastructure platform use have a considerable impact on the relationships between SIS-District and other infrastructure domains. These provincial differences produce anomalies in the SIS-District relationships that do not fit the overall trends that I found in the study, particularly concerning the theme of data centre use inertia. In Alberta, e-mail is delivered using a public cloud platform in 97% of cases, and a district-based private cloud platform is the most common SIS infrastructure. Consequently, I found a low negative relationship between SIS-District and E-mail-District in the entire study.

A similar provincial phenomenon exists with Website-Outsourced: It is the most dominant platform for Alberta (59%), nonexistent in Saskatchewan (0%), and present in small numbers in British Columbia (18%). These provincial differences produced positive relationships between SIS-District and Website-Outsourced and a corresponding negative relationship between SIS-District and Website-District. This again demonstrates that a district's location/province has the greatest impact on its IT infrastructure.

A final example of the provincial impact on SIS-District infrastructure is the very strong positive relationships between SIS-District and Financial-District in Saskatchewan. As is evident in other infrastructure relationships, the use of a district-based private cloud platform in one domain usually relates to the use of a district-based private cloud platform in other domains. This supports the theme of data centre inertia and, contrasted with the findings for Alberta and British Columbia, demonstrates the impact of a district's province/location on its infrastructure.

SIS public cloud. SIS-PublicCloud relationships support the theme of data centre inertia. Districts that used a public cloud platform for SIS, which I found in Alberta and Saskatchewan, also used public cloud for financial systems. This was a very strong positive relationship in

Saskatchewan and a moderate positive relationship found across the entire study. Conversely, when SIS is run on a public cloud, districts were unlikely to use a district-based private cloud platform for financial systems, given the alternative of using a public cloud platform.

A somewhat surprising finding was the moderate negative relationship between SIS-PublicCloud and Authentication-District. However, this is a by-product of the scarcity of SIS-PublicCloud (found in 7 of the 75 cases) in relation to the total number of cases that used Authentication-District (found in 71 of the 75 cases). This again is an effect of SIS-CommunityCloud being an exclusively British Columbia phenomenon, which skews the findings for other SIS platforms.

LMS platform relationships.

Figure 47 presents the study's findings concerning LMS platform relationships.

	Relationship Item								
LMS-District (62)	Authentication-District (71)	AB-S (0.84)	S (0.63), AB (0.60)	All (0.36)					
	Authentication-Traditional (7)						S (-0.48)	AB (-0.60)	AB-S (-0.84)
	E-mail-District (61)			S (0.45)					
	Social-Facebook-Use (55)		L (0.65)						
	Website-Outsourced (23)						AB (-0.47)		
LMS-Outsourced (10)	LMS-Traditional (3)		BC (0.53), All (0.52)						
	Website-District (56)						S (-0.40)		BC-S (-0.78)
LMS-PublicCloud (16)	E-mail-District (61)						All (-0.34), S (-0.44)		
	E-mail-PublicCloud (46)				All (0.27)				
	Financial-District (64)					All (-0.24)			
	Library-PublicCloud (15)		AB-S (0.51)	AB (0.39)					

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure 47. LMS platform relationships.

LMS district-based private cloud. The use of a district-based private cloud platform for LMS often meant that districts used a district-based private cloud platform for other elements of IT infrastructure as well. For example, LMS-District had multiple positive relationships with Authentication-District that ranged from very strong positive in AB-S to moderate positive in the entire study. Given these positive relationships, Authentication-Traditional, an alternative to Authentication-District, had negative relationships. Similarly, LMS-District had a moderate positive relationship with E-mail-District. Last, the negative relationship between LMS-District and Website-Outsourced supports the dichotomy between district managed and non–district managed.

LMS outsourced private cloud. The substantial positive relationship in British Columbia and across the entire study between LMS-Outsourced and LMS-Traditional reveals that districts can combine a variety of platforms to meet their needs in the LMS domain. Although LMS-District and LMS-PublicCloud appear to be complete solutions that do not require an additional complementary or supplementary LMS platform, districts that use LMS-Outsourced and/or LMS- Traditional tended to use both platforms. Moreover, LMS-Outsourced had a negative relationship with Website-District, which supports this study's findings that when IT services are not located at the district data centre, other services also tend not to be located at the district data centre. The relationships for LMS-Outsourced further support the theme of data centre inertia that I discussed earlier in this chapter.

LMS public cloud. LMS-PublicCloud and LMS-District represent the trend of districts to stay within a single preferred infrastructure platform for multiple IT domains. I found positive relationships between LMS-PublicCloud and E-mail-PublicCloud, as well as between LMS-PublicCloud and Library-PublicCloud. Similarly, I found negative relationships between LMS-

PublicCloud and E-mail-District, as well as LMS-PublicCloud and Financial-District. This supports the dichotomy between services located within a district's own private cloud infrastructure and those not.

Library platform relationships.

Figure 48 presents the study's findings concerning library platform relationships.

	Relationship Item								
Library-District (52)	Library-CommunityCloud (2)						AB (-0.48)		
	Library-Outsourced (2)						AB (-0.48)		
	Library-PublicCloud (15)							S (-0.60), All (-0.61), BC (-0.64)	L (-0.78), SK-S (-0.82), SK (-0.85), BC-L (-1)
	Library-Traditional (8)						All (-0.43), S (-0.47)	BC (-0.64)	BC-S (-0.70)
	Website-Outsourced (23)						BC (-0.37)		
Library-PublicCloud (15)	Financial-District (64)					All (-0.26)		AB-S (-0.57)	
	Library-District (52)							S (-0.60), All (-0.61), BC (-0.64)	L (-0.7), SK-S (-0.8), SK (-0.8), BC-L (-1)
Library-Traditional (8)	Library-District (52)						All (-0.4), S (-0.4)	BC (-0.64)	BC-S (-0.70)
	Website-Outsourced (23)			BC (0.45)					

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure 48. Library platform relationships.

Library district-based private cloud. The relationships between Library-District strongly support the dichotomy between IT services delivered from a district's data centre and those not. In Library-District I found negative relationships between Library-CommunityCloud, Library-Outsourced, Library-PublicCloud, Library-Traditional, and Website-Outsourced. All of these relationships further support the theme of data centre use inertia.

Library public cloud. The use of Library-PublicCloud creates a negative relationship between Financial-District. This again supports the dichotomy between districts that use district-based private cloud infrastructure and those that deliver their IT services on platforms outside a district-based private cloud infrastructure.

***Library traditional*.** The relationships between Library-Traditional further support the theme of data centre use inertia. For Library-Traditional I found a moderate positive relationship between Website-Outsourced in British Columbia. Similarly, I found a negative relationship between Website-Outsourced and Library-District. These relationships again support the dichotomy between IT infrastructure delivered on a district-based private cloud infrastructure and infrastructure that is not.

Authentication platform relationships. In this study I have presented two authentication infrastructure platforms: district-based private cloud infrastructure at a district's data centre(s) and traditional infrastructure, found on-premises at district schools. As is evident in the very strong negative relationship, these two authentication platforms are most frequently alternatives to each other and rarely used in parallel. Figure 49 presents the study's findings concerning authentication platform relationships.

***Authentication district-based private cloud*.** The Authentication-District relationship findings support the trend of a district-based private cloud platform use for multiple IT domains. This is supported by the moderate positive relationships for Authentication-District in the entire study between E-mail-District, Financial-District, and LMS-District. LMS-District had a very strong relationship with Authentication-District in the 20 cases in the AB-S category. The Authentication-District findings further support the dichotomy between the negative relationships between IT services delivered at the district's data centre and IT services not delivered at the district's data centre. For example, Financial-Outsourced and SIS-PublicCloud have moderate negative relationships with Authentication-District across all of the cases in the study.

Authentication traditional. The Authentication-Traditional findings also support the aforementioned dichotomy through the various negative relationships between Authentication-Traditional and LMS-District. This phenomenon is particularly evident in the 20 cases of the AB-S category, in which I found a very strong negative relationship between Authentication-Traditional and LMS District.

	Relationship Item								
Authentication-District (71)	Authentication-Traditional (7)								All (-0.74), S (-0.80), AB-S (-1), AB (-1)
	E-mail-District (61)			S (0.36), All (0.34)					
	Financial-District (64)			All (0.40), S (0.36)					
	Financial-Outsourced (1)						All (-0.49)		
	LMS-District (62)	AB-S (0.84)	S (0.63), AB (0.60)	All (0.36)					
	SIS-PublicCloud (7)						All (-0.33)		
Authentication-Traditional (7)	Authentication-District (71)								All (-0.74), S (-0.80), AB (-1), AB-S (-1)
	LMS-District (62)						S (-0.48)	AB (-0.60)	AB-S (-0.84)

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure 49. Authentication platform relationships.

E-mail platform relationships.

Figure 50 presents the study's findings on e-mail platform relationships.

E-mail district-based private cloud. The relationships for e-mail infrastructure further support the study's findings of a dichotomy between a district-based private cloud platform and non–private cloud district infrastructure. What makes the e-mail relationships particularly interesting is the fact that all but two relationships in Figure 50 apply to the entire study. One of

	Relationship Item								
E-mail-District (61)	Authentication-District (71)			S (0.36), All (0.34)					
	E-mail-PublicCloud (46)						All (-0.38), S (-0.46)		
	Financial-District (64)				All (0.28)				
	LMS-District (62)			S (0.45)					
	LMS-PublicCloud (16)						All (-0.34), S (-0.44)		
	SIS-CommunityCloud (38)			All (0.31)					
	SIS-District- (38)					All (-0.27)			
	Website-District (56)				All (0.27)				
	Website-Outsourced (23)					All (-0.28)			
E-mail-Public Cloud (46)	E-mail-District (61)						All (-0.38), S (-0.46)		
	Social-Facebook-DoNotUse (9)						All (-0.30), S (-0.40)		AB-S (-1)
	Social-Facebook-Use (55)			S (0.35)	All (0.26)				
	LMS-PublicCloud (16)				All (0.27)				
	SIS-CommunityCloud (38)						All (-0.44)	S (-0.62)	M (-0.79)
	SIS-District- (38)	M (0.79)		S (0.43), All (0.36)					
	SIS-Outsourced (1)								AB (-1), AB-S (-1)
	Social-Twitter-DoNotUse (8)					All (-0.26)			
	Social-Twitter-Use (63)				All (0.25)				
	Website-Outsourced (23)				All (0.23)				

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure 50. E-mail platform relationships.

these two relationships was the moderate positive relationship between E-mail-District and LMS-District in the smallest, S category. The other relationship was a very strong negative relationship between E-mail-PublicCloud and SIS-Outsourced in Alberta and the AB-S category. Also noteworthy is the large number of districts involved in the statistically significant relationships in all districts in the study. For example, the moderate positive relationships between E-mail-District and Authentication-District were based on occurrences of each infrastructure platform in 61 and 71 of the 75 cases/districts, respectively.

In keeping with the study's major relationship trend of a district-based private cloud platform inertia, E-mail-District has positive relationships between Authentication-District, Financial-District, and Website-District in the entire study. A moderate positive relationship exists between E-mail-District and SIS-CommunityCloud; however, as I discussed previously, this is largely a result of British Columbia's almost exclusive use of SIS community cloud in its 33 cases. The presence of SIS-CommunityCloud in British Columbia is also responsible for the low negative relationship between E-mail-District and SIS-District across the entire study. Other negative relationships with E-mail-District were those among E-mail-PublicCloud, LMS-PublicCloud, and Website-Outsourced. These relationships underscore the dichotomy between the infrastructure in districts' data centres and the infrastructure hosted outside those district-based data centres.

E-mail public cloud. E-mail-PublicCloud has a low positive relationship between LMS-PublicCloud and Website-Outsourced, which further supports the study's relationship finding that districts comfortable with the use of infrastructure outside their data centres tend to have multiple infrastructure domains delivered outside their data centres.

E-mail-PublicCloud and E-mail-District had a moderate negative relationship across the entire study. The negative relationship was not stronger as the theme of data centre use inertia might suggest, because these two platforms can be used to complement each other, in addition to being alternatives. I found the use of E-mail- PublicCloud in parallel to E-mail-District in cases that used public cloud-based Office 365 for student e-mails while they kept staff e-mails on a district-based private cloud platform such as Microsoft Exchange. However, when cases used public cloud-based GAFE, public cloud use displaced district-based private cloud e-mail solutions. As is evident here, a district's choice of software within a platform is an important determinant of the type of cloud computing that districts adopt. For this reason I discuss software relationships in an upcoming section of this analysis chapter.

As with E-mail-District, E-mail-PublicCloud has more complicated relationships with SIS platforms, largely because of the use of community cloud in British Columbia. E-mail-PublicCloud and SIS-CommunityCloud had negative relationships, as did E-mail-PublicCloud and SIS-Outsourced. However, E-mail-PublicCloud and SIS-District had positive relationships. I explored the possible causes of these relationships in greater detail in the SIS section. Nevertheless, these relationships underscore the impact of a district's province/location on its IT infrastructure decisions.

Financial platform relationships.

Figure 51 presents the study's findings concerning financial platform relationships.

	Relationship Item								
Financial-District (64)	Authentication-District (71)			All (0.40), S (0.36)					
	E-mail-District (61)				All (0.28)				
	Financial-PublicCloud (16)							AB (-0.67), AB-S (-0.68)	All (-0.70), S (-0.82), SK (-1), SK-S (-1)
	Library-PublicCloud (15)					All (-0.26)		AB-S (-0.57)	
	LMS-PublicCloud (16)					All (-0.24)			
	SIS-CommunityCloud (38)				All (0.25)				
	SIS-District- (38)	SK (1), SK-S (1)							
	SIS-PublicCloud (7)						S (-0.47)	All (-0.51)	SK (-1), SK-S (-1)
Financial-Outsourced (1)	Authentication-District (71)						All (-0.49)		
Financial-PublicCloud (16)	Financial-District (64)							AB (-0.67), AB-S (-0.68)	All (-0.70), S (-0.82), SK (-1), SK-S (-1)
	SIS-District- (38)								SK (-1), SK-S (-1)
	SIS-PublicCloud (7)	SK (1), SK-S (1)		S (0.43), All (0.39)					

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure 51. Financial platform relationships.

Financial district-based private cloud. Financial-District relationships were consistent with the study's trend of a district-based private cloud platform infrastructure being used for multiple IT domains/services in a district. Moderate positive relationships existed between Financial-District and Authentication-District and low positive relationships between Financial-District and E-mail-District. A particularly interesting finding is that in Saskatchewan a very strong positive relationship existed between Financial-District and SIS-District. Each of the 10 cases that used a district-based private cloud infrastructure for SIS in Saskatchewan also used Financial-District.

The findings for SIS relationships, as I discussed previously, are unique because of the dramatic provincial differences; namely, the phenomenon of SIS community cloud in British Columbia. SIS-CommunityCloud had a low positive relationship with Financial-District across the entire study, which reflects a preference for centralized control of both student record/SIS and financial functions.

Finance public cloud. The relationships between SIS and financial infrastructure platforms further support the study's finding of a trend towards data centre use inertia. Financial-PublicCloud had a very strong positive relationship with SIS-PublicCloud in Saskatchewan. In all three instances in Saskatchewan's use of public cloud in the financial domain, the cases also used public cloud in the SIS domain. This relationship, especially in the context of the equally strong positive relationships between SIS-District and Finance-District in Saskatchewan, is particularly strong support. An extension of this finding is the very strong negative relationship between Finance-PublicCloud and SIS-District.

Because districts typically use a single financial platform, Financial-District or Finance-PublicCloud, I found a very strong negative relationship across the entire study between

Financial-District and Finance-PublicCloud. In a few instances the districts used public cloud parallel to district-based private cloud infrastructure. When they used both platforms, they used the public cloud solution for minor school-level transactions and accounts (e.g., School Cash Suite for cafeteria operations and petty cash accounts). The district-based private cloud platform continued to be used for the majority of accounting needs. This phenomenon was strongest in Alberta, which is why I found only a substantial negative relationship between Financial-District and Finance-PublicCloud. This contrasts with Saskatchewan and the entire study, for which there was a very strong negative relationship between Financial-District and Finance-PublicCloud.

Website platform relationships.

Figure 52 presents the study's findings concerning website platform relationships.

Website district-based private cloud. Website infrastructure has both positive and negative relationships that support the study's overall finding that district-based private cloud infrastructure in one domain of IT services often indicates district-based private cloud use in other IT domains. An example of this is the low positive relationship between Website-District and E-mail-District. Similarly, negative relationships exist between Website-District and LMS-Outsourced, particularly in BC-S, where I found a very strong negative relationship.

As I discussed in the SIS section, the relationships between Website and SIS are unique given the prevalence of SIS-CommunityCloud in British Columbia. The British Columbia Ministry of Education strongly encourages community cloud use, and it is the predominant choice in British Columbia (29 of the province's 33 cases) (Province of British Columbia, 2018). In other provinces, SIS-CommunityCloud was absent entirely. Consequently, the relationships

	Relationship Item								
Website-District (56)	E-mail-District (61)				All (0.27)				
	Social-Facebook-Use (55)						S (-0.31)		
	LMS-Outsourced (10)						S (-0.40)		BC-S (-0.78)
	SIS-CommunityCloud (38)	M (0.79)							
	SIS-District- (38)								M (-0.79)
	Website-Outsourced (23)								BC (-0.79), AB-S (-0.81), BC-S (-0.83), S (-0.86), AB (-0.87), All (-0.88), M (-1)
Website-Outsourced (23)	E-mail-District (61)					All (-0.28)			
	E-mail-PublicCloud (46)				All (0.23)				
	Social-Facebook-Use (55)			S (0.38)	All (0.27)				
	Library-District (52)						BC (-0.37)		
	Library-Traditional (8)			BC (0.45)					
	LMS-District (62)						AB (-0.47)		
	SIS-CommunityCloud (38)					All (-0.23)			M (-0.79)
	SIS-District- (38)	M (0.79)			All (0.25)				
	Website-District (56)								BC (-0.79), AB-S (-0.81), BC-S (-0.83), S (-0.86), AB (-0.87), All (-0.88), M (-1)
	Website-PublicCloud (5)			S (0.34)					
Website-PublicCloud (5)	Website-Outsourced (23)			S (0.34)					

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.
	+.50 to +.69	Substantial positive relationship.
	+.30 to +.49	Moderate positive relationship.
	+.10 to +.29	Low positive relationship.

	-.10 to -.29	Low negative relationship.
	-.30 to -.49	Moderate negative relationship.
	-.50 to -.69	Substantial negative relationship.
	-.70 or lower	Very strong negative relationship.

Figure 52. Website platform relationships.

between website and SIS platforms reflect the impact of a district's province/location on IT infrastructure. Website-District and SIS-CommunityCloud have a very strong positive relationship in the M size category. Similarly, and counterintuitively, SIS-District and Website-District have a very strong negative relationship in the M category. However, of the nine cases in the M size category, six were from British Columbia, three were from Alberta, and none were from Saskatchewan. This provincial distribution, in combination with SIS community cloud in British Columbia, explains these relationships and underscores province/location being the greatest determinant of a district's IT infrastructure.

Website outsourced private cloud. The Website-Outsourced relationships were consistent with the study's findings of a dichotomy between infrastructure located in a district's data centre(s) and infrastructure located outside the district's data centre(s). This was evident in the low positive relationship between E-mail-PublicCloud, which is outside a district's data centre(s), and the low negative relationship with E-mail-District, which is located in a district's data centre(s). I found these negative relationships in all cases in the study. The Website-Outsourced relationships with Library-District and Library-Traditional were similarly consistent with this overall trend. Library-District had a negative relationship with Website-Outsourced, whereas Library-Traditional had a positive relationship. The negative relationship between Website-Outsourced and LMS-District was consistent with this trend as well.

Social-media platform relationships.

Social media to social media relationships. I examined K-12 districts' use of social media—namely, Facebook and Twitter—in Western Canada. Because they both operate on public cloud platforms, I examined the relationships between the public cloud platform and other infrastructure platforms in each district's use of these social media tools. As I discussed in the previous chapter, I identified three levels of social media use: active use by a district; active blocking of these social media services by a district; and non-use, non-blocking. Figures 53 and 54 show the Facebook and Twitter relationships, respectively, with other infrastructure platform domains.

These relationships show that districts' social media use tends to be consistent on the public cloud platform. This supports the broader finding of this study that districts that use a non–district-based private cloud solution for one aspect of their IT infrastructure tend to use a non–district-based private cloud solution for other elements as well. Facebook and Twitter blocking or non-use often occurred together. Similar findings concern the active use of Facebook and Twitter. A district's use of Facebook and its public cloud platform revealed a very

	Relationship Item								
Social-Facebook-Block (11)	Social-Twitter-Block (4)	BC-S (0.78)	BC (0.68), S (0.57), All (0.57)						
	Social-Twitter-Use (63)						BC (-0.40), All (-0.44)	S (-0.60)	BC-S (-0.70)
Social-Facebook-DoNotUse (9)	E-mail-PublicCloud (46)						All (-0.30), S (-0.40)		AB-S (-1)
	SIS-Outsourced (1)	AB-S (1)							
	Social-Twitter-DoNotUse (8)	BC-L (1), BC (0.90), BC-S (0.78), L (0.78)	All (0.66)	S (0.45)					
	Social-Twitter-Use (63)							All (-0.51)	BC (-0.77), BC-L (-1)
Social-Facebook-Use (55)	E-mail-PublicCloud (46)			S (0.35)	All (0.26)				
	LMS-District (62)		L (0.65)						
	Social-Twitter-Block (4)						All (-0.39), S (-0.44)		
	Social-Twitter-DoNotUse (8)							S (-0.52), All (-0.57)	BC-S (-0.70), BC (-0.79), BC-L (-1)
	Social-Twitter-Use (63)	BC-L (1), BC-S (1), BC (0.92), L (0.82), All (0.72), S (0.71)							
	Website-District (56)						S (-0.31)		
	Website-Outsourced (23)			S (0.38)	All (0.27)				

PHI COEFFICIENT RELATIONSHIP LEGEND

+.70 or higher	Very strong positive relationship.			-.10 to -.29	Low negative relationship.
+.50 to +.69	Substantial positive relationship.			-.30 to -.49	Moderate negative relationship.
+.30 to +.49	Moderate positive relationship.			-.50 to -.69	Substantial negative relationship.
+.10 to +.29	Low positive relationship.			-.70 or lower	Very strong negative relationship.

Figure 53. Facebook platform relationships.

	Relationship Item								
Social-Twitter-Block (4)	Social-Facebook-Block (11)	BC-S (0.78)	BC (0.68), S (0.57), All (0.57)						
	Social-Facebook-Use (55)						All (-0.39), S (-0.44)		
Social-Twitter-DoNotUse (8)	E-mail-PublicCloud (46)					All (-0.26)			
	Social-Facebook-DoNotUse (9)	BC-L (1), BC (0.90), BC-S (0.78), L (0.78)	All (0.66)	S (0.45)					
	Social-Facebook-Use (55)							S (-0.52), All (-0.57)	BC-S (-0.70), BC (-0.79), BC-L (-1)
	SIS-CommunityCloud (38)			S (0.36)	All (0.25)				
Social-Twitter-Use (63)	E-mail-PublicCloud (46)				All (0.25)				
	Social-Facebook-Block (11)						BC (-0.40), All (-0.44)	S (-0.60)	BC-S (-0.77)
	Social-Facebook-DoNotUse (9)							All (-0.51)	BC (-0.77), BC-L (-1)
	Social-Facebook-Use (55)	BC-L (1), BC-S (1), BC (0.92), L (0.82), All (0.72), S (0.71)							
	SIS-CommunityCloud (38)						S (-0.32)		

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure 54. Twitter platform relationships.

strong positive relationship in the entire study between the use of Twitter and its public cloud platform.

I found a connection between Facebook and Twitter use across the study and particularly in British Columbia. When districts used, blocked, or neither used nor blocked Facebook, they often treated Twitter similarly. Of the 75 cases in the study, a relatively small number (n = 11) blocked Facebook, and an even smaller number (n = 4) blocked Twitter. However, when they blocked one, I found a substantial positive relationship with the other's blocking as well. This was most prevalent in the smallest cases in British Columbia, in the BC-S category, where I found a very strong positive relationship. Conversely, I found negative relationships between the use of one social media service and the blocking of the other. This was true of all cases, where a moderate negative relationship existed between the blocking of one and the use of the other; it was particularly true of the BC-S category, which showed a very strong negative relationship. Districts that did not use Facebook and those that did not use Twitter also showed positive relationships. Conversely, I found negative relationships among the cases that did not use Facebook and those that used Twitter. In all of the cases in the study, these relationships were substantial (substantial positive and substantial negative, respectively). In British Columbia the relationships were particularly pronounced: very strong, respectively. In addition, I found positive relationships—moderate positive and very strong positive, respectively—between Facebook-DoNotUse and Twitter-DoNotUse in the size categories of S and L. The findings of negative relationships between Facebook-Use and Twitter-Block and Twitter-DoNotUse in the entire study (moderate negative and substantial negative, respectively) further support this finding. Similar negative relationships exist between Twitter-Use and Facebook-Block and Facebook-DoNotUse in the entire study (moderate negative and substantial negative, respectively). The link between Facebook and Twitter use and the associated use of public cloud infrastructure was particularly strong in British Columbia, where the BC-L and BC-S categories had phi coefficients of 1.0, which indicates that when one occurred, the other also always occurred.

Social media to platform relationships. The social media to platform relationships support this study's findings of a theme of data centre use inertia, in which districts that used non–district-based private cloud infrastructure tended to use that infrastructure for multiple IT domains. This theme of data centre use inertia can be found in the relationships between public cloud-based social media and the use of public cloud infrastructure for e-mail. Social-Facebook-

DoNotBlock, which implies the non-use of public cloud for social media, had negative relationships with E-mail-PublicCloud. This was a low negative relationship in the entire study, a moderate negative relationship for the S category, and a very strong negative relationship in AB-S cases. Similarly, in all cases I found a low negative relationship between Social-Twitter-DoNotBlock and E-mail-PublicCloud.

A somewhat surprising finding was the substantial positive relationship between Social-Facebook-Use and LMS-District in the L category. I expected a stronger relationship with LMS-PublicCloud and Social-Facebook-Use. However, in this case, I believe that this relationship is a by-product of the prevalence of LMS-District in 71% of L category district schools (versus 7% LMS-PublicCloud). I found Social-Facebook-Use in 71% of the cases in the L category. The lack of a corresponding negative relationship between LMS-PublicCloud and Social-Facebook-Use supported this finding.

Infrastructure Software Relationships

The importance of software decisions to IT infrastructure. A key determinant of IT infrastructure in K-12 is the software available on a given infrastructure platform. This is a significant factor that influences district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for district schools—the central research question of this study. The influence of software on infrastructure is linked to the available software for a given infrastructure platform. In some instances the same software is available on multiple platforms. For example, the library software packages of Destiny and L4U are available as SaaS public cloud subscription services as well as on private cloud and traditional platforms. However, it is more common for software to be available on only a limited range of platforms. For example, GAFE and Office 365 are available only on a public cloud platform. Conversely, the districts did not offer Unix/Linux e-mail solutions, such as Zimbra or IceWarp, as a public cloud SaaS solution during this research. These Unix/Linux-based e-mail software packages required installation on traditional or private cloud platforms. Consequently, a district's IT infrastructure for a domain such as e-mail or SIS is a result of decisions on both the infrastructure platform and the software available on that platform. A decision on one impacts the other.

Furthermore, a district's software and platform decisions for a single domain often have implications across other domains. This is evident in the previous section's theme of data centre use inertia. In this section I explore more deeply the software relationships that shape a district's IT infrastructure through the lens of four major themes that I outline in the following section.

Strategic software relationship themes. A quantitative analysis of the study's infrastructure findings concerning software reveals four recurring themes. I present and describe them in Table 19 and explore them in the following subsections.

Complementary platforms and software within a domain**.** A finding of this study is that when districts use multiple software solutions to address the needs of a single domain, such as finance or e-mail, they deliver these solutions on different platforms. One reason is to take advantage of the inherent characteristics of a given platform. For example, a public cloud e-mail solution such as Office 365 might be a cost-effective way to provide thousands of students with e-mail accounts (Microsoft, 2018). However, such a solution might not meet the real or perceived regulatory requirements that govern a district. Conversely, some districts use both a public cloud solution (e.g., Office 365) and a private cloud solution (e.g., Microsoft Exchange), the latter of which they perceive as being more in line with regulatory requirements.

A second reason for the complementary use of platforms and software within a domain is to add features that might not be available in the main software package used for a domain.

Table 19

Strategic Software Relationship Themes and Definitions

Strategic software relationship themes	Definitions and examples
Complementary platforms	Complementary platforms and software are used within a domain. Districts use complementary platforms and software in a single domain to meet their needs. An example of this would be the use of either a traditional or public cloud-based financial system, in addition to a district-based private cloud financial system.
Similar platforms	A preference for the use of similar platforms across domains, namely the use of district-based private cloud platforms, or non-district-based private cloud platforms such as public cloud, outsourced private-cloud, or traditional platforms. This follows the theme of districts' data centre use inertia, discussed earlier. An example of this would be the use of LMS-District, SIS-District, and Library-District by the same district.
Software ecosystems	Strategic and philosophical software ecosystems. Districts use strategic software ecosystems that are often linked to a prominent vendor, such a Microsoft or Google. District leaders may also have a philosophical preference for open source platforms, such as Unix/Linux. An example of this would be the use of Authentication-District-ActiveDirectory, E-mail-District-MicrosoftExchange, and E-mail-PublicCloud-Office365 by the same district.
Exclusive use	The exclusive use of one software on a single platform within an IT domain. Districts rarely use different software within a single domain on the same platform. An example of this would be the use of LMS-District-PowerSchool, as such districts do not run another LMS product on that platform, such as LMS-District-Maplewood.

Because most software packages are available on certain platforms and not on others (e.g., GAFE is available only on a public cloud platform and not on a private cloud platform), districts sometimes use additional software solutions and their associated platforms to supplement what they have in place. Two examples of this from the financial domain are School Cash Suite, a public cloud solution, and Simply Accounting, a traditional on-premises solution. Some districts use these two software solutions in addition to a district-based private cloud solution to meet schools' specific accounting needs in areas in which the main, centralized, district-based private cloud accounting solution might not fully meet them. To clarify these examples: The majority of schools' accounting operations (e.g., staff salaries, payment of utilities, etc.) use district-based private cloud platform accounting software solutions; schools use non–district-based private cloud solutions such as School Cash Suite and Simply Accounting to help them to track smaller, school-level transactions, such as minor student fees and/or student-cafeteria purchases.

A preference for a similar platform across domains. A theme that is evident from the software relationships in this section is districts' preference for a similar platform across domains of IT services. This theme echoes the earlier finding in the previous section that the platform to platform relationships illustrate that when a district uses a district-based private cloud platform, it tends to use that platform for multiple IT services. Similarly, districts that do not run IT services within their district-based private cloud infrastructure tend not to do so for multiple IT domains. These other, non–district-based private cloud platforms include public cloud, traditional on-premises infrastructure, and outsourced private cloud infrastructure. My examination of software relationships, both software to platform and software to software, confirms this finding.

Software ecosystems. A key finding of this section on software relationships is the districts' use of strategic software ecosystems, where compatible technologies are used across multiple IT infrastructure domains. These compatible technologies are often from the same vendor (e.g., GAFE for both e-mail and LMS domains, Microsoft's Exchange and Active Directory products for e-mail and authentication domains, etc.). The reasons for the use of software ecosystems vary: increased compatibility, volume-purchase discounts, a familiar user interface, a preference for smaller/local vendors, or an ideological preference for noncommercial, community-supported software such as Unix/Linux (Silic & Back, 2017; Ven & Verelst, 2008). An examination of the statistically significant software relationships revealed the finding that districts tend to build compatible software solutions across their numerous domains. These software choices, in turn, determine the IT platforms and overall infrastructure because not all software solutions are available on all platforms.

The exclusive use of one software on a single platform within a domain. A finding of this study is that it is rare for districts to use multiple software solutions on the same platform within a single IT infrastructure domain. In many instances, the districts used a single software solution to meet their needs in an IT infrastructure domain. An example of this is that most cases had only one SIS system. In certain instances, however, the use of complementary software solutions on different platforms is beneficial within an infrastructure domain. An example is the use of a district-based private cloud financial system for major accounting functions and the use of an on-premises financial software system for minor transactions. However, such complementary software solutions are almost always delivered using different platforms. This is a key distinction between this theme and the theme of complementary software and platform use that I discussed earlier. This finding on the exclusive use of one software on a single platform within a domain is supported by the figures in the following sections. These figures show that a statistically significant positive relationship does not exist between two types of software on the same platform of an IT infrastructure domain.

Coincidental software relationships. In addition to the four strategic software relationship themes that I discussed in the previous section, the analysis of software relationships also revealed coincidental software relationships. The definition of a coincidental software relationship in this study is a relationship that is the by-product of two variables with overlapping use, but not a relationship that itself has a strategic underpinning. Coincidental software relationships were especially common in the SIS domain, where a district’s province/location heavily influenced its SIS platform and software use. Similarly, the use of some software is regional, perhaps because of the location of the vendor's headquarters and the willingness to support local businesses. In British Columbia, examples of coincidental relationships that do not have an apparent strategic underpinning are the positive relationships between SIS-CommunityCloud-BCeSIS/MyEducationBC and SDS financial software. These relationships show no apparent strategic benefit, unlike the built-in integration found in many products from the same vendor (e.g., a district's use of Microsoft Exchange, Microsoft Office365, and Microsoft ActiveDirectory) that I discussed in the strategic software ecosystem section earlier.

Discussion delimitations. This section describes the delimitations of the forthcoming discussion of the statistically significant software relationships among different elements of a K-12 district's infrastructure through the lens of the four strategic software relationship themes that I presented in the previous section. These relationships include software to platform relationships and software to software relationships. Given the large number of findings on statistically significant software relationships, positive and negative, an exhaustive discussion of each within the dissertation body is not possible. In the following subsections I present only the positive relationships that were statistically significant in the entire study. Refer to Appendixes O and P for a full listing of positive relationships pertaining to all province and size categories, in addition to those that I discuss here. Moreover, to further focus this discussion on only the most pertinent and universal relationships, should a statistically significant relationship occur only one or two times or never, I will not discuss it because such a small sample is a poor foundation for the assertion of a broader trend.

I will also not present or discuss the negative software relationships. A finding of this study is that districts rarely use multiple software products to address their needs in a single domain. This is the fourth strategic software relationship theme that was presented previously: the exclusive use of one software on a single platform within a domain. The inclusion of the very large number of negative relationships that this phenomenon produced would obfuscate the key positive relationship findings.

SIS software relationships. Figure 55 presents the SIS software relationships that are applicable to all cases in the study. As with all of the domains that I discuss later in this section with regard to their respective figures, Figure 55 contains the relationships, their strengths in terms of phi coefficients, and a relationship type demarcation that indicates the broader software relationship theme(s) that I discussed earlier and that the relationship matches.

A distinguishing feature of the software relationships in the SIS domain, compared to the software relationships in other IT infrastructure domains, is that the majority are coincidental relationships. The dominance of the community cloud platform for the SIS domain in British Columbia creates coincidental relationships between SIS Community Cloud-BCeSIS/ MyEducationBC and Financial District-SDS. Figure 55 reveals that of the 11 instances of SDS, all but one occurred in British Columbia, which supports this assertion of coincidental relationships.

The SIS-District and GAFE relationships are further examples of coincidental relationships with the SIS domain. The SIS-District and E-mail-PublicCloud-GAFE relationships, as well as the SIS-District and LMS-PublicCloud-GAFE relationships, are also apparent by-products of the regional use of GAFE. SIS-District was found mostly in Alberta and Saskatchewan, and both provinces showed greater use of GAFE. These relationships are examples of coincidental overlapping demographic relationships rather than strategic relationships.

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION				RELATION- SHIP TYPES
STUDENT INFORMATION SYSTEM: PLATFORM TO SOFTWARE RELATIONSHIPS						
SIS-CommunityCloud (29)	Financial-District-SDS (10)		S (0.54)	All (0.33)		**CR**
	Financial-Combined-SDS (11)			S (0.48)	All (0.28)	**CR**
SIS-District- (38)	E-mail-PublicCloud-GAFE (30)	M (0.79)	AB-S (0.57)	All (0.47), S (0.37)		**CR**
	LMS-PublicCloud-GAFE (11)				All (0.25)	**CR**
SIS-PublicCloud (7)	Library-PublicCloud-Destiny (4)	SK (0.77)	S (0.50)	All (0.33)		**SR - SP**
STUDENT INFORMATION SYSTEM: SOFTWARE TO SOFTWARE RELATIONSHIPS						
SIS-CommunityCloud BCeSISMyEducationBC (29)	Financial-District-SDS (10)		S (0.54)	All (0.33)		**CR**
	Financial-Combined-SDS (11)			S (0.48)	All (0.28)	**CR**
SIS-District-CIMS (4)	E-mail-District-FirstClass (5)			All (0.41)		**SR - SP**
SIS-District-Maplewood StudentInformation System (4)	Financial-District-DynamicsNAV (7)			All (0.33)		**SR - SP**
SIS-District-PowerSchool (19)	E-mail-PublicCloud-GAFE (30)	M (0.79), L (0.78)	All (0.58), S (0.56)			**CR**
	LMS-District-PowerSchool (3)			S (0.49), All (0.35)		**SR - SE**
SIS-District-SchoolLogic (12)	Financial-District-DynamicsNAV (7)			S (0.45), All (0.36)		**SR - SP**
SIS-PublicCloud-Maplewood StudentInformation System (5)	Authentication-Traditional-ActiveDirectory (6)			All (0.31)		**SR - SP**

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

RELATIONSHIP TYPE CODE LEGEND

SR - CP	Strategic Relationship–Complementary Platform.	**SR - SE**	Strategic Relationship–Software Ecosystem.
SR - SP	Strategic Relationship–Similar Platform	**CR**	Coincidental Relationship

Figure 55. SIS software to platform and software to software relationships.

Following coincidental relationships, the second most prevalent theme in the SIS domain is the strategic use of similar platforms by districts. This is evident in Figure 55 in the extensive use of a district-based private cloud platform across multiple infrastructure domains such as SIS, e-mail, and finance. This theme of strategic use of similar platforms is expanded by the use of the public cloud platform for SIS and library functions. Moreover, the use of public cloud and traditional infrastructure, solutions that do not require district data centre use, adds support to this theme and the earlier finding of data centre use inertia.

The final theme revealed in the software relationships in the SIS domain is the use of strategic software ecosystems. This is seen in the relationships between the use of PowerSchool as an SIS and PowerSchool as an LMS. Although PowerSchool is primarily an SIS, it can be configured to be used as an LMS as well (PowerSchool, 2018). The use of one integrated system from the same vendor for both SIS and LMS can reduce IT and record-management efforts. These efficiencies are at the centre of the software ecosystem theme and why this theme is found in other domains as well.

LMS software relationships. Figure 56 presents the LMS software relationships that are applicable to all cases in the study. Contrasting the SIS domain that I discussed previously, the relationships in Figure 56 are primarily strategic and match the strategic relationship themes that I identified at the beginning of this section. Of these themes, the most prominent is the use of a similar platform across multiple domains. For example, when a district used a district-based private cloud platform for LMS functions, it also often used it for authentication. Similarly, when a district used the public cloud platform for LMS functions, it also often used it for e-mail. Moreover, the use of alternatives to district-based private cloud alternatives is shown in the relationships between LMS-Traditional and public cloud or outsourced infrastructure. It is seen in the LMS through the positive relationships between LMS-Traditional and E-mail-PublicCloud-GAFE. These relationships all support the theme of the use of a similar platform across multiple domains.

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION				RELATION-SHIP TYPES
LEARNING MANAGEMENT SYSTEM (LMS): PLATFORM TO SOFTWARE RELATIONSHIPS						
LMS-District (62)	Authentication-District-ActiveDirectory (66)	AB-S (0.84), S (0.77)		AB (0.47)	All (0.26)	**SR - SP**
LMS-PublicCloud (16)	E-mail-PublicCloud-GAFE (30)			S (0.35), All (0.30)		**SR - SP**
LMS-Traditional (3)	E-mail-PublicCloud-Office365 (17)			BC (0.44), All (0.37)		**SR - SP**
	LMS-Outsourced-Moodle (10)		BC (0.53), All (0.52)			**SR–SP** **SR - CP**
LEARNING MANAGEMENT SYSTEM (LMS): SOFTWARE TO SOFTWARE RELATIONSHIPS						
LMS-District-Blackboard (6)	E-mail-PublicCloud-Office365 (17)		S (0.56)	All (0.30)		**CR**
LMS-District-Moodle (47)	E-mail-Combined-ExchangeAll (49)			S (0.30), AB (0.41)	All (0.23)	**CR**
LMS-Outsourced-Moodle (10)	LMS-Traditional-Moodle (3)		BC (0.53), All (0.52)			**SR–SP** **SR - CP**
LMS-PublicCloud-GAFE (11)	E-mail-PublicCloud-GAFE (30)			All (0.43), S (0.41)		**SR–SP** **SR - SE**
LMS-Traditional-Moodle (3)	E-mail-PublicCloud-Office365 (17)			BC (0.44), All (0.37)		**SR - SP**

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

RELATIONSHIP TYPE CODE LEGEND

SR - CP	Strategic Relationship–Complementary Platform.	**SR - SE**	Strategic Relationship–Software Ecosystem.
SR - SP	Strategic Relationship–Similar Platform.	**CR**	Coincidental Relationship.

Figure 56. LMS software to platform and software to software relationships.

A second theme that the software relationships in the LMS domain supported is the use of complementary platforms within a domain. This is supported by substantial positive relationships between the use of Moodle on traditional and outsourced private cloud infrastructure platforms. In these instances, the school districts were able to mitigate the challenges of one platform by operating the same software on two platforms in parallel.

A third theme that the software relationships for the LMS domain support is the strategic use of software ecosystems. The districts' use of GAFE for both LMS and e-mail services supports this theme. By using GAFE and the same software and platform for students' e-mail (e.g., Gmail within GAFE), some districts simplified the management of their students' LMS accounts (e.g., Google Classroom within GAFE).

Library software relationships. Figure 57 presents the library software relationships that apply to all districts in the study, the majority of which are coincidental relationships. An explanation is that library software can be considered a peripheral aspect of a district's IT infrastructure. Library software has considerably fewer cross-domain implications than other software and platform decisions. For example, a district's decision on e-mail can be leveraged to streamline LMS access, as I discussed in the previous section through the examples of Gmail and Google Classroom in the GAFE. Similarly, districts can use PowerSchool as both an SIS and an LMS, which again presents an opportunity to streamline IT infrastructure and user-account management. The software relationships presented in Figure 57 do, however, support the strategic relationship theme of similar platform use across multiple domains. This is demonstrated in the positive relationships between district-based private cloud library software and other district-based private cloud software in the e-mail and finance domains. However, the vast majority of the software relationships are merely coincidental and demonstrate overlapping use, but not a strategic underpinning.

Authentication software relationships. In contrast to the previous section on the software relationships for the library domain, which were predominantly coincidental, the authentication software relationships are almost entirely strategic and nearly exclusively between the authentication and e-mail domains. All of the universal relationships presented in Figure 58, with the exception of the one coincidental relationship, support the theme of a strategic software ecosystem. For example, districts that use Microsoft Active Directory for authentication also use Microsoft Exchange and/or Microsoft Office365. Conversely, the few districts that used a

Unix/Linux-based authentication solution had a very strong positive relationships and substantial positive relationships with the alternative, non-Google and non-Microsoft e-mail solutions. These relationships support the theme of a strategic software ecosystem that I discussed previously.

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		**PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION**				**RELATION-SHIP TYPES**
LIBRARY: PLATFORM TO SOFTWARE RELATIONSHIPS						
Library-District (52)	Authentication-Traditional-ActivedDirectory(6)	All (0.79)				**CR**
Library-Traditional (8)	LMS-District-ScholantisandorSharePoint (7)			All (0.33)		**CR**
	SIS-District-CIMS (4)			S (0.47), All (0.30)		**CR**
	Financial-Combined-SDS (11)			BC (0.45), S (0.35), All (0.34)		**CR**
LIBRARY: SOFTWARE TO SOFTWARE RELATIONSHIPS						
Library-District-InsigniaLibrarySystem (7)	Financial-PublicCloud-atrieveERP (9)		AB (0.53)	All (0.30)		**CR**
	E-mail-District-Zimbra (4)	AB-S (1)		All (0.33)		**SR–SP**
	Library-Combined-L4U (16)		SK (0.69), All (0.61), AB (0.59), S (0.54), BC (0.53)			**CR**
Library-District-Symphony (6)	E-mail-District-FirstClass (5)			All (0.31)		**SR–SP**
	Financial-District-PeopleSoftFinancialManagement (5)	AB (0.80)	All (0.51)			**SR–SP**
Library-Traditional-L4U (6)	Financial-District-SDS (10)			BC (0.47), All (0.31)		**CR**
	Financial-Combined-SDS (11)			BC (0.47)	All (0.29)	**CR**
Library-Combined-L4U (16)	LMS-Combined-Blackboard (7)				All (0.28)	**CR**

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.
	+.50 to +.69	Substantial positive relationship.
	+.30 to +.49	Moderate positive relationship.
	+.10 to +.29	Low positive relationship.

RELATIONSHIP TYPE CODE LEGEND

SR - CP	Strategic Relationship–Complementary Platform.
SR - SP	Strategic Relationship–Similar Platform.
SR - SE	Strategic Relationship–Software Ecosystem.
CR	Coincidental Relationship.

Figure 57. Library software to platform and software to software relationships.

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION				RELATIONSHIP TYPES
AUTHENTICATION: SOFTWARE TO SOFTWARE RELATIONSHIPS						
Authentication-District-ActiveDirectory (66)	E-mail-District-Exchange2010 (31)			BC (0.38), All (0.30)		**SR–SE** **SR–SP**
	E-mail-Combined-ExchangeAll (49)		BC (0.60)	All (0.42)		**SR–SE** **SR - SP**
	E-mail-Combined-MicrosoftExchangeO365 (50)		BC (0.60)	All (0.43)		**SR - SE**
Authentication-District-OpenLDAP (4)	E-mail-District-Zimbra (4)	BC (0.80), All (0.73)				**SR - SE** **SR - SP**
	Authentication-Combined-Unix/LinuxAll (6)	S (0.80), All (0.80), BC (0.74)				**SR–SE** **SR - SP**
	E-mail-Combined-NonGoogleNonMicrosoft (12)		BC (0.55), S (0.54), All (0.54)			**SR–SE** **SR - SP**
Authentication-Combined-ActiveDirectory (69)	E-mail-Combined-ExchangeAll (49)		BC (0.60)	All (0.40)		**SR–SE** **SR - SP**
	E-mail-Combined-MicrosoftExchangeO365 (50)		BC (0.60)	All (0.41)		**SR - SE**
Authentication-Combined-Unix/LinuxAll (6)	E-mail-Combined-NonGoogleNonMicrosoft (12)	M (1), BC-S (0.78), BC (0.74)	S (0.68), All (0.67)			**SR–SE** **SR - SP**
	Financial-Combined-SDS (11)				All (0.29)	**CR**

PHI COEFFICIENT RELATIONSHIP LEGEND

(red)	+.70 or higher	Very strong positive relationship.
(orange)	+.50 to +.69	Substantial positive relationship.
(yellow)	+.30 to +.49	Moderate positive relationship.
(light yellow)	+.10 to +.29	Low positive relationship.

RELATIONSHIP TYPE CODE LEGEND

SR - CP	Strategic Relationship–Complementary Platform.
SR - SP	Strategic Relationship–Similar Platform.
SR - SE	Strategic Relationship–Software Ecosystem.
CR	Coincidental Relationship.

Figure 58. Authentication software to platform and software to software relationships.

Beyond the theme of a strategic software ecosystem, authentication software relationships also support the theme of similar platform use across domains. This is evident in the numerous software relationships presented in Figure 58. Examples of these relationships include the relationships between Authentication-District-ActiveDirectory and E-mail-District-Exchange2010 and between Authentication-District-OpenLDAP and E-mail-District-Zimbra. This further supports the finding of data centre use inertia, which shows a district's rare use of its district-based private cloud infrastructure for just one IT infrastructure domain.

The one coincidental software relationship in the authentication domain was between districts that used a Unix/Linux-based authentication solution and districts that used the financial software SDS. This relationship is the by-product of overlapping use in the same region; namely, small districts in British Columbia.

E-mail software relationships. Because of the importance and central nature of e-mail for a district, many districts have made strategic decisions to align their e-mail software and platforms with their other IT domains. This alignment is evident in the many examples of software ecosystem relationships in Figures 59 and 60. For example, districts that use MicrosoftOffice 365 tend to use Microsoft Exchange 2013, both of which Microsoft designs to be interoperable. The positive relationships between the use of Active Directory and the use of Microsoft Exchange and/or Office 365 (E-mail-Combined- Microsoft ExchangeO365) adds further support, as do the positive relationships between E-mail-PublicCloud-GAFE and LMS-PublicCloud-GAFE. A further example of software ecosystem relationships is districts' use of non-Google and non-Microsoft solutions for e-mail and authentication. Contrasting the examples of software relationships that a single vendor has designed for interoperability, the non-Google and non-Microsoft software relationships reflect a district's philosophical preferences for smaller companies and/or open source products. This again supports the theme of strategic software ecosystems as a determinant of IT infrastructure in Western Canadian K-12 districts and the adoption (or nonadoption) of cloud computing.

The themes of software ecosystem and complementary platforms are related in the e-mail domain. The positive relationships between districts' use of both Microsoft Exchange and Office 365 is evidence of the theme of complementary platforms within a single domain. A version of

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION				RELATION-SHIP TYPES
E-MAIL: PLATFORM TO SOFTWARE RELATIONSHIPS						
		+.70 or higher	+.50 to +.69	+.30 to +.49	+.10 to +.29	
E-mail-PublicCloud (46)	LMS-PublicCloud-GAFE (11)				All (0.25)	**SR - SP**
	SIS-District-PowerSchool (19)	M (0.79)		S (0.43), All (0.39)		**CR**
	SIS-District-SchoolLogic (12)			S (0.34)	All (0.27)	**CR**
	SIS-Combined-PowerSchool (21)	M (0.79)		S (0.38), All (0.37)		**CR**
	SIS-Combined-SchoolLogic (13)			S (0.38)	All (0.29)	**CR**
E-MAIL: SOFTWARE TO SOFTWARE RELATIONSHIPS						
		+.70 or higher	+.50 to +.69	+.30 to +.49	+.10 to +.29	
E-mail-District-Exchange2010 (31)	Authentication-District-ActiveDirectory (66)			BC (0.38), All (0.30)		**SR–SE** **SR - SP**
	Authentication-Combined-ActiveDirectory (69)			BC (0.38)	All (0.24)	**SR–SE** **SR - SP**
E-mail-District-FirstClass (5)	Library-District-Symphony (6)			All (0.31)		**SR - SP**
	SIS-District-CIMS (4)			All (0.41)		**SR - SP**
	Authentication-Combined-Unix/LinuxAll (6)			All (0.31)		**SR - SE** **SR–SP**
	Library-Combined-Symphony (7)			All (0.31)		**SR - SP**
E-mail-District-Zimbra (4)	Authentication-District-OpenLDAP (4)	BC (0.80), All (0.73)				**SR - SE** **SR–SP**
	Library-District-L4U (7)	AB-S (1)		All (0.33)		**SR - SP**
	Authentication-Combined-Unix/LinuxAll (6)		BC (0.60), All (0.58)			**SR–SE** **SR - SP**
E-mail-PublicCloud-GAFE (30)	LMS-PublicCloud-GAFE (11)			All (0.43), S (0.41)		**SR–SE** **SR - SP**
	SIS-District-PowerSchool (19)	M (0.79), L (0.78)	All (0.58), S (0.56)			**CR**
	Library-Combined-Insignia (8)			S (0.33)	All (0.24)	**CR**
	SIS-Combined-PowerSchool (21)	M (0.79), L (0.78)	All (0.52)	S (0.43)		**CR**
E-mail-PublicCloud-Office 365 (17)	E-mail-District-Exchange2013 (16)			S (0.45), All (0.33)		**SR–SE** **SR - CP**
	LMS-District-Blackboard (6)		S (0.56)	All (0.30)		**CR**
	LMS-Traditional-Moodle (3)			BC (0.44), All (0.37)		**SR - SP**
	Financial-PublicCloud-SchoolCashSuite (4)		BC (0.55)		All (0.29)	**SR - SP**
	LMS-Combined-Blackboard (7)			S (0.48)	All (0.26)	**CR**

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

RELATIONSHIP TYPE CODE LEGEND

SR - CP	Strategic Relationship–Complementary Platform.	**SR - SE**	Strategic Relationship–Software Ecosystem.
SR - SP	Strategic Relationship–Similar Platform.	**CR**	Coincidental Relationship.

Figure 59. E-mail software to platform and software to software relationships (1/2).

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION				RELATION-SHIP TYPES
E-MAIL: SOFTWARE TO SOFTWARE RELATIONSHIPS						
E-mail-Combined-ExchangeAll (49)	Authentication-Combined-ActiveDirectory (69)		BC (0.60)	All (0.40)		**SR–SE SR - SP**
	Authentication-District-ActiveDirectory (66)		BC (0.60)	All (0.42)		**SR–SE SR - SP**
	E-mail-PublicCloud-Office365 (17)	BC-L (0.79)		All (0.32)		**SR–SE SR - CP**
	LMS-Combined-Moodle (54)			AB (0.41)	All (0.23)	**SR–SP**
E-mail-Combined-Microsoft ExchangeO365 (50)	Authentication-Combined-ActiveDirectory (69)		BC (0.60)	All (0.41)		**SR - SE**
	Authentication-District-ActiveDirectory (66)		BC (0.60)	All (0.43)		**SR - SE**
E-mail-Combined-NonGoogleorMS (12)	Authentication-Combined-Unix/LinuxAll (6)	M (1), BC-S (0.78), BC (0.74)	S (0.68), All (0.67)			**SR–SE SR - SP**
	Authentication-District-OpenLDAP (4)		BC (0.55), S (0.54), All (0.54)			**SR–SE SR - SP**
	E-mail-District-FirstClass (5)	AB-S (1)	BC (0.65), All (0.61), S (0.54)			**SR–SE SR–SP**
	E-mail-District-Zimbra (4)	AB-S (1)	S (0.54), All (0.54)	BC (0.44)		**SR–SE SR - SP**

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

RELATIONSHIP TYPE CODE LEGEND

SR - CP	Strategic Relationship–Complementary Platform.	**SR - SE**	Strategic Relationship–Software Ecosystem.
SR - SP	Strategic Relationship–Similar Platform.	**CR**	Coincidental Relationship.

Figure 60. E-mail software to platform and software to software relationships (2/2).

Microsoft Exchange, found in 49 of the 75 cases, is the most common e-mail software in Western Canada. However, in addition to Microsoft Exchange, which is designed to run in a private cloud data centre, many districts also used a public cloud e-mail solution such as Office 365 or GAFE in parallel. Frequently, districts used Microsoft Exchange for their internal faculty and staff e-mail and then used a public cloud e-mail solution for student e-mails. The motivations behind this dichotomy were districts' efforts to comply with their understanding of the provincial legislation concerning data privacy and data residency. This is a major motivation for the use of district-based private cloud infrastructure in the e-mail domain. Conversely, the difficulty and expense of providing e-mail accounts (and associated storage) to thousands of students is a major motivation for the use of a public cloud solution in the e-mail domain. For these reasons, many districts have staff e-mail accounts on Microsoft Exchange and student accounts on Microsoft Office 365. The positive relationship between the two e-mail software types and their different platforms is a strong example of the theme of complementary platforms within a domain. Furthermore, because Microsoft Exchange and Microsoft Office 365 are designed to be interoperable, the theme of a strategic software ecosystem is similarly supported.

Beyond the software ecosystem and complementary platform relationships that I have described, the e-mail domain presents strong support for the theme of similar platform use across a district's IT infrastructure domains. Districts that use public cloud for e-mail tend to use public cloud for other domains as well. This is evident in the universal positive relationships between Office 365 and SchoolCashSuite, as well as between GAFE use for e-mail and GAFE use for LMS. A similar phenomenon exists in district-based private cloud, where districts often used their data centres for multiple IT infrastructure domains. The multiple relationships with E-mail-District- Zimbra and E-mail-District- FirstClass support this strategic relationship theme further.

Financial software relationships. The financial domain of IT infrastructure is similar to the library domain in that it is a more peripheral aspect of a district's overall IT infrastructure. As with the library domain, a district's financial IT systems rarely provide opportunities that can benefit other IT infrastructure domains (e.g., streamlined user-account management through the integration of SIS and LMS functions, as I discussed previously). The large number of coincidental relationships presented in Figure 61 are evidence of the peripheral nature of the financial domain in a K-12 district.

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION				RELATION-SHIP TYPES
FINANCIAL: PLATFORM TO SOFTWARE RELATIONSHIPS						
Financial-District (64)	SIS-CommunityCloud-BCeSISMyEducationBC (29)				All (0.25)	**CR**
Financial-Traditional (4)	E-mail-PublicCloud-GAFE (30)	All (0.94)				**CR** **SR - SP**
	Financial-District-DynamicsNAV (7)			All (0.33)		**SR - CP**
	SIS-District-Maplewood StudentInformationSystem (4)	SK-S (1), S (0.80)		All (0.47)		**CR**
FINANCIAL: SOFTWARE TO SOFTWARE RELATIONSHIPS						
Financial-District-atrieveERP (35)	Financial-PublicCloud-SchoolCashSuite (4)				All (0.25)	**SR - CP**
	Financial-Combined-SchoolCashSuite (5)				All (0.28)	**SR - CP**
Financial-District-DynamicsNAV (7)	LMS-District-Blackboard (6)		S (0.63)	All (0.41)		**SR - SP**
	SIS-District-Maplewood StudentInformationSystem (4)			All (0.33)		**SR - SP**
	SIS-District-SchoolLogic (12)			S (0.45), All (0.36)		**SR - SP**
	LMS-Combined-Blackboard (7)		S (0.54)	All (0.36)		**SR - SP**
	SIS-Combined-SchoolLogic (13)			S (0.42), All (0.33)		**SR - SP**
Financial-District-PeopleSoft FinancialManagement (5)	Library-District-Symphony (6)	AB (0.80)	All (0.51)			**SR - SP**
	Library-Combined-Symphony (7)	AB (0.80)	All (0.51)			**SR - SP**
	LMS-Combined-Desire2Learn (4)	AB (0.80)		All (0.41)		**CR**
Financial-District-SDS (10)	Library-Traditional-L4U (6)			BC (0.47), All (0.31)		**CR**
	SIS-CommunityCloud-BCeSISMyEducationBC (29)		S (0.54)	All (0.33)		**CR**
	Authentication-Combined-Unix/LinuxAll (6)			All (0.31)		**CR** **SR - SP**
Financial-PublicCloud-atrieveERP (9)	Library-District-InsigniaLibrarySystem (7)		AB (0.53)	All (0.30)		**CR**
	Library-Combined-Insignia (8)			AB (0.44)	All (0.27)	**CR**
Financial-PublicCloud-SchoolCashSuite (4)	E-mail-PublicCloud-Office365 (17)		BC (0.55)		All (0.29)	**SR - SP**
Financial-Combined-SDS (11)	Library-Traditional-L4U (6)			BC (0.47)	All (0.29)	**CR**
	SIS-CommunityCloud-BCeSISMyEducationBC (29)			S (0.48)	All (0.28)	**CR**
	Authentication-Combined-Unix/LinuxAll (6)				All (0.29)	**CR**

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

RELATIONSHIP TYPE CODE LEGEND

SR - CP	Strategic Relationship–Complementary Platform.	**SR - SE**	Strategic Relationship–Software Ecosystem.
SR - SP	Strategic Relationship–Similar Platform.	**CR**	Coincidental Relationship.

Figure 61. Financial software to platform and software to software relationships.

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		**PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION**				**RELATION-SHIP TYPES**
WEBSITE: PLATFORM TO SOFTWARE RELATIONSHIPS						
Website-District (56)	E-mail-PublicCloud-Office365 (17)				All (0.24)	**CR**
	E-mail-Combined-NonGoogleNonMicrosoft (12)				All (0.25)	**SR - SP**
Website-Outsourced (23)	E-mail-PublicCloud-GAFE (30)			All (0.40), S (0.36)		**SR - SP**
	LMS-PublicCloud-GAFE (11)				All (0.29)	**SR - SP**
	SIS-District-PowerSchool (19)	M (0.79)			All (0.27)	**CR**
	SIS-Combined-PowerSchool (21)	M (0.79)			All (0.22)	**CR**
Website-PublicCloud (5)	LMS-PublicCloud-GAFE (11)	All (1.00)				**SR - SP**

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

RELATIONSHIP TYPE CODE LEGEND

SR - CP	Strategic Relationship–Complementary Platform.	**SR - SE**	Strategic Relationship–Software Ecosystem.
SR - SP	Strategic Relationship–Similar Platform.	**CR**	Coincidental Relationship.

Figure 62. Website software to platform and software to software relationships.

The strategic relationships in the financial domain are predominantly relationships among similar infrastructure platforms across other IT infrastructure domains. This again supports the theme of data centre inertia in this study. For example, districts that used a district-based private cloud platform for financial software often also used a district-based private cloud platform for LMS, SIS, library, and authentication software. Conversely, districts that were comfortable with the use of public cloud for financial operations had a positive relationship with the use of public cloud for e-mail. The positive relationships between Financial-PublicCloud-SchoolCashSuite and E-mail-PublicCloud-Office365 support this finding.

In addition to the theme of the use of similar platforms for multiple domains, Figure 61 presents the theme of complementary platform use in the financial domain. For example, districts that used Financial-District-DynamicNAV had a moderate positive relationship with the use of financial software on a traditional, in-school platform. The implication of this is that the districts had needs that the district-based private cloud software alone did not fully meet, which necessitated the use of a supplemental on-premises financial software. Another finding in support of the theme of the complementary use of platforms within a domain is the low positive relationship between Financial-District-atrieveERP and Financial-PublicCloud-SchoolCashSuite. As with the previous example, the districts use two financial solutions together to address a need that one solution does not completely fulfill.

Website software relationships. The most prevalent theme of the website software relationships presented in Figure 62 is the use of similar platforms across multiple IT domains. For example, Website-District has a low positive relationship with E-mail-Combined-NonGoogleNonMicrosoft. E-mail-Combined-NonGoogleNonMicrosoft is a descriptor for districts that used an e-mail software other than from Google or Microsoft. Because the districts used all of these non-Google, non-Microsoft e-mail solutions on a district-based private cloud platform, this low positive relationship supports the theme of similar platforms across multiple IT domains. Another example of this theme is the low positive relationship between Website-PublicCloud and LMS-PublicCloud. Last, websites run on an outsourced private cloud platform had a positive relationship with non–district-based private cloud software in the e-mail and LMS infrastructure domains. These relationships all strongly support this study’s finding of data centre use inertia.

Social media software relationships. Figure 63 presents the relationships between a district's social media policies and the software that such a district uses. These relationships are all coincidental. The relationship between Social-Facebook-DoNotUse and Authentication-District-ActiveDirectory is an example of a coincidental relationship in which a relationship appears because of the extensive use of the variables within a region, but without a more meaningful underpinning. For example, most districts used Active Directory for authentication; it is therefore not surprising to find that districts that do not use Facebook have a very strong positive relationship with the use of Active Directory. Another such example is the relationship between Social-Twitter-DoNotUse use and SIS-CommunityCloud- BCeSIS/MyEducationBC, which is an extension of two overlapping demographic/provincial phenomena.

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		**PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION**				**RELATION-SHIP TYPES**
SOCIAL MEDIA SOFTWARE RELATIONSHIPS						
Social-Facebook-Block (11)	SIS-District-MaplewoodStudentInformationSystem (4)		SK (0.63)	S (0.46), All (0.40)		**CR**
	SIS-Combined-Maplewood (9)			All (0.31)		**CR**
Social-Facebook-DoNotUse (9)	Authentication-District-ActiveDirectory (66)	All (0.88)				**CR**
	E-mail-District-FirstClass (5)	AB-S (1)		All (0.39)		**CR**
	E-mail-Combined-NonGoogleNonMicrosoft (12)	AB-S (1)			All (0.28)	**CR**
Social-Twitter-DoNotUse (8)	SIS-CommunityCloud-BCeSISMyEducationBC (29)			S (0.36)	All (0.25)	**CR**

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

RELATIONSHIP TYPE CODE LEGEND

SR - CP	Strategic Relationship–Complementary Platform.	**SR - SE**	Strategic Relationship–Software Ecosystem.
SR - SP	Strategic Relationship–Similar Platform.	**CR**	Coincidental Relationship.

Figure 63. Social media software to software relationships.

Summary of Objective Relationships

This section examined the influence of objective factors on the adoption of cloud computing IT infrastructure by the leaders of K-12 districts. These factors included demographic relationships (such as a district's size and province), a district's leadership structure, and the IT infrastructure of a district.

The correlation analysis in this chapter revealed that IT infrastructure in Western Canadian K-12 districts was most heavily influenced by a district's location/province. A district's size was the second most influential factor. Who was responsible for IT infrastructure decisions in the 75 districts had little impact on their IT infrastructure and resulted in few statistically significant relationships.

The IT infrastructure in a K-12 district was found to influence cloud computing adoption, especially the type of cloud computing used. Districts used similar infrastructure platforms across multiple IT functions/domains. For example, districts that used their district data centre for private cloud often delivered IT services for multiple IT functions/domains from that data centre (e.g., library and financial services). Districts also used complementary infrastructure platforms, such as public cloud and private cloud infrastructure, to meet their needs (e.g., the use of Microsoft Office365 and Microsoft Exchange). Additionally, the adoption of cloud computing was related to software ecosystems in which districts used compatible products, often from a single vendor, across multiple infrastructure domains (e.g., the use of private cloud Microsoft software for e-mail and authentication). Lastly, districts typically used only one software on one infrastructure platform within an IT function/domain. For example, when a district used a public cloud e-mail solution, such as Google's Gmail, that district did not run Microsoft's Office365 public cloud solution in parallel.

Subjective Relationships

Overview

In the previous section I examined objective factors such as the influence of a software type and/or platform on other elements of infrastructure, and in this section I examine the participants' subjective responses concerning a district's leadership with regard to IT infrastructure. These subjective elements include the decision model that the study participants identified as most closely matching their district, as well as the influences/priorities that shape their districts' infrastructure. In the first subsection I examine the statistically significant relationships among the districts' decision models. A full list of these relationships is presented in Appendix Table N1. In the second subsection I examine the impact of districts' influences/priorities on their IT infrastructure (see Appendix Table N2 for these findings). Although in the following two subsections I discuss the details of the statistically significant relationships for both of these subjective factors, an important finding of this study is that subjective factors have relatively little impact on a district's IT infrastructure, especially compared to the considerable impact of the objective factors that I discussed previously.

Decision-Model Relationships with Infrastructure

E-mail domain relationships with decision models. The impact of decision models on infrastructure is limited, as is evident in the small number of findings shown in Figure 64. The most interesting findings concerning relationships between decision models and infrastructure are in the e-mail domain, in which differences are illuminated between the process and rational models. I found negative relationships between the process model and the use of Microsoft e-mail products such as Microsoft Exchange and Office 365 in all cases. Despite being on different platforms, district-based private cloud and public cloud, respectively, the negative

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)			DECISION MODELS AND PHI COEFFICIENT RELATIONSHIP			
			Political (27)	Rational (23)	Anarchy (1)	Process (29)
Infrastructure Domains	E-mail	E-mail-District-Exchange2010 (32)		S (0.29)		**All (-0.35)**, S (-0.45), BC (-0.48)
		E-mail-District-Exchange2013 (17)	SK-S (-0.80)			
		E-mail-PublicCloud-Office365 (18)		SK-S (0.81), SK (0.72), S (0.31)		**All (-0.22)**
		E-mail-Combined-ExchangeAll (51)				**All (-0.24)**, BC (-0.40)
		E-mail-Combined-Microsoft ExchangeO365 (52)				**All (-0.26)**, BC (-0.40)
	Website	Website-Outsourced (26)	S (0.29)			
		Website-PrivateCloudSchoolLevel (4)	AB-S (0.65), AB (0.47), S (0.40)			
		Website-PublicCloud (5)	**All (0.25)**			

RELATIONSHIP LEGEND

Format	Description
Bold red text with yellow highlight: All (0.49)	Positive relationship applicable to all cases
Bold blue text with blue highlight: All (-0.23)	Negative relationship applicable to all cases
Red text: AB (0.46)	Positive relationship applicable to a province and/or size category
Blue text: BC (-0.41)	Negative relationship applicable to a province and/or size category

PHI COEFFICIENT RELATIONSHIP GUIDE

+.70 or higher	Very strong positive relationship.	-.10 to -.29	Low negative relationship.
+.50 to +.69	Substantial positive relationship.	-.30 to -.49	Moderate negative relationship.
+.30 to +.49	Moderate positive relationship.	-.50 to -.69	Substantial negative relationship.
+.10 to +.29	Low positive relationship.	-.70 or lower	Very strong negative relationship.

Figure 64. Decision model relationships with IT infrastructure.

relationships between Microsoft e-mail software and the process model persisted. These negative relationships in the entire study were almost always accompanied by even stronger negative relationships in British Columbia, which had the highest use of non-Google and non-Microsoft e-mail solutions. British Columbia also had the smallest percentage of process model cases (26%; Figure 12). Because the process model is characterized by agreement on a goal, but uncertainty about the steps to achieve the goal, the use of less common, less well supported, and often less capable e-mail solutions is consistent with the process model's definition. In contrast, the use of Microsoft e-mail solutions, both from public cloud and district-based private cloud infrastructure, is associated with the rational model. The rational model is characterized by agreement on a goal and the steps necessary to achieve that goal. The use of the more widely supported and used Microsoft e-mail solutions is consistent with the rational model.

Website domain relationships with decision models. An interesting finding in the website domain is the positive association between the political model and non–district-based private cloud website hosting options. In the entire study I found a low positive relationship between Website-PublicCloud and the political model. In Alberta, in the categories of AB-S and S, I found positive relationships between school-level website hosting and the political model. The political model also had positive relationships with Website-Outsourced in the smallest, S category. The implication of these relationships is that districts aligned with the political model are more likely to use platforms that take their website hosting needs outside their data centres.

Relationships with Influences/Priorities That Shape IT Infrastructure

As I reported in the previous section on decision model relationships, the organizational adoption factors of Frambach and Schillewaert's (2002) framework are adopter characteristics, social network, environmental influences, supplier efforts, and technology characteristics. Appendix N illustrates all of the statistically significant relationships associated with each organizational adoption factor that the interview participants identified as the most influential on a district's IT infrastructure. These relationships depict the demographic, leadership, and infrastructure associations with different top district priorities/influences.

Figure 65 presents the statistically significant relationships among infrastructure, platforms, software, and the top priorities/influences of a district. The purpose of this analysis was to determine the extent to which the priorities of district leaders shape the IT infrastructure and cloud computing adoption of K-12 districts. As I discuss further in the following subsections, only a few statistically significant relationships indicated an association between leadership priorities/influences and the IT infrastructure of a district. Most of the relationships depicted in Figure 65 are applicable only to size and/or province categories and, as in the SIS domain, are affected by other factors such as the regional use of a software and/or platform. In the following subsections I examine the relationships between infrastructure and the organizational adoption factors from Frambach and Schillewaert's framework, but a finding of this study is that these organizational adoption factors have a limited role on the IT infrastructure of K-12 districts in Western Canada.

SIS domain relationships with influences. The distribution of SIS platforms across the three Western Canadian provinces overshadows the SIS relationships with influences/priorities. Because British Columbia was the only province with SIS community cloud, location/province heavily impacted the other relationships with SIS community cloud and BCeSIS/MyEducation BC. Figures 65 further supports the prominent impact of location/province on IT infrastructure as there are positive relationships between SIS-CommunityCloud and Rank-TechnologyCharacteristics-First.

Outside the unique SIS community cloud environment of British Columbia, I found two other relationships between the organizational adoption factors identified in Frambach and Schillewaert's (2002) framework and SIS software. I found low positive relationships between SIS-Combined-SchoolLogic and Rank-AdopterCharacteristics-First. This implies that the use of SchoolLogic is associated with districts that identified adopter characteristics as their highest priority/influence. Similarly, SIS-Combined-Maplewood had a low positive relationship with Rank-EnvironmentalInfluences-First. These relationships suggest that the top priorities/influences of a district IT influence infrastructure in the SIS domain. When the priorities differ, a different SIS decision can occur.

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)			FACTORS OF GREATEST INFLUENCE (RANK=FIRST) AND PHI COEFFICIENT RELATIONSHIP				
			Adopter Characteristics (34)	**Social Network (4)**	**Environmental Influences (14)**	**Supplier Efforts (2)**	**Technology Characteristics (26)**
Infrastructure Domains	**E-mail**	E-mail-PublicCloud (50)					BC (0.36),
		E-mail-PublicCloud-GAFE (32)			SK (0.77)		
		E-mail-PublicCloud-Office365 (18)					BC (0.37)
	Library	Library-District(56)			, BC-S (0.57)		
		Library-PublicCloud (16)					BC-S (0.70),
	LMS	LMS-Outsourced (10)	**All (-0.25),**				
		LMS-District-Moodle (48)	AB (0.37)**All (0.23)**				SK (-0.77)
		LMS-District-Scholantisandor SharePoint (7)	**All (-0.26)**		XL (1)AB (0.68)**All (0.32)**		
		LMS-Outsourced-Moodle (10)	**All (-0.24)**				
		LMS-Combined-Moodle (55)					SK (-0.77)
	SIS	SIS-CommunityCloud (31)	**All (-0.22),**				XL (0.80), **All (0.21)**
		SIS-District- (41)					XL (-0.80)
		SIS-CommunityCloud-BCeSIS MyEducationBC (31)	**All (-0.21)**				XL (0.80), **All (0.21)**
		SIS-District-Maplewood StudentInformationSystem (4)			S (0.40)		
		SIS-Combined-Maplewood (9)			SK-S (0.80)S (0.36)**All (0.25)**		
		SIS-Combined-PowerSchool (21)			S (-0.29)		
		SIS-Combined-SchoolLogic (15)	**All (0.23)**				
	Social	Social-Facebook-Block (12)	**All (-0.22)**, S (-0.36)		**, All (0.26)**		
		Social-Facebook-DoNotUse (9)			**, All (0.25)**		
		Social-Facebook-Use (59)	S (0.27)		S (-0.38), **All (-0.40)**, BC (-0.43)		
		Social-Twitter-DoNotUse (9)	S (-0.31)		S (0.32), **All (0.25)**		
		Social-Twitter-Use (67)	S (0.41), **All (0.24)**		**All (-0.25)**, S (-0.32)		
	Website	Website-PublicCloud (5)		, AB (0.63), **All (0.41)**,			

RELATIONSHIP LEGEND

Format	Description
Bold red text with yellow highlight: All (0.49)	Positive relationship applicable to all cases
Bold blue text with blue highlight: All (-0.23)	Negative relationship applicable to all cases
Red text: AB (0.46)	Positive relationship applicable to a province and/or size category
Blue text: BC (-0.41)	Negative relationship applicable to a province and/or size category

PHI COEFFICIENT RELATIONSHIP GUIDE

+.70 or higher	Very strong positive relationship.
+.50 to +.69	Substantial positive relationship.
+.30 to +.49	Moderate positive relationship.
+.10 to +.29	Low positive relationship.

-.10 to -.29	Low negative relationship.
-.30 to -.49	Moderate negative relationship.
-.50 to -.69	Substantial negative relationship.
-.70 or lower	Very strong negative relationship.

Figure 65. Infrastructure relationships between priorities/influences.

LMS domain relationships with influences. The LMS domain contained two examples of differences in district priorities/influences that were associated with different IT infrastructure. I found a low positive relationship among the districts that identified adopter characteristics as their highest priority and LMS-District-Moodle. Conversely, the districts that identified environmental influences as having the greatest impact on their decision making had a moderate positive relationship with the use of LMS-District-ScholantisandorSharePoint. These two relationships illustrate the impact of different district priorities/influences on IT infrastructure in the LMS domain.

Library domain relationships with influences. The library domain had no relationships with organizational adoption factors that were statistically significant in the entire study. This supports the finding that differences in priorities/influences among districts have only a limited impact on their IT infrastructure.

The only relationships that I found in the library domain were in the BC-S category, in which the districts identified environmental influences as the most influential factor on their IT infrastructure; I found a substantial positive relationship with Library-District. In contrast, in this same BC-S category, I found a very strong positive relationship between Library-PublicCloud and Rank-TechnologyCharacteristics-First. These two relationships are consistent with other findings on infrastructure in British Columbia, where districts often preferred the use of district-based private cloud over public cloud infrastructure because of the need for compliance with the Office of the Information and Privacy Commissioner for British Columbia (Office of the Information and Privacy Commissioner for British Columbia, 2012).

E-mail domain relationships with influences. The e-mail domain had no relationships with organizational adoption factors that were statistically significant in the entire study. This supports the finding that differences in priorities/influences among districts have only a limited impact on their IT infrastructure.

The limited relationships in the e-mail infrastructure domain largely echo the relationships of the library domain with regard to the use of public cloud infrastructure in British Columbia. In the e-mail domain, districts in British Columbia that identified technology characteristics as the most influential on their IT infrastructure decision-making had moderate positive relationships with the use of E-mail-PublicCloud and E-mail-PublicCloud-Office365. This matches the library domain's findings for districts' public cloud use in both domains, the ranking of technology characteristics as the top priority/influence in decision making was associated with public cloud infrastructure use.

An interesting finding is the strong positive relationship in Saskatchewan districts between E-mail-PublicCloud-GAFE and Rank-EnvironmentalInfluences-First. As per Frambach and Schillewaert's (2002) conceptual framework, this relationship implies that districts heavily influenced by the actions of the other districts surrounding them and/or by regulations have a strong positive relationship with the use of GAFE in the e-mail domain. In the absence of other statistically significant relationships pertaining to Saskatchewan in the e-mail domain, it is difficult to draw additional inferences.

Website domain relationships with influences. An interesting finding in the website domain is the positive relationship among districts that identified their social network as the greatest influence on their IT infrastructure and the use of public cloud infrastructure. In the entire study I found a moderate positive relationship between Rank-SocialNetwork-First and Website-PublicCloud. I found an even stronger, substantial positive relationship between these two in cases in Alberta. When district IT leaders identified their social network as having the greatest influence on their IT infrastructure decision making, it meant that they relied heavily on the recommendations of their knowledgeable peers. An implication of these positive relationships between Rank-SocialNetwork-First and Website-PublicCloud is the favourable recommendation that public cloud infrastructure must receive, especially in the website infrastructure domain.

Social media domain relationships with influences. The social media domain presents multiple examples of differences in policies and infrastructure practices that result from districts' different top priorities/influences. This is evident in the relationships associated with districts that identified adopter characteristics as the organizational adoption factor that had the greatest influence on their decision making. In contrast are the relationships in districts in which the participants identified environmental influences as the organizational adoption factor of greatest influence. Because Facebook and Twitter both operate on public cloud infrastructure, the relationships that I have discussed here pertain to public cloud infrastructure use, as well as the specific social media software.

When the participants identified adopter characteristics as having the greatest influence on their IT infrastructure, their districts often had favourable policies for the use of public cloud social media platforms such as Facebook and Twitter. This is evident in Rank-AdopterCharacteristics-First's low positive relationships with Social-Twitter-Use and Social-Facebook-Use and the low negative relationship with Social-Facebook-Block. In contrast, when the participants identified environmental influences as having the greatest influence on their IT infrastructure, the policies for the use of these same social media platforms were often restrictive. This is evident in Rank-EnvironmentalInfluences-First's positive relationships with Social-

Facebook-Block, Social-Facebook-DoNotUse, and Social-Twitter-DoNotUse, as well as the negative relationships with Social-Facebook-Use and Social-Twitter-Use.

These relationships are consistent with other infrastructure domain relationships that I discussed previously in this section, especially given that Facebook and Twitter are operated on public cloud infrastructure. With the one exception of GAFE use in Saskatchewan for e-mail, districts in which environmental influences had the greatest influence on their IT infrastructure decision making did not have statistically significant positive relationships with the use of public cloud infrastructure. This again supports the finding that differences in districts' priorities/ influences are reflected in their IT infrastructure, though only to a small extent compared to the impact of other factors such as location, size, and software ecosystem.

Summary of Subjective Relationships

This section examined the influence of subjective factors on the adoption of cloud computing IT infrastructure by the leaders of K-12 districts. These included the relationships between the Daft (2013) contingency decision-making framework's decision models and a district's IT infrastructure. Similarly, this section examined the relationships between a district's IT infrastructure and the Frambach and Schillewaert (2002) influences on organizational innovation adoption. Only a negligible number of statistically significant relationships were found for these subjective factors. This indicates that the IT infrastructure of a K-12 district in Western Canada, particularly its adoption of cloud computing, is determined by objective rather than subjective factors.

CHAPTER 6: CONCLUSION

Overview

This chapter presents a synthesis of this study's findings, an analysis of the findings, and their interpretation in answer to the central research question. This chapter is organized according to the three research subquestions, which are presented in Table 20. The three sections of this chapter are a summary of the following topics: (1) IT leadership structures and decision-making processes in Western Canadian K-12 districts; (2) the current level of cloud computing adoption in these districts; and (3) the interplay of these human and nonhuman factors in determining cloud computing adoption.

IT Leadership Structures and Decision-Making Processes

A key aim of this study was to more fully understand the current IT leadership structures and decision-making processes in large K-12 school districts in Western Canada. These findings are valuable in themselves, and they also create the foundation for an understanding of the complex interplay of human and nonhuman factors that determine IT infrastructure and cloud computing adoption.

Leadership Structures

Organizational branches responsible for IT. The findings of this study concerning IT leadership structures reveal that two branches of the superintendent's office primarily made IT decisions: the instructional branch and the financial branch. These branches accounted for 43% and 35% of the cases, respectively. A dedicated technology branch was responsible for IT infrastructure decisions in only 13% of cases overall. Other branches, such as human resources or services, infrastructure, and facilities, accounted for 9% combined. This organization of IT roles implies that in most districts, IT operations were a subordinate function in service of other

Table 20

Research Questions and Key Insights

CENTRAL QUESTION: "What factors influence district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for district schools?"	
Research Questions	Key insights
Q1. What are the IT leadership structures and processes at the district level for large Western Canadian K-12 school districts?	• This study revealed the decision-making processes in Western Canadian K-12 districts and identified the organizational branches and hierarchy leaders that are most often responsible for IT infrastructure decisions. Most often, IT decisions were made within an instructional or financial branch of a school district. • Another key finding of this study is that districts have a highly collaborative approach to IT decision making that brings forward needs and solutions from multiple stakeholder groups. The result of this collaborative approach is that differences in IT infrastructure between the districts were rarely related to leadership factors. • When districts were asked to identify the Daft (2013) decision model that best described their decision-making process concerning IT infrastructure, they responded with the following distribution: rational model (30%), process model (37%), political model (31%), and anarchy model (1%). As districts grew in size, the decision models often progressed from the process to the rational to the political model. • The influences and priorities that determine IT infrastructure in Western Canada were the same, regardless of a district's location or size. These influences/priorities, in descending order, were perceived innovation characteristics, adopter characteristics, environmental influences, social network influences, and supplier marketing efforts.
Q2. What is the current level of cloud computing adoption in large K-12 school districts in Western Canada?	• This study revealed the infrastructure practices across Western Canadian K-12 districts. This included the software and infrastructure platforms used, as well as the associations between the use of different platforms and software. Cloud computing use by K-12 districts was ubiquitous. Only a very small percentage of software was run not using cloud computing. In these rare instances, the use of traditional, non-cloud computing infrastructure was to complement cloud computing solutions. • A key finding was that districts that use a district-based private cloud infrastructure tend to use this infrastructure for multiple domains. Districts that are comfortable with operating their IT services outside of their district-based private cloud infrastructure, through public cloud for example, tend to use such infrastructure for multiple domains.
Q3. What is the interplay of human and nonhuman factors that influence infrastructure decisions by district-level IT leadership in K-12?	• IT infrastructure in Western Canadian K-12 school districts was most heavily influenced by districts' location and the associated provincial legislation. A district's size was the second most influential factor. Last, districts made strategic choices in software and platforms and selected complementary combinations. • The findings revealed four themes in the districts' strategic use of software and platforms: They used complementary and similar platforms when appropriate; they embraced software ecosystems in which they used compatible products, often from a single vendor, across multiple infrastructure domains; and last, the districts frequently used one software on one platform in a domain. • More subjective factors, such as who is responsible for IT leadership in a district, a district's decision model, and its influences/priorities, produced only a relatively negligible number of statistically significant relationships in the quantitative correlation analysis. This suggests that objective factors, such as a province's location, size, and other IT infrastructure, play a greater role in shaping IT infrastructure.

goals such as instruction or financial management, rather than as dedicated functions in themselves.

Hierarchy levels responsible for IT. A deeper analysis of where district IT decisions occurred in term of the district leadership hierarchy levels further support the previous section's conclusion concerning IT as a subordinate function within districts. As Figure 10 illustrates, the people at the third leadership hierarchy level most often made a district's IT decisions. Regarding the more detailed discussion in chapter 4, the third-level hierarchy role might have a title such as information and communication systems manager who would report to the second hierarchy level, such as the director of innovative learning or the chief financial officer, depending on the branch within which IT infrastructure duties were organized for the district. This second hierarchy level would then report to the highest hierarchy level of the superintendent and board of education. Table 15 shows the IT decision makers within K-12 districts in Western Canada, both in terms of leadership branch and hierarchy level. As is evident in this table, in only 37% of cases did the people who made the IT decisions for the district have a direct reporting relationship with the top level of the organization, such as the superintendent or board of education. Within 50% of the cases, the third hierarchy level made the IT infrastructure decisions and then reported to either the instructional branch or the financial branch.

Decision-Making Processes

The findings of this study concerning the processes involved in IT decision making in K-12 districts reveal a highly collaborative approach that includes input from technicians, cross-branch consultation among stakeholders, and formalized technology advisory committees. These collaborative approaches limit the impact of differences in the IT leadership structures on the resulting IT infrastructure. The collaborative process helps bring forward the concerns/needs of many of the district stakeholders. The implication of this process is that concerns pertaining to one branch, such as instruction, do not exist in a silo. Consequently, when stakeholders share these concerns through a district's collaborative decision-making process, the concerns are incorporated into the broader district's IT strategy. This reduces the differences in IT infrastructure when different branches of the district are responsible for IT infrastructure. The lack of statistically significant relationships between IT infrastructure and IT leadership, which I discussed in chapter 5, supports this assertion.

Decision Models

This study also presented an opportunity to ask the participants to identify which of the four decision-model frameworks best describes the IT infrastructure processes in their district. Across the entire study, the findings were rational (30%), process (37%), political (31%), and anarchy (1%). Because these four models are aligned across the two axes of strategy knowledge and problem/goal/priority consensus, IT districts in Western Canada can be described as most often sharing agreement on direction (67%)—a shared characteristic of the rational and process models. The political model, which consists of the prioritization of stakeholder and political considerations over purely technical considerations, was a characteristic of 31% of cases and was increasingly prevalent as the districts grew in size. The implication/interpretation of this is that, as districts grow in size, it is not that they become less clear on the priorities of IT infrastructure; rather, they become increasingly aware of the growing number of stakeholders whom their IT infrastructure decisions affect. Because a participant from only one district described the anarchy model, there are not enough data to make a deeper interpretation. The interpretation of the anarchy model is that it is a marker of a dysfunctional organization with poor leadership and poor direction. The low occurrence of the anarchy model in this study is an overall indicator of positive, healthy decision-making processes in Western Canadian K-12 districts.

Influences and Priorities

Frambach and Schillewaert's (2002) framework on organizational innovation adoption was central to this study in that it identified the influences and priorities that shape IT infrastructure decisions in Western Canadian K-12 districts. The findings of this study reveal that the most influential factors were perceived innovation characteristics, closely followed by adopter characteristics. Environmental influences and social network influences followed these two main considerations. Supplier marketing efforts were a distant last; the participants reported that they have little influence on a district's decision-making process. Figure 31 summarizes these findings; it is a visual depiction of these factors' relative strength and rank.

A key finding of this study is that, regardless of districts' location or size, the influences and priorities that shaped their IT infrastructure were very similar. This is apparent in the figures in chapter 4, which present the strength and mean averages of these influences/priorities across provincial and size case categories. This is particularly helpful in understanding IT infrastructure in Western Canada. Whereas in British Columbia, Alberta, and Saskatchewan the motivations, influences, and priorities that drive IT infrastructure are similar, a series of other factors created statistically significant differences among the districts.

The Current Level of Cloud Computing Adoption

A central aim of this study was to more fully understand the current level of cloud computing adoption in large K-12 school districts in Western Canada. An understanding of the current level of cloud computing adoption in large Western Canadian K-12 districts is the foundation for understanding the complex interplay of human and nonhuman factors that determine this infrastructure. However, in addition to being a foundation for deeper analysis, the infrastructure findings in K-12 school districts in Western Canada are also in themselves valuable. This study gave, for the first time, an in-depth view of the IT infrastructure practices for K-12 in Western Canada concerning both platforms and software.

The Ubiquity of Cloud Computing in Western Canada

Chapter 4 presented two major findings concerning IT infrastructure in Western Canada. The first finding is the extensive use of cloud computing. Every case used cloud computing in at least one domain of IT infrastructure. As Figure 13 shows, cloud computing was the dominant infrastructure platform across all infrastructure domains. Only a small percentage of the cases had traditional, non-cloud infrastructure. Figure 28 demonstrates that even in these rare instances, traditional infrastructure often complemented cloud computing use.

A Widespread Intention to Continue Using Cloud Computing Infrastructure

The second finding of chapter 4 concerning IT infrastructure in Western Canada is the widespread intention of the districts that have adopted cloud computing to continue to use it. This is evident in Figure 29, which shows districts' intentions towards adoption, continued use, search for alternatives, or discontinuation of use. None of the 75 cases in Western Canada intended to discontinue their use of cloud computing. A key finding of this study is that once districts adopt cloud computing, they do not search for alternatives or plan to discontinue their use of cloud computing. Of the few cases that used a traditional, school-based IT infrastructure platform as an alternative to cloud computing (rather than as a complement to cloud computing), many were searching for alternatives or planned to discontinue their use of traditional, school-based IT infrastructure in the near future.

The Interplay of Factors Influencing Cloud Computing Adoption

The third research subquestion, concerning the interplay of human and nonhuman factors that influence the infrastructure decisions of district-level IT leadership in K-12, is the most critical in addressing the overall research question of "What factors influence district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for district schools?" The preceding two subquestions on IT infrastructure and IT leadership make possible the answer to the third subquestion and the overall research question. Based upon the two preceding subquestions, it is possible to identify the factors that determine IT infrastructure in K-12 districts in Western Canada. The statistical analysis of positive and negative correlations that I discussed in chapter 5 revealed the significant relationships that make answering these questions possible.

Demographic Influences on IT Infrastructure

A district's location was the greatest determinant of its IT infrastructure and cloud computing adoption in the three provinces that I examined in this study. The considerable volume of statistically significant findings related to districts' locations are evidence of this (Figures 42 to 44). The findings associated with a district's location are linked to the regulatory environment of that province. The quotations in Table F5 show this strong influence and further support the conclusion of the heavy impact of a district's location on its IT infrastructure.

In determining a district's IT infrastructure, second to its location was the district's size. The large volume of statistically significant findings related to a district's number of students (Figure 45) supports this assertion. The volume of findings for district location and size was the greatest of all of the factors that I examined. Other factors, such as who makes IT decisions in a district or the district's prevailing decision model, revealed only a negligible volume of statistically significant relationships associated with IT infrastructure

Though the number of findings concerning a district's size was considerable, the volume of findings was far less than for districts' location/province. This was a surprising finding. I expected more commonality among districts of similar size than in similar provinces. However, two factors explain this phenomenon. The first is the very strong influence of a district's regulatory environment on its IT infrastructure—far greater than I expected. The second is the highly scalable nature of cloud computing. Cloud computing use was far more common than I anticipated prior to conducting this study. The highly scalable nature of cloud computing, especially public cloud, allows districts of vastly different sizes to use the same software solution.

Strategic Use of Software and Platforms

A district's overall IT infrastructure strategy heavily shapes its cloud computing adoption. From my examination of software and infrastructure platforms, four themes emerged. These are presented in chapter 5 and explained in greater detail in Table 19.

Complementary platforms. The first theme is the use of complementary infrastructure platforms. Districts used different infrastructure platforms, such as public cloud and private cloud–district to benefit from the strengths of each platform and to overcome limitations. An example of this is the use of Microsoft Office 365 and Microsoft Exchange in British Columbia to comply with provincial regulations on data residency and privacy.

Similar platforms. The second theme is districts' use of similar platforms across domains. When districts invested in a data centre and required a private cloud–district platform for one domain, they often used their data centre for additional domains.

Software ecosystems. The third theme is the use of software ecosystems that enhance system compatibility and/or align with a district's IT philosophy. This theme emerged in districts that used Google or Microsoft suites across multiple domains, as well as in districts that embraced Unix/Linux-based software across multiple domains because of their philosophical preference for open-source software solutions.

Exclusive use. The fourth theme is the exclusive use of one software and platform for an IT domain. In many instances, a single software and platform solution was the most appropriate. This was especially true in domains such as LMS or SIS, where a single system on a single platform simplified management and ensured data consistency.

The Negligible Impact of Subjective Factors

A finding of this study is that objective factors such as location, size, and compatibility with existing IT infrastructure largely shape IT infrastructure and the adoption of cloud computing in Western Canadian K-12 districts. I examined both objective and subjective factors and found very few statistically significant correlations between IT infrastructure and subjective factors such as decision models, who is responsible for IT infrastructure in a district, and the influences/priorities that affect decision making. The negligible volume of statistically significant relationships for subjective factors is likely a result of the following: first, the widespread agreement on influences/priorities, regardless of district location or size; second, the high degree of collaboration in the decision-making process for IT infrastructure. This extensive collaboration, documented in chapter 4 and illustrated in Tables G1-G3, gives a voice to multiple stakeholders and reduces the impact of a single stakeholder group. Consequently, given the very similar subjective conditions in districts across British Columbia, Alberta, and Saskatchewan, the objective factors surface and become the more prominent determinants of IT infrastructure.

CHAPTER 7: IMPLICATIONS AND RECOMMENDATIONS

Overview

In this chapter I present the implications and recommendations of this research on cloud computing adoption in Western Canadian K-12 districts. This study has important implications and recommendations that will benefit the following groups: (1) academics and researchers, (2) K-12 district and IT leaders, (3) educational technology professionals, and (4) society overall, especially marginalized groups. Last, I present future research opportunities.

Implications and Recommendations for Academics and Researchers

Effective Participant-Engagement Strategies

In this research I achieved a 100% participation rate from 75 K-12 districts in the three Western-most provinces of Canada. Because a typical response rate in similar social science research is 5%-10%, the exceptionally high participation was the result of the recruitment strategies that I described in chapter 3 (Adams & Umbach, 2012). My view of the participant recruitment process is consistent with the ontological foundations of my research; namely, complexity theory. A key notion in complexity-theory literature is that singular interventions rarely transform complex systems (Clark, 2012; Glouberman & Zimmerman, 2002; Greenhalgh, Plsek, Wilson, Fraser, & Holt, 2010). Exceptionally high participation in a study is rarely the result of a single feature of the study's design. Rather, the high rate, particularly in this study, resulted from the confluence of the multiple factors that I identified in the methodology chapter, two of which were of particular importance to this study's high participation rate. I discuss them below.

A year-long participant recruitment window. The first key factor that benefitted this study's participant recruitment strategy was the year-long recruitment window. During this time

I persuaded very busy professionals, many of whom were initially reluctant, to participate in my study. My willingness to reschedule on multiple occasions and to conduct the interviews at a time convenient to the participants signalled that I deeply valued their contributions. Moreover, I responded to e-mails promptly, and my cell phone was always turned on and at my side. Not missing a participant's call was absolutely critical to the high participation rate. The year-long participant recruitment period of the study made all of these nuances possible. I therefore recommend that future researchers extend their data collection/participant recruitment period for as long as possible.

Personally connecting with the study participants. The second factor was my personal involvement in all aspects of the research, particularly during the participant recruitment and interview process. I did not send mass e-mails or use a research assistant or an online survey tool. Instead, I personally handled each aspect of the recruitment and interview process. This resulted in a highly personalized experience for the participants that signalled my deep commitment to learning about them and their districts. Another benefit of my personal involvement was the streamlined interviews that my familiarity with the technical and leadership aspects of the participants' work made possible. Because of my leadership and technical background as a K-12 CIO, the semistructured interview resembled a conversation and helped me to avoid asking redundant questions. Within the time constraints of the semistructured interview, my background allowed the participants and I to focus on the most important aspects of their districts. I sought clarification only when necessary. My unique professional background as a K-12 CIO was a major factor that signalled to the participants that I understood their work and that they did not waste the time that they took to speak with me on someone who did not understand the full implications of what they were describing. I therefore recommend that future researchers be personally involved in as much of their study as possible, using less personal tools such as automated online surveys and hired assistants sparingly. The expertise of the principal investigator, acquired over many years, are rarely replaceable.

Support for Mixed-Methods Research

Furthering the exposure and legitimacy of mixed-methods research. Through this research I hope to bring to new audiences the benefits of mixed-methods research. By conducting this research, and sharing it broadly, I have hopefully reinforced the value of both qualitative and quantitative techniques in exploring a research question. In chapter 3, I presented the subjective-objective dichotomy that is well documented in academic literature (Burrell and Morgan, 1979; Palys, 2003). Authors such as Becker (1996), Onwuegbuzie, Johnson, and Collins (2012) argue that such a divide is unnecessary. These authors argue that qualitative and quantitative methods can coexist in service of a research question (Onwuegbuzie, 2012). This research is an example of how both qualitative and quantitative methods can deepen the understanding of a research topic.

The recipients of this study's final report will include the educational and technology leaders of Western Canadian K-12 districts. A recommendation found later in this chapter is for increased professional development, which hopefully includes graduate-level study of educational technology at universities. Other academics are also the intended audience of this work. This research has the potential to inspire current and future academics to use mixed-methods research in their work when it is appropriate. This will allow these scholars to go beyond the inherent limitations of a purely qualitative or quantitative approach.

The need for required qualitative and quantitative research methods courses. While completing my doctoral coursework at my university, my cohort had both required and elective courses. Qualitative research methods was a required course, while quantitative research methods was an elective course. This was a function of scheduling, and, by offering the quantitative research methods course as an elective, it made it possible for students to take other courses that they perhaps found more relevant. In hindsight, I disagree with this approach and recommend that both qualitative and quantitative courses be required for graduate students, especially doctoral students.

While producing this dissertation, I reflected on how much my professors and coursework prepared me. I am grateful for the guidance of my professors, and for the required and elective courses I took. I was fortunate to have made the decision to challenge myself with the quantitative research methods course, and to make myself uncomfortable in order to build my skills as an academic (I enrolled in the course clearly recalling how I struggled with calculus as an undergraduate, and aware that I had a perfect GPA to ruin). I also know that without the quantitative research methods course, I would have been unwilling to use a data transformation model mixed methods triangulation design for my study. Rather, I would have conducted only a qualitative study because, sadly, I would have been unfamiliar with the quantitative tools available to bring additional meaning out of my data. Worse yet, I fear that as I would progress deeper into my academic career, I would never take the time to build my quantitative research skills and perhaps develop a bias favouring qualitative research.

I was fortunate in making the right decisions for myself in taking both qualitative and quantitative research methods courses. I am also grateful to the university and program head for making the quantitative research methods course available (I recall enrollment in that elective was low). With the benefit of hindsight concerning my own experiences, I strongly recommend that universities serve the best interests of future academics by ensuring that both qualitative and quantitative research methods courses are required.

Educating Future Leaders to Have an Understanding of IT Infrastructure

As I have presented in the first chapter, IT infrastructure (cloud computing or traditional on-premises infrastructure) is a critical, underlying element of contemporary education. Recalling the joint statement from the Office of the Privacy Commissioner of Canada, the Office of the Information and Privacy Commissioner of Alberta, and the Office of the Information and Privacy Commissioner of British Columbia: “Organizations must take care to fully assess the benefits, risks, and implications for privacy when considering a cloud computing solution.” (OPC, 2012, Make an Informed Decision section, para. 1). Unfortunately, there is currently little formal education available to equip the leaders of these organizations with the knowledge necessary to make these important decisions. I therefore recommend that universities offer a graduate-level course, courses, and/or certificate to address this.

Superintendents and associate superintendents of K-12 districts are presently unlikely to find courses that can inform their IT infrastructure decision making, and it is also unlikely that they were exposed to the relevant information in their education prior to their current senior leadership positions. First, though courses and texts are available that address the planning and management of educational technologies, these do not focus on a technical understanding of the underlying IT infrastructure (University of Alberta, 2018; University of British Columbia, 2018; University of Saskatchewan, 2018). Second, courses/programs are available to learners who seek technical training in IT infrastructure, however they do not concentrate on technology leadership, especially within an educational context. Instead, these courses/programs focus primarily on preparing future IT practitioners, and therefore go into detail beyond what the leaders of K-12 districts require (British Columbia Institute of Technology, 2018; Northern Alberta Institute of Technology, 2018; Saskatchewan Polytechnic, 2018). Third, the limited technology leadership programs that are available focus on a business rather than an educational context (CIO Association of Canada, 2018). Fourth, given that cloud computing is a relatively new phenomenon, the current senior leaders of K-12 districts are unlikely to have had any preparation in cloud computing through their prior formal education (e.g., undergraduate or graduate studies, even in computer science).

Given the importance of leaders in education understanding IT infrastructure, and the current lack of opportunities for them to develop such an understanding, I recommend that universities offer a graduate-level course (or courses) to remedy this problem. Such a course would provide learners with a general technical overview of IT infrastructure platforms, and the benefits and challenges associated with each. This would include an analysis of the contemporary IT infrastructure platforms, and would help learners understand IT infrastructure more fully. Rather than focusing on the technical details, this analysis would concentrate on the elements that are most pertinent to district leaders, such as regulatory compliance, the total cost of ownership, the implications for staffing, accounting implications (capital expenditure versus operations expenditure), and so on. The purpose of such a course would be twofold. First, such a course would provide the learners with a current, timely understanding of IT infrastructure and related issues. For example, learners would complete the course with an understanding of the legislation and regulations affecting the IT infrastructure of the K-12 districts in their province. This would be of immediate benefit to current superintendents and associate superintendents as they lead their districts and plan IT infrastructure projects. Second, such a course would build within students the capacity for lifelong learning. This would be of benefit to both current and future district leaders, equipping them with the analytical skills and technical vocabulary to understand the inevitable forthcoming advances in IT infrastructure, as well as the changes to the associated laws, accounting conventions, etc.

A New Conceptual Framework for Organizational Innovation Adoption

In the fourth chapter I presented this study's findings on the environmental influences on the adoption of cloud computing in Western Canada. Unlike the participants' responses regarding other influences on organizational innovation adoption, their responses about the environmental influences ranged considerably. This is evident in Figure 36 and is supported by the corroborating quotations from the study's participants in Appendix Table F5. A finding on the environmental influences that affect cloud computing adoption in K-12 districts is that the government, through its privacy legislation, often strongly influenced the district leaders. At the same time, the actions of their neighbouring districts only minimally influenced these district leaders. The result of this dichotomy, as is evident in this study's findings, was an averaging of these two factors in their responses. This dichotomy presents a limitation of Frambach and Schillewaert's (2002) conceptual framework with regard to organizational innovation adoption, as well as an opportunity for this research to make a scholarly contribution with a modified framework. Figure 66 presents a slight expansion of their conceptual framework, which I therefore titled "The Modified Frambach and Schillewaert (2002) Framework of Organizational Innovation Adoption." The individual-acceptance portion of the framework is identical to the original framework's (Figure 2) individual acceptance portion. This modification of the original framework will ensure more accurate findings in future research.

Under the environmental influences in their framework, Frambach and Schillewaert (2002) referred to network externalities with regard to government: The original Frambach and

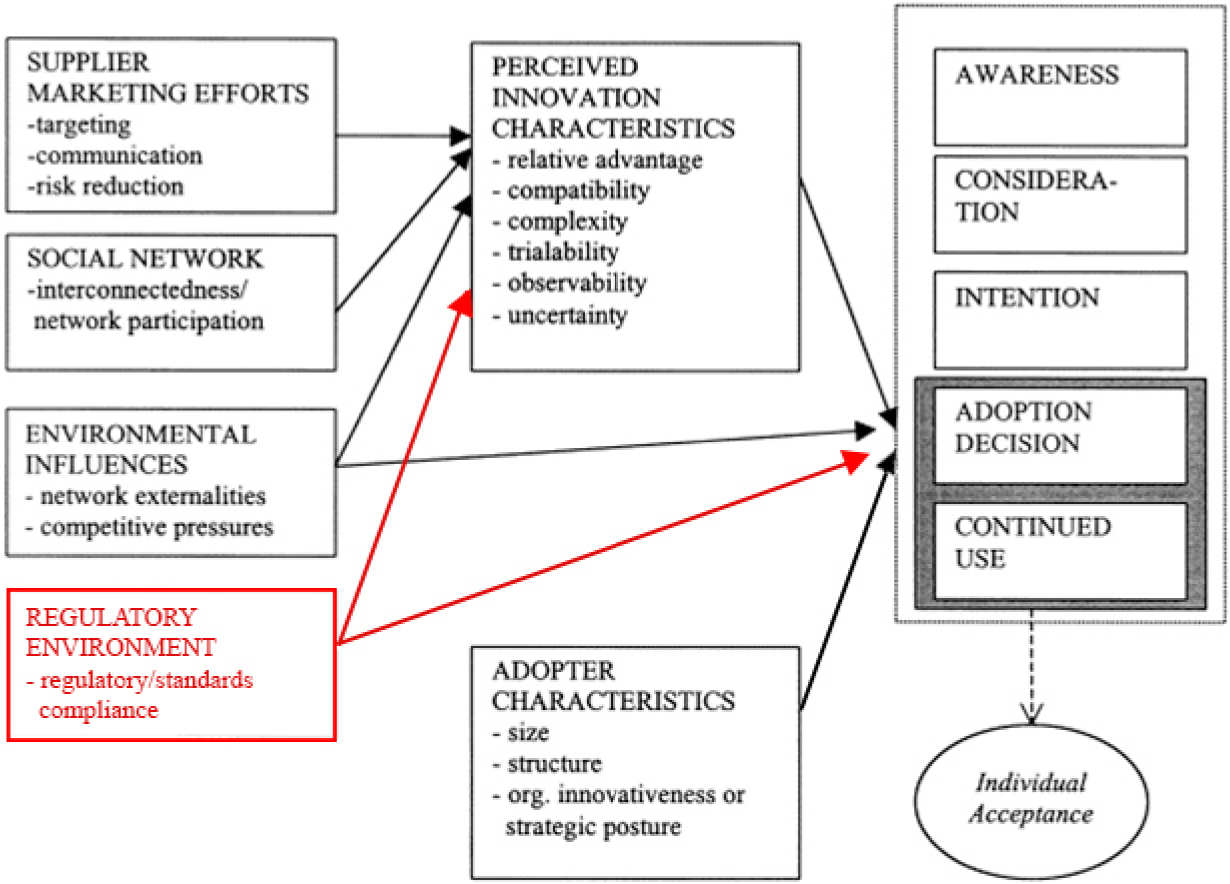


Figure 66. The modified Frambach and Schillewaert (2002) framework of organizational innovation adoption.

Schillewaert (2002) framework correctly recognizes the importance of interoperability and compatibility when organizations consider an innovation for adoption. An example of this in Western Canadian K-12 districts is that students' record information from an SIS must be regularly submitted in a standardized, predetermined format to each province's Ministry of Education to track their progress towards graduation and facilitate postsecondary admissions by sharing their grades in a common format with colleges, universities, and technical training institutions across Canada. These are all examples of the network externalities that Frambach and Schillewaert described.

> The theory is that the value of an innovation and, hence, its adoption probability, is determined by the number of other users. In the case of organization adoption, positive network externalities exist when intrinsic utility of an innovation increases when a firm's suppliers, customers, competitors, or other organizations (e.g., government) also use the innovation. For example, information systems investments (e.g., extranets or EDI) may generate greater value and gain importance once a sufficient number of business partners use these systems. (p. 167)

Not included in the original Frambach and Schillewaert (2002) framework is the regulatory environment that influences an organization's innovation adoption. An example from this research is the role of provincial privacy legislation (see the corroborating quotations in Table F5). I repeatedly found that privacy legislation impacts the IT infrastructure platform and software decisions of K 12 district leaders in Western Canada. As with environmental influences, the new regulatory-environment influence affects both the perceived innovation characteristics, through compatibility, and the adoption decision itself. This concern with regulatory/standards compliance is outside the original Frambach and Schillewaert framework, in which they solely conceptualized environmental influences, in addition to competitive pressures, "in terms of network externalities or critical mass" (p. 167). Consequently, a regulatory-environment influence is an important addition to the established Frambach and Schillewaert framework and will increase the accuracy of the findings in future research.

Implications and Recommendations for District and IT Leaders

Another audience who can benefit from this study is the senior leadership of school districts. These include IT leaders, superintendents, trustee boards, and so on; namely, those who shape the roles, responsibilities, and reporting structures of K-12 districts. The findings on

IT leadership will help leaders to reflect on their current organizational structures, practices, and priorities as they compare to those in other districts in Western Canada. For this reason, this study should be shared and read widely by those in K-12 districts everywhere. This self-reflection will facilitate improvements should the leaders in districts become aware of additional approaches that they perceive might improve teaching and learning in their districts. The following subsections present four recommendations for IT leaders from this research.

The Importance of a Dedicated District Information Technology Branch

Opportunities for digital transformation. I first recommend that K-12 districts formalize a dedicated IT branch that reports directly to the highest level of the organization. This dedicated IT branch would be comparable to the financial and instructional branches already in many districts, which currently report directly to the superintendent (or equivalent). Only 13% of the district in this study had a dedicated IT branch whose staff reported to the district's highest level of decision making. This is problematic, especially at a time when organizations are undergoing digital transformation, which allows IT leaders to make substantial and transformative contributions to their organizations. The greatest obstacle to digital transformation initiatives for organizations in 2017 was "low digital literacy or lack of expertise among employees and leadership" (Solis, 2017, p. 16). When IT leaders are not given a voice at the most senior level of a K-12 district, they have a more limited opportunity to contribute, and their valuable technical expertise risks being underutilized. This can result in missed opportunities for districts concerning innovations that can benefit of teaching and learning.

Proactive rather than reactive IT. This proposed change to a district's leadership structures will benefit the districts because it permits IT leaders to become part of the highest-level conversations on strategy, vision, and stakeholder needs. It also gives these IT leaders an opportunity, because of their deep technical knowledge, to offer solutions and strategies that will benefit their districts. This will permit IT leaders to play a proactive and potentially transformative role in K-12 education by creating, at the organization's highest levels, opportunities to transform teaching and learning activities. With this structural change to the organization of K-12 districts, IT leaders can help their organizations avoid rather than solve problems. Moreover, IT leaders, with their technical insights, can offer new, technology-enabled ideas that will benefit multiple stakeholders in their districts.

The Need for Technology Leaders Who Understand Education

Whereas the first recommendation is aimed at districts and their need to involve IT leaders more in senior-level decision making, the second is aimed at IT leaders to ensure that they deserve the elevated role. I recommend that IT leaders become knowledgeable in the areas of current educational philosophies, pedagogical approaches, and curriculum and extend their expertise beyond just their specific IT functions. This recommendation echoes the literature review section in chapter 2 on digital transformation and the importance of IT leadership. IT leaders must be capable IT professionals, but must also possess expertise specific to the industry in which they work. IT leaders in K-12 districts must therefore concern themselves with how advances in technology can positively transform the experiences of students, teachers, and parents. As I mentioned in the previous section, IT leaders already have the technical understanding that is critical to innovation and digital transformation. An understanding of the field of education will improve IT leaders' ability to contribute to their districts and to better assess how emerging technologies can help teaching and learning inside and outside district classrooms.

The Need for Ongoing Professional Development and Support

A need for IT leaders to remain current in education and technology. The third recommendation concerns professional development and applies to both district leadership and IT branch leaders equally. As discussed in the previous recommendation, and again echoing the literature review section on digital transformation, there is a need for educational and technology leaders to remain current in their knowledge/skills. IT leaders in K-12 districts have a compounded challenge given that they must be knowledgeable in both education and technology. These K-12 district IT leaders must be aware of evolving curriculum, instructional strategies, educational philosophies, and so on. The rapidly changing field of IT has a similar need for ongoing professional development, and demands that IT professionals stay current in their knowledge of ongoing advances in software, hardware, security, software development approaches, and so on (PwC, 2015; Whitman & Mattord, 2016). The need for IT professionals to ensure that their skills are current has become particularly important in recent years because of the growing global concern over cybersecurity and the need to protect their organizations' information (BHEF, 2017; ISACA, 2017).

Personal initiative in seeking professional development. I recommend that IT leaders in education make it a priority to engage aggressively in professional development in the fields of both education and technology. This is required for them to be able to steer their districts effectively towards opportunities and away from threats. As I have argued in the previous subsection, IT leaders in K-12 must be well informed on curricular and pedagogical developments in education. This goes above and beyond the already substantial need for professional development in the technical aspects of IT. The need for professional development for IT leaders in K-12 education is therefore particularly great and these individuals must be personally committed to lifelong learning. This might include active membership in professional associations, enrollment in graduate or certificate programs, and so on.

Organizational support for professional development. Given that the need for professional development is exceptionally great for IT leaders in K-12 education, I recommend that K-12 districts make professional development a high organizational priority. When IT leaders show initiative and commitment to professional development, their K-12 districts must be supportive. Such support for professional development at a minimum should include release time, and, when possible, financial assistance. Both IT leaders' and their districts' investments of time, energy, and/or money are worthwhile given the great scope of the impact of IT decisions on the activities within a district.

Continued Collaboration

My fourth recommendation is that districts adopt, continue, and/or expand upon their existing collaborative decision-making processes concerning IT infrastructure. As I presented in chapter 4, many districts already demonstrate extensive collaboration among stakeholders on the development of IT infrastructure. This fourth recommendation calls for districts to continue this practice and for even more districts to adopt such a collaborative approach if they are not already doing so.

Technology advisory committees. The collaborative process that I recommend begins with gathering input from IT support staff and technology advisory committees. This broad consultation will help K-12 leaders to understand more fully the diverse technology needs of their districts. Once they identify their needs, the senior leadership of the district can then evaluate them. Again I often found that the senior leadership's decision making is a collaborative process that includes many branches of the district. I therefore recommend that this continue and be widely adopted because it allows senior leaders, beyond those responsible for IT infrastructure, to participate in formulating solutions to best meet their districts' diverse stakeholder needs.

Collaboration across organizational branches. The collaborative approach that I propose can also be a very helpful tool in overcoming the limitations of leaders' knowledge of technology and/or education. As I discussed in earlier subsections, these limitations most often constrained digital transformation initiatives in 2017 (Solis, 2017). The collaborative approach that many districts already use helps to overcome these technical-knowledge limitations. Similarly, the highly collaborative approach leads to broader nontechnical considerations that technology-focused leaders might not initially consider (e.g., educational implications, financial implications, etc.). Supporting these assertions is the correlation analysis in chapter 5, which revealed negligible statistically significant relationships between IT infrastructure and whoever was responsible for IT infrastructure decisions in the districts. The implication of this is that high levels of collaboration will help districts to make more informed decisions to better balance diverse stakeholder needs.

Implications and Recommendations for Educational Technology Professionals

A Future of Cloud Computing

A continuing shift to cloud computing infrastructure across industries. The IT infrastructure teams' use of cloud computing in the K-12 districts of BC, Alberta, and Saskatchewan means that they continue to be leaders in infrastructure practices. The heavy use of cloud computing in Western Canadian K-12 education still greatly exceeds the use in other industries, even as cloud computing adoption overall increases (Columbus, 2017; ITWC, 2016, 2017b). The practices of IT leaders in other sectors are now catching up to those of Western Canadian K-12 districts:

> CIOs who may have been slow to embrace [cloud] for security or data sovereignty issues now rate the cloud as the most productive technology in their growing arsenal. . . . By far the most productive technology, 70% of respondents rated cloud as having met or exceeded expectations, and more organizations are using cloud services. (ITWC, 2017a, p. 12)

Across multiple sectors, cloud computing use is expected to grow further in the coming years, which will enable current and future technology initiatives (Rold & Maurer, 2017). This includes the expansion of existing technologies, such as the use of mobile, and access to content anywhere. It also includes next-generation technologies such as machine learning, artificial intelligence, greater data analytics, and the Internet of Things (SAP, 2017). The NMC/CoSN Horizon Report: 2017 K-12 edition outlines these future technologies, many of which rely heavily on cloud computing by virtue of the extraordinary computational power that they require (Freeman, Becker, Cummins, Davis, & Giesinger, 2017).

A reduction in regulatory barriers to cloud computing adoption. A recurring concern that the study's participants raised is government legislation as an inhibitor of cloud computing adoption in Canada. This was a barrier to cloud adoption that the preliminary PEST analysis (Appendix B) identified. The wide extent of this concern over government regulation is documented in the corroborating quotations in Table F5; it includes all three provinces in the study. However, the actions of cloud vendors are now diminishing these regulatory concerns:

> Further growth in cloud services is expected next year in Canada as vendors have moved to remove the one remaining obstacle to Canadians embracing cloud for their key infrastructure — data sovereignty. The majority responded that they are more likely to “move into the cloud” now that “significantly large cloud providers have recently moved to Canada and are addressing the concerns of data sovereignty.” (ITWC, 2017a, p. 14)

Moreover, governments at multiple levels are revisiting the policies and regulations that impact the use of cloud computing in Canada:

> In summer 2014, the GC began consulting the IT industry to seek their input to the GC’s Cloud Adoption Strategy. More than 60 industry organizations participated in a request for information and in subsequent face-to-face meetings with government officials. This industry engagement has been complemented by continuous discussions with other levels of government and other federal governments. (Government of Canada, 2016, para. 12)

The Government of Canada’s examination of its current policies, with the aim of refining the regulations that affect IT infrastructure, further reduces the traditional inhibiting political/ governmental factors that influence the adoption of cloud computing in Canada. This suggests even greater use of cloud computing infrastructure, especially public cloud, into the future.

Overcoming IT Staffing Challenges

K-12 districts and other educational organizations, such as postsecondary institutions, must be aware of the global competition for IT skills and proactively ensure that they have the necessary staff to support their IT systems. I presented this challenge in chapter 2’s literature review in the section on the global demand for IT talent. The following recommendations, based on the findings of this study, can help districts address these challenges.

Use mainstream software. My first recommendation for Canadian K-12 districts to address the challenges of staffing an IT department is to move away from lesser-known software solutions towards more mainstream software solutions. This recommendation applies to all of the infrastructure domains in this study. An exception is new software, which might not be in wide use yet because of its novelty. However, if districts are using older software solutions that are no longer as widely used as their more modern, competing products, these districts are at a disadvantage concerning future hiring should their current IT staff change.

Examples of products that districts should transition away from are DeskNow in the e-mail domain and Windsor in the SIS domain. As the tables in Appendix H show, these software solutions exist in only 1% of the cases, and only in those in the smallest, S size category. The smallest districts' use of such niche software compounds the problem. First, IT people who are experienced in the use of such niche software are much more difficult to find than IT people who are knowledgeable about more mainstream software. Second, finding such IT people in the smaller communities associated with the S size category is an additional challenge. By moving towards more mainstream software solutions, districts can take early steps to address future IT staffing concerns.

Use public cloud infrastructure. My second recommendation for Canadian K-12 districts to address their IT staffing challenges is to begin to transition their IT infrastructure platforms away from traditional and private cloud district-based IT infrastructure towards public cloud solutions. This recommendation is the product of a confluence of three factors: the difficulty of finding and retaining quality IT staff, the gradual reduction in the political barriers to public cloud computing use in Canada, and the continuing increase in public cloud solutions available in Canada. I discussed all of these factors earlier; they make a move towards the public cloud a sound measure to further mitigate the challenges of staffing a district's IT department with appropriately talented individuals.

Make jobs more interesting. A concern that might result from my second recommendation, particularly for IT practitioners and IT teams in K-12 districts, is the loss of jobs for IT staff in K-12 districts. This is a reasonable concern and a result that I anticipated when I conducted my interviews with the district leaders. It is surprising that the adoption of public cloud platforms did not result in the districts' reduction of their IT staff. Instead, when K-12 districts shifted towards public cloud platforms, they changed the roles of their IT staff away from the management of physical servers towards the integration of separate public cloud data/software services to create a unified experience for the community of students, parents, and teachers they serve. The following is a quotation from one of the study's participants who described the district's achievement after the shift away from focusing on operating its data centre towards the integration of public cloud services:

> Our students can be sitting at a bus stop with their iPhone; they log into [the portal], it knows who they are, what bus they're on, and it shows them a Google Map with an icon that's updated every minute of their bus as it's moving down the road, both going to school and coming home. So, with high usage all day, every day of this, we've got parents that are sitting at work going, "Gee, it's pretty snowy out there today. I wonder if Johnny's bus is going to be a little bit late." They'll log into [the portal] and see where their bus is. . . . We have auto alerts in it, so if there's a change in a mark, if there's a change in attendance, . . . parents will get an automated e-mail that says, "There's a change in [the portal]. Log in and have a look and see what the change is." . . . It's massively used. Massively used. (Anstice, p. 13)

A third recommendation is to elevate the work of IT leaders and their teams, as well as improve their working conditions. This goes beyond changing the IT infrastructure of K-12 districts to mitigate the challenge of finding suitable IT staff and the call to raise the profile of the important work of IT teams. As the quotation above illustrates, IT teams have an opportunity to transform the experiences of students, teachers, and parents dramatically. As I argued earlier, IT leaders must both have an opportunity to collaborate at the highest levels of K-12 district issues and be prepared for the opportunity by being well versed in contemporary educational issues. This will allow IT leaders and their teams to focus on more exciting transformational projects, such as the systems-integration example that I gave, rather than on merely responsive troubleshooting roles.

Moreover, moving e-mail systems to the public cloud will help districts to offer their employees a better work-life balance. This is possible because the IT teams of the major cloud providers such as Google or Microsoft handle critical problems such as e-mail outages on the district’s behalf. The shift towards public cloud, which often entails the outsourcing of more basic IT infrastructure concerns to major cloud providers, creates an opportunity for districts to offer their employees a better work-life balance as a means of attracting and retaining talent in a highly competitive global environment. This approach can become a competitive advantage for K-12 districts because IT professionals in most industries are struggling with their workloads.

My third recommendation echoes those in the contemporary academic literature on IT talent management and retention. This literature recommended the following strategies: aligning employees’ tasks with the organization’s mission and vision, ensuring that the work is more rewarding and engaging, improving the work-life balance, and creating a positive culture in which employees prefer to stay (Pasha & Ahmed, 2017). The current environment in which cloud computing IT specialists having the highest average salary of those in all IT areas makes it difficult for Canadian K-12 districts to compete for IT talent on purely financial terms (Global Knowledge, 2017, p. 11). K-12 districts can appeal to IT professionals with offers that money cannot buy: work-life balance, opportunities to be involved in the decision-making process, and opportunities to transform the lives of children in district schools.

Implications and Recommendations for the Benefit of Society

In addition to academics, educational leaders, and IT practitioners, this research has positive implications for society in general, in both a Western Canadian and a global context. As presented in chapter 2's literature review, "ICT, particularly mobile technology, holds great promise" in achieving educational goals around the world (UNESCO, 2015, p. 47). The aim of my research was to better understand the factors that influence district-level K-12 IT leadership on the adoption (or nonadoption) of cloud computing for district schools, and to share these findings widely.

Though this research can benefit a broad audience, students and teachers in socioeconomically challenged areas can arguably gain the most. An important goal was eventually to improve student learning by facilitating the exchange of ideas and best practices concerning IT infrastructure. However, included in this goal is the somber recognition of the challenges of marginalized groups for whom regular access to technology-enhanced learning experiences is problematic. Financial constraints can limit K-12 districts' technology infrastructure for teachers and students, and thereby adversely affect educational activities (Brown, 2017; Tawfik, Reeves, & Stich, 2016). Through this research, and the distribution of its findings, I hope to narrow the socioeconomic gap that educational technology can sometimes cause.

Facilitating the exchange of successful practices. An intention of this research, demonstrated in my grouping of the findings by province and size, is to facilitate an exchange of ideas among comparable districts to help them to overcome some of their educational technology-related challenges. These findings include software or platform practices across numerous infrastructure domains, the decision-making process on IT infrastructure, and the priorities that influence districts. Through this research I hope to help to make districts as efficient as possible, given their constrained resources.

Raising awareness of free public cloud solutions available for K-12. Some public cloud computing solutions—namely, Google's G Suite for Education and Microsoft's Office 365—are offered to K-12 schools free of charge. A better understanding of cloud computing adoption has the potential to pave the way for greater access to such and similar educational resources, especially for those for whom access was previously unavailable or limited for financial reasons. Though a district having access to these free software solutions does not eliminate other educational technology-related challenges, such as reliable Internet connectivity or students'/teachers' access to computers, it can help K-12 districts by eliminating some costs. Access to these free software solutions has the potential to be especially beneficial in socioeconomically marginalized areas.

By facilitating the exchange of ideas and best practices, particularly concerning IT infrastructure, my intention is to help districts to deliver the best possible teaching and learning environments within their situational constraints. This echoes the Incheon Declaration for Education 2030: "Innovation and ICT must be harnessed to strengthen education systems, disseminate knowledge, provide access to information, promote quality and effective learning and deliver services more efficiently" (UNESCO, 2015, p. 32).

Future Research Opportunities

This research illuminates not only the important and timely issues concerning cloud computing adoption in Western Canada, but also new opportunities for future research. This section presents four examples of opportunities for future researchers to pursue. These opportunities allow for additional exploration of cloud computing and leadership in K-12 districts, beyond both the delimitations and limitations of this study.

Future researchers could extend this study beyond the three provinces of Western Canada and apply the research to other regions of Canada, as well as other regions of the world. Although the purpose of my research was to examine the differences in infrastructure and cloud computing adoption among similar K-12 districts, an interesting extension would be an examination of the differences among K-12 districts in different countries and/or jurisdictions.

A second opportunity for future researchers would be to investigate in greater detail the differences in adoption among the different cloud computing types. Because this is the first research of its kind on cloud computing adoption in Western Canada, little was previously known about whether the K-12 districts were using cloud computing or traditional, on-premises IT infrastructure. Consequently, I designed the research questions for the semistructured interviews to understand cloud computing adoption at a macro level. Future research could be conducted to understand the motivations for districts' adoption of the different types of cloud computing, such as public cloud versus private cloud.

A third opportunity for future researchers would be to explore the user experience within Western Canada of the IT infrastructure domains in this study. A delimitation and limitation of this study was that it focused exclusively on IT infrastructure and the leaders of IT at the district level. Consequently, little is still known concerning how students and teachers in schools engage with the cloud computing infrastructure that is so prevalent in Western Canadian K-12 districts. Does the actual experience of students and teachers in the classrooms with the cloud-hosted IT infrastructure align with the perceptions/intentions of the district IT leaders? From the perspective of the technology users in schools, are there gaps in the delivery of IT services such as SIS, LMS, e-mail, etc.? For example, can students and teachers access their district's cloud computing servers reliably, or are there other issues that limit their use of their district's IT infrastructure (e.g., internet connectivity issues to schools, wireless connectivity problems within schools, etc.). This study on cloud computing adoption at the district level creates a foundation for future studies on the experiences of students, teachers, administrators, and other staff within schools with this infrastructure.

A fourth opportunity for future researchers would be to use Frambach and Schillewaert`s (2002) new modified framework to explore organizational innovation adoption. As I discussed earlier, this framework would facilitate a clearer distinction in the environmental-influences category between competitive pressures and the regulatory environment. The use of the modified Frambach and Schillewaert framework will help future researchers to better understand the factors that influence leaders' adoption of an innovation. This new framework could be applied to research such as this, of K-12 districts, as well as more broadly, across other industries.

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APPENDIX A: GLOSSARY OF TERMS

Table A1

Glossary of Terms

Terms	Definitions	Literature
cloud computing	"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models." (p. 2)	U.S. Department of Commerce, National Institute of Standards and Technology. (2011). *The NIST definition of cloud computing: Recommendations of the National Institute of Standards and Technology* (NIST Publication No. 800-145). Retrieved from http://csrc.nist.gov/ publications/nistpubs/800-145/SP800-145.pdf
economies of scale	"The reduction in average cost that is possible from increasing the usage of an IT service or asset. See also economies of scope." (p. 29)	Information Technology Infrastructure Library (ITIL). (2011). *ITIL glossary and abbreviations*. Retrieved from http://www.itil-officialsite.com/nmsruntime /saveasdialog.aspx?lID =1180&sID=242
economies of scope	"The reduction in cost that is allocated to an IT service by using an existing asset for an additional purpose. For example, delivering a new IT service from an existing IT infrastructure. *See also* economies of scale." (p. 29)	Information Technology Infrastructure Library (ITIL). (2011). *ITIL glossary and abbreviations*. Retrieved from http://www.itil-officialsite .com/nmsruntime/ saveasdialog.aspx?lID =1180&sID=242
educational technology	"Educational technology is the study and ethical application of theory, research, and best practices to advance knowledge as well as mediate and improve learning and performance through the strategic design, management and implementation of learning and instructional processes and resources." (Association for Educational Communications and Technology, 2017, Publications section, para. 1)	Association for Educational Communications and Technology. (2017). *Home*. Retrieved from http://aect.site-ym.com/

(table continues)

Terms	Definitions	Literature
information technology (IT),	"Any equipment or interconnected system or subsystem of equipment, that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information. The term 'information technology' includes computers, ancillary equipment, software, firmware and similar procedures, services (including support services), and related resources. . . . The term does not include any equipment that contains embedded information technology that is used as an integral part of the product, but the principal function of which is not the acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information. For example, HVAC (heating, ventilation, and air conditioning) equipment such as thermostats or temperature control devices, and medical equipment where information technology is integral to its operation, are not information technology." (University of Washington, 2012) The terms information technology (IT), information communication technology (ICT), and information systems (IS) are closely connected and best conceptualized with a severely overlapped Venn diagram. IT is the most central term; ICT emphasizes the inclusion of communication aspects; IS emphasizes the inclusion of information/data processing. For the purpose of this research, the term information technology (IT) will be used.	University of Washington (2012). What is electronic and information technology?. [online] Retrieved from http://www.washington .edu/accessit/articles?106
innovation	"Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace." (p. 1334)	Baregheh, A., Rowley, J., & Sambrook, S. (2009). Towards a multidisciplinary definition of innovation. *Management Decision, 47*(8), 1323-1339.
digital transformation	"The realignment of, or new investment in, technology and business models to more effectively engage digital customers at every touchpoint in the customer experience lifecycle." (para. 6)	Solis, B., Szymanski, J., & Lieb, R. (2014). *The 2014 state of digital transformation.* Retrieved from http://www.briansolis.com /2014/07/2014-state-digital-transformation/

(table continues)

Terms	Definitions	Literature
innovation acceptance	“[The] organizational adoption decision is only the beginning. . . . The acceptance or assimilation within the organization now becomes important.” (p. 164) Within this document, *adoption* refers to organizational level decisions to make use of an innovation. “Acceptance” refers to the acceptance or assimilation of the innovation by the individual members of the organization. Acceptance of an innovation by an organizations members/individuals may or may not occur following an organization’s decision to adopt an innovation.	Frambach, R. T., & Schillewaert, N. (2002). Organizational innovation adoption: A multi-level framework of determinants and opportunities for future research. *Journal of Business Research*, *55*(2), 163-176.
innovation adoption	“Adoption refers to the decision of any individual or organization to make use of an innovation.” (p. 163) To clearly distinguish between organizational and individual behaviours, in this document I will use *adoption* exclusively to refer to the actions of an organization. I will use *acceptance* to refer to individual actions.	Frambach, R. T., & Schillewaert, N. (2002). Organizational innovation adoption: A multi-level framework of determinants and opportunities for future research. *Journal of Business Research*, *55*(2), 163-176.
IT infrastructure	Information technology (IT) infrastructure is defined as all of the components used for processing application systems and that allow end-user interaction with these systems. The components include computers, storage media, telecommunications networks, data storage, peripheral devices, operating systems, database management system software, security systems and the physical environment used to house and support these components. (para. 17)	Canada Border Services Agency (2008). *ARCHIVED - Audit of Information Technology Infrastructure — General Controls*. Retrieved from http://www.cbsa-asfc.gc.ca/agency-agence/reports-rapports/ae-ve/2008/itigc-iticg-eng.html
IT resources	IT resources refers to the subcomponents of IT infrastructure. Although IT infrastructure refers to “all of the components used for processing application systems and that allow end-user interaction with these systems” (para. 17), IT resources refers to these components separately or in combinations. The term *IT resources*, however, does not refer to the full IT infrastructure. Examples of IT resources include “computers, storage media, telecommunications networks, data storage, peripheral devices, operating systems, database management system software, [and] security systems” (para. 17). IT resources, however, do not include the physical environment used to house these components.	Canada Border Services Agency (2008). *ARCHIVED - Audit of Information Technology Infrastructure — General Controls*. Retrieved from http://www.cbsa-asfc.gc.ca/agency-agence/reports-rapports/ae-ve/2008/itigc-iticg-eng.html

(table continues)

Terms	Definitions	Literature
IT services	The maintenance and delivery of IT resources. "A service provided by an IT service provider. An IT service is made up of a combination of information technology, people and processes. A customer-facing IT service directly supports the business processes of one or more customers and its service level targets should be defined in a service level agreement. Other IT services, called supporting services, are not directly used by the business but are required by the service provider to deliver customer-facing services. See also core service; enabling service; enhancing service; service; service package." (p. 42)	Information Technology Infrastructure Library (ITIL). (2011). *ITIL glossary and abbreviations*. Retrieved from http://www.itil-officialsite.com/nmsruntime/saveasdialog.aspx?lID=1180&sID=242
referential/ snowball sampling	"The researcher uses initial respondents to find other respondents who are included in the target group of the network analysis. This method therefore requires that the researchers have knowledge about 'insiders' in the population to be studied, before beginning the data collection procedure" (p. 40) In this research, the initial respondents were identified primarily through document analysis. The primary source of information was the employee directory of a district's the superintendent's office, which was publicly available via the district's website. Administrative staff also directed the researcher to the appropriate individual for study, providing updated information when needed when the website documents were out of date. Study participants were asked if others within their organization could provide a similarly deep or alternative perspective.	von der Fehr, A., Sølberg, J., & Bruun, J. (2018). Validation of networks derived from snowball sampling of municipal science education actors. *International Journal of Research & Method in Education*, *41*(1), 38-52.
satisficing	A decision-making strategy whereby decisions are made to appease stakeholders' interests in the immediate and short term. This is an amalgamation of the terms satisfy and suffice. It is a strategy in which a solution that meets most needs is chosen over one which is an optimal solution (but in a narrow domain that meets fewer needs).	Simon, H. A. (1987). Satisficing. In J. Eatwell, M. Milgate, & P. Newman (Eds.), *The new Palgrave dictionary of economics* (Vol. 4, pp. 243-245). London, UK: Macmillan.
triangulation	The term triangulation is rooted in a metaphor from navigation and military strategy that used multiple reference points to locate an object's exact position. Within research, the term refers to the use of more than one method or source to validate data. "Multiple and independent measures, if they reach the same conclusions, provide a more certain portrayal of the . . . phenomenon." (p. 602)	Jick, T. D. (1979). Mixing qualitative and quantitative methods: Triangulation in action. *Administrative science quarterly*, *24*(4), 602-611.

APPENDIX B: A PEST ANALYSIS OF CLOUD COMPUTING ADOPTION

Table B1

A PEST Analysis of Contemporary Facilitators and Inhibitors of Cloud Computing Adoption in Large Canadian K-12 Districts

	Conditions	Literature
Political	**Facilitating conditions**	
	• Raised expectations from governments for the delivery of education o Documents such as the British Columbia Ministry of Education's "BC's Education Plan" put forth goals relating to personalized learning, flexibility, and choice. These parallel similar goals/initiatives in Alberta and Saskatchewan. o Learning empowered by technology is a major component of education, both current and planned, in the provinces of British Columbia, Alberta, and Saskatchewan.	Alberta Education, 2013; British Columbia Ministry of Education, 2011; Saskatchewan Ministry of Education, 2013
	Inhibiting conditions	
	• Operational concerns and a reduction in consumer control o Cloud computing shifts control from individuals, organizations, and nations to the providers of cloud services. Cloud computing creates new jurisdictional challenges. It creates ambiguity as to the location of data, as well as complicates consumer recourse and choice. • Privacy and regulatory concerns o The Office of the Privacy Commissioner of Canada expresses concerns relating to cloud computing. The following points briefly outline these concerns: ▪ Jurisdiction–transmission, location, and ownership of data. ▪ Creation of new data streams–secondary analysis of data beyond its originally intended purpose. ▪ Security–the sharing and transfer of data is often optimized for the providers' business model efficacy rather than users' data security. ▪ Data intrusion–unpermitted access, mining, and/or commoditization of data. ▪ Lawful access–cloud computing creates challenges for legitimate, lawful access requests as more than the intended data may be accessed. ▪ Processing–appropriate mechanisms need to be in place for data to be securely accessed, corrected, and deleted. ▪ Misuse of processing data–a clear distinction needs to exist between the organization and the cloud provider as processor. In the event of misuses of data, regulators need to be informed of the cloud provider's actions. ▪ Permanence of data–measures need to be in place to ensure that data is permanently removed from cloud infrastructure within an agreed upon period of time at the request of the data's owner. ▪ Ownership of data–ownership of data, particularly secondary data generated by the initial data, may be unclear. o Provincial legislation ▪ In addition to national privacy legislation, school districts are governed by provincial-level privacy legislation.	Daneshgar, Worasinchai, & Low, 2011; Kloch et al., 2011; Kloch, Petersen, & Madsen, 2011; McCarthy, 2002; Office of the B.C. Information and Privacy Commissioner (n.d.). ; Office of the Information and Privacy Commissioner of Alberta, 2006; Office of the Privacy Commissioner of Canada, 2010; Office of the Saskatchewan Information and Privacy Commissioner, 2005; Stoddart, 2005; Sulistio, Reich, & Doelitzscher, 2009; Sultan, 2010

	Conditions	Literature
	▪ In Saskatchewan, the Office of the Saskatchewan Information and Privacy Commissioner has “The Freedom of Information and Protection of Privacy Act”. ▪ In Alberta, the Office of the Information and Privacy Commissioner of Alberta has “The Freedom of Information and Protection of Privacy Act” ▪ In British Columbia, the Office of the Information and Privacy Commissioner for British Columbia has the “Freedom of Information and Protection of Privacy Act” for the public sector and “Personal Information Protection Act” for the private sector. o USA Patriot Act ▪ United States’ 2001 Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act (USA Patriot Act) allows the government of the United States to access the data when it is held in or enters the United States. ▪ This legislation is particularly relevant to cloud computing as many of the world’s most prominent cloud computing providers (Google, Amazon, and Microsoft) are based in the United States.	
	Facilitating conditions	
Economic	• Global and Canadian economic conditions o Broad acceptance of cloud computing began to emerge and mature in the late 2000s, coinciding with a global financial crisis that originated in August 2007 following the burst of the credit bubble in the United States’ housing market. o Following the financial crisis, the global economy entered a “Great Recession” where economic activity in the G-7 countries dropped by more than 5% and global unemployment jumped in excess of 30 million (most from advanced economies). o Canadian economic conditions were impacted by the global financial downturn, though to a lesser extent than many other nations. Canada also experienced a recovery more rapid than following previous recessions. o Total expenditures on K-12 education in Western Canadian provinces have remained relatively flat, ranging between a 0% to 5% change for the 2009-2011 period. o Cloud computing and supply-side economies of scale o Cost advantages relating to power and facility ▪ Electricity costs are among the largest elements of the total cost of ownership for IT infrastructure. Large data centres offer electrical efficiencies over smaller sites. ▪ Large cloud computing companies have the ability to take advantage of geographic variability in electrical rates, real estate costs, and taxation. o Infrastructure labour costs ▪ A single system administrator can service multiple servers in a large data centre. ▪ Management tasks can be automated to be applied to multiple servers at once in a multi-tenant data centre (an advantage over traditional IT where operations are often performed at each server separately). o Security and reliability ▪ In a multi-tenant data centre environment security concerns can be addressed to benefit all customers/tenants. This is an advantage of	Bank of Canada, 2011; Bhardwaj, Jain, & Jain, 2010; Briscoe, & Marinos, 2009; Cai, Zhang, Zhou, Gong, Cai, Mao, et al., 2009; CDW-G, 2012; Chien, & Chien, 2010; Daneshgar, Worasinchai, & Low, 2011; Dimitrakos, 2010; Hanna, 2010; Harms, & Yamartino, 2010; Harris, 2012; Jayakar, Schejter, & Taylor, 2010; Kloch, Petersen, & Madsen, 2011; Petrakou, Brandt, Gustavsson, & Jokela, 2011; Statistics Canada, 2013; Sultan, 2010; Sultan, 2011; Tsaravas, & Themistocleous, 2011

Conditions	Literature
▪ scale as smaller, independent organizations may not have the resources to deliver a comparable level of security. o Buying power ▪ Many large cloud computing companies enjoy favourable, volume-related pricing when they purchase computer hardware and software for their data centres. • Cloud computing and demand-side economies of scale o Cloud computing accommodates variability in existing demand for computing resources ▪ Organizations can quickly provision through cloud computing service providers' additional resources to address time-of-day patterns and cyclical/seasonal spikes in usage. ▪ Organizations can similarly adapt to changing computational demands, such as processor-intensive tasks (e.g., mathematical calculations) versus storage-intensive tasks (e.g., electronic record storage). ▪ The rapid elasticity of cloud computing allows for organizations to meet changing computation requirements without the need to own physical IT infrastructure or software. o Growth in demand and higher expectations of performance ▪ Growth in overall demand, both expected and unexpected, can be more quickly and easily responded to by scaling up services from a cloud service provider. This is a preferable alternative to traditional IT models where the options were either purchasing IT infrastructure in advance of demand (an uncertain investment), or responding to demand when resources were stretched (resulting in suboptimal performance prior to upgrades). ▪ As cloud computing becomes more ubiquitous, user expectations of performance will increase. More computing operations will be done with the expectation of real-time processing. The costs of meeting these expectations using traditional IT infrastructure will rise. • Economic Considerations of Bring Your Own Device (BYOD) o As BYOD becomes increasingly mainstream in organizations, it represents a shift in end-user device costs from the organization to the individual. Rather than organizations/schools providing individuals with computers, people bring their own. Not only are initial purchase costs avoided or reduced by the organization, but so too are maintenance costs. o While BYOD, and the associated greater levels of connectivity by an organization's members, often results in an increase in the demands on the organization's IT infrastructure, IT costs either remain neutral or decrease.	
Inhibiting conditions	
• The expense of educational technology to institutions o When compared to traditional models of IT infrastructure, cloud computing, especially in public cloud form, offers considerable economies of scale. However, there is a considerable expense to the delivery of technology-enabled learning. These expenses may include IT management salary, network infrastructure, data hosting costs, Internet access costs, etc. o The use of educational technology, including cloud computing, often involves facility upgrades to enable the use of new instructional technologies. This might include wireless access points, lecture capture technology, projectors in classrooms, etc. • The expense of educational technology to individuals	CDW-G, 2012; Desrochers & Wellman, 2011; Kirschstein & Wellman, 2012

	Conditions	Literature
	o It is preferable that all students in a class have access to the technology required to support technology-enhanced learning activities. While the growing number of personal devices capable of accessing Internet resources is increasing in classrooms, there is a financial cost to households associated with their children's devices and Internet access. The reality remains that not all families will have the financial resources to provide their children with personal devices or Internet at home. o An available remedy for the inequality relating to students' access to personal devices is for schools to have support programs such as loaner devices or stipends to help families pay for broadband access. These programs, however, shift economic concerns from individuals to institutions, rather than eliminating them.	
	Facilitating conditions	
Social	• New social and collaboration norms o Globally integrated networks facilitate social interactions and collaboration, overcoming traditional constraints such as travel time and cost. o The ubiquity of connected devices allows individuals to interact with others for productive and social purposes whenever and wherever they are. • Bring Your Own Device (BYOD) and the consumerization of IT as growing social norms o "Bring Your Own Device (BYOD) is a powerful wave that hasn't yet crested. Whether students are in school or college, they've grown up learning, living, and playing on mobile devices—and they want to use them inside and outside the classroom. Likewise, teachers, administrators, and staff are working smarter and more efficiently thanks to their tablets and smartphones" (Cisco, 2012, p. 1). o BYOD is underpinned by cloud computing as the devices themselves are limited in power and storage. It is a personal device's ability to connect to the Internet and cloud computing resources that enables its functionality. o Organizations are accepting employee-owned devices in some way, shape or form at an increasing rate. o "BYOD growth in the workplace is seen as inevitable" (Harris, 2012).	Chen et al., 2011; Williams 2009; Cisco Systems, 2012a; Cisco Systems, 2012b; Daneshgar et al., 2011; Dimitrakos, 2010; Gagliardi et al., 2010; Harris, 2012; IBM, 2011; Martinovic et al., 2009; Petrakou et al., 2011; Tumer, 2010; Williams, 2009
	Inhibiting conditions	
	• Expectations and self-regulation in a constantly connected world o With increasingly ubiquitous access to the Internet, both through traditional and mobile personal devices, social norms and expectations are changing. This is particularly relevant to expectations of when and where people work. Similarly, social norms are evolving towards raised expectations of connectedness. o Self-regulation of technology use is a challenge for some in an increasingly connected world. Literature on technology overuse and addiction grows, with recognition in the forthcoming American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM5). • Equality concerns for low-income populations o Though cloud computing (and BYOD, which it enables) has economic advantages over traditional computing models, there is still a cost which may be prohibitive to low-income populations. o As online activities become more common, access to a credit card (or similar form of electronic payment) becomes another barrier excluding certain disadvantaged groups.	American Psychiatric Association, 2013; Bayraktar & Gün, 2007; Block, 2008; Byun et al. 2009 Desrochers & Wellman, 2011; Handa, Maheshwari, & Saraf, 2011; Kirschstein & Wellman, 2012; Limayem, Hirt, & Cheung, 2007; Meerkerk, van den Eijnden, Franken, & Garretsen, 2010;

	Conditions	Literature
		Turel, Serenko, & Giles, 2011; Yang & Tung, 2007
	Facilitating conditions	
Technological	• Broad network access and reliability o With cloud computing, access to resources is broad and often available via multiple devices. These include fixed devices, such as desktop or laptop computers, as well as mobile devices such as cell phones and tablets. This is in contrast to traditional IT infrastructure where resources were often limited to a defined network. o Availability is near constant (24/7/365) with most large cloud computing service providers. Periods of service unavailability are usually brief and disruptions are often much less common and/or severe than in traditional IT infrastructure. o With cloud computing, data is replicated across multiple sites resulting in redundancy and improved data access and reliability. • Resource pooling and rapid elasticity o Large cloud computing service providers have data centres with massive storage and processing capacity far in excess of what independent organizations typically develop on their own. These computing resources are shared by and available to the cloud computing service providers' multiple customers. o Expanding available storage or processing capacity via a large cloud computing provider is rarely constrained by factors that often limit traditional IT infrastructure expansion. These traditional constraints may include available electricity to a building or server room, physical space, cooling equipment, etc. Due to the planning, design, and scale of large cloud computing data centres, these factors are greatly reduced. o In cloud computing, capacity scaling is done at the data centre of the cloud computing provider and not on the customer organization's premises. Given the robustness of large cloud computing data centres, expansion of a customer organization's computing capacity is often merely an allocation of existing datacentre resources (rather than a physical, on-site expansion of hardware and software as with traditional IT infrastructure). o Organizations often have choice as to the type of cloud computing infrastructure they provision: SaaS, PaaS, and/or IaaS. This differs from infrastructure solutions developed on premises, which require developing all three layers, even if only software is required.	Bhardwaj, Jain, & Jain, 2010; Briscoe & Marinos, 2009; Chien & Chien, 2011; Daneshgar, Worasinchai, & Low, 2011; Furht & Escalante, 2010; Khajeh-Hosseini, Greenwood, & Sommerville, 2010; Kloch, Petersen, & Madsen, 2011; Rastogi, 2010; Rittinghouse & Ransome, 2009; Sulistio, Reich, & Doelitzscher, 2009; Sultan, 2010; Tsaravas & Themistocleous, 2011; Vaquero, Rodero-Merino, Caceres, & Lindner, 2008; Velte, Velte, & Elsenpeter, 2009
	Inhibiting conditions	
	• Network access concerns o The availability of cloud computing services is dependent on network and Internet access. Disruptions to Internet service to users results in loss of access to cloud computing resources. This differs from traditional infrastructure where Internet connectivity would not affect on-site access to files stored on the local network. o The speed of a local network can typically range from 100 Mbps to 1 Gbps to 40 Gbps. This is considerably less than the speed of Internet access, particularly while uploading data. Consequently, depending on the types of files being transferred, cloud computing may not be an appropriate solution given the limitations of data transfer speeds. • Control moves to cloud computing service providers away from individuals ands organizations.	Armbrust, Fox, Griffith, Joseph, Katz, et al., 2009; Daneshgarl, Worasinchai, & Low, 2011; Dikaiakos, Katsaros, Mehra, Pallis, & Vakali, 2009; Dillon, Wu, & Chang, 2010; Kloch, Petersen, & Madsen, 2011;

Conditions	Literature
o A cloud computing concern is performance unpredictability of maintenance, upgrades, and service disruptions. Moreover, business, operational, and security problems are often not communicated to a cloud computing providers' customers in advance. In contrast, traditional IT infrastructure, which is owned/managed by a business and located onsite, provides greater transparency. o The location of data across multiple jurisdictions and servers, as is common in many cloud computing scenarios, complicates governance issues. The complexity of software licensing increases, as does adherence to the laws of multiple jurisdictions. o Data retention, deletion, and portability are also more complicated in cloud computing scenarios than in traditional IT infrastructure settings. Data stored on an organization's traditional, physical, on-premises servers is easier to verify as backed up, deleted, and transferred. Cloud computing infrastructure, particularly the deletion of sensitive content (often in compliance with privacy legislation), leads to less certainty.	Subramanian & Wargo, 2013 Sulistio, Reich, & Doelitzscher, 2009; Sultan, 2010; Tsaravas & Themistocleous, 2011

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APPENDIX C: LARGE K-12 SCHOOL DISTRICTS IN WESTERN CANADA

Table C1

Large K-12 School Districts in Western Canada

British Columbia		Alberta		Saskatchewan	
K-12 school district name	**Student enrolment in 2012-2013**	**K-12 school district name**	**Student enrolment in 2012-2013**	**K-12 school district name**	**Student enrolment in 2012-2013**
Surrey (SD 36)	74,019	Calgary School District No. 19	106,828	Saskatoon (SD 13)	21,550
Vancouver (SD 39)	59,468	Edmonton School District No. 7	83,891	Regina (SD 4)	20,140
Coquitlam (SD 43)	34,298	Calgary Roman Catholic Separate School District No. 1	48,952	St. Paul's (RCSSD 20)	15,670
Burnaby (SD 41)	26,255	Edmonton Catholic Separate School District No. 7	35,220	Regina (RCSSD 81)	9,946
Richmond (SD 38)	22,761	Rocky View School Division No. 41	18,478	Prairie Spirit (SD 206)	9,883
Central Okanagan (SD 23)	22,160	Elk Island Public Schools Regional Division No. 14	16,360	Saskatchewan Rivers (SD 119)	8,403
Greater Victoria (SD 61)	20,267	Pembina Hills Regional Division No. 7	11,681	South East Cornerstone (SD 209)	8,145
Langley (SD 35)	20,112	Chinook's Edge School Division No. 73	10,750	Prairie Valley (SD 208)	8,099
Abbotsford (SD 34)	19,892	Red Deer Public School District No. 104	10,237	Prairie South (SD 210)	6,522
Kamloops/Thompson (SD 73)	16,898	Parkland School Division No. 70	9,826	Horizon (SD 205)	6,257
Delta (SD 37)	16,321	Black Gold Regional Division No. 18	9,205	Chinook (SD 211)	6,040
North Vancouver (SD 44)	16,013	Christ the Redeemer Catholic Separate Regional Division No. 3	9,101	Good Spirit (SD 204)	6,021
Maple Ridge-Pitt Meadows (SD 42)	15,005	Lethbridge School District No. 51	9,044	Living Sky (SD 202)	5,482

(table continues)

British Columbia		Alberta		Saskatchewan	
K-12 school district name	**Student enrolment in 2012-2013**	**K-12 school district name**	**Student enrolment in 2012-2013**	**K-12 school district name**	**Student enrolment in 2012-2013**
Nanaimo-Ladysmith (SD 68)	14,635	Foothills School Division No. 38	7,598		
Chilliwack (SD 33)	14,078	Grande Prairie School District No. 2357	7,530		
Prince George (SD 57)	13,705	Red Deer Catholic Regional Division No. 39	7,442		
Saanich (SD 63)	11,791	Wolf Creek School Division No. 72	7,251		
Comox Valley (SD 71)	11,259	Palliser Regional Division No. 26	7,132		
Sooke (SD 62)	10,527	Medicine Hat School District No. 76	6,907		
Vernon (SD 22)	8,410	St. Albert Public School District No. 5565	6,851		
Cowichan Valley (SD 79)	7,922	Golden Hills School Division No. 75	6,394		
New Westminster (SD 40)	7,665	Battle River Regional Division No. 31	6,275		
West Vancouver (SD 45)	7,115	Greater St. Albert Roman Catholic Separate School District No. 734	6,149		
Mission (SD 75)	6,256	Alberta Distance Learning Centre	6,076		
Peace River North (SD 60)	6,244	Elk Island Catholic Separate Regional Division No. 41	5,778		
North Okanagan-Shuswap (SD 83)	6,205	Northern Lights School Division No. 69	5,749		
Okanagan Skaha (SD 67)	6,168	Peace Wapiti School Division No. 76	5,556		
Kootenay Lake (SD 8)	5,755	Fort McMurray Public School District No. 2833	5,328		
Southeast Kootenay (SD 5)	5,509	Fort McMurray Roman Catholic Separate School District No. 32	5,199		

(table continues)

British Columbia		Alberta		Saskatchewan	
K-12 school district name	**Student enrolment in 2012-2013**	**K-12 school district name**	**Student enrolment in 2012-2013**	**K-12 school district name**	**Student enrolment in 2012-2013**
Nechako Lakes (SD 91)	5,454	Wild Rose School Division No. 66	5,092		
Coast Mountains (SD 82)	5,437				
Campbell River (SD 72)	5,367				
Cariboo-Chilcotin (SD 27)	5,145				
Data Source: British Columbia Ministry of Education (2013). *Schools & Institutions Map.* Retrieved from http://www.learnlivebc.ca/toolkit/map-bc-schools		*Data Source:* Alberta Education (2013). *Alberta Education - Student Population.* Retrieved from http://education.alberta.ca/department/stats/students.aspx		*Data Source:* Saskatchewan Ministry of Education (2013). *School Divisions - Education*. Retrieved from http://www.education.gov.sk.ca/School-Division	

APPENDIX D: SEMISTRUCTURED INTERVIEW QUESTIONS

PART A

IT Leadership Structures, Influences, and Processes in K-12 Districts
(THEORETICAL BASE: Contingency Decision-Making Framework, Daft, 2013)

Decision-Making Unit: Who?

1. Who is responsible for IT infrastructure decisions in your district? Individual or group?

Influences and Processes: How?

2. Describe the process of IT infrastructure decision-making?

Cloud Computing Decisions: Consistent or Unique Process?

3. Do infrastructure decisions regarding cloud computing fit the previously described process or are they unique? Please describe.

PART B

Snapshot of Present IT Infrastructure and Cloud Computing Adoption in K-12 Districts in Western Canada
(THEORETICAL BASE: Frambach and Schillewaert Framework, 2002)

QUESTIONS:

4. Briefly describe the IT infrastructure of your district for the following technologies (see below):
5. Are they traditional IT infrastructure (hosted at the school or district level), cloud computing, or hybrid? Please describe.
6. How would you describe your district's level of cloud computing adoption in following technology?
    a. *Nonadoption: Awareness–Consideration–Intention*
       E.g., SIS–Consideration but decided against.

    b. *Adoption: Adoption Decision–Continued Use (complementary, supplemental, replacement, trial)*
       E.g., LMS–replacement for on-site, complementary

TECHNOLOGIES:

- Student Information Systems (SIS) - (e.g., student records, parent data, etc.)
- Learning Management System (LMS) - (online course platform such as Moodle)
- Library Services
- Security and authentication - (e.g., Active Directory, DNS)
- E-mail
- Other? Are there other IT infrastructure aspects that have not been discussed here yet that you would like to mention?

PART C

The Interplay of Factors that Influence Infrastructure Decisions by IT Leadership (THEORETICAL BASE: Frambach and Schillewaert Framework, 2002)

INFLUENCES OF ADOPTION AND NONADOPTION

Regarding Adoption:

7. How would you rank the following influence on your decision to adopt cloud computing? Please briefly explain why.
    - internal organizational characteristics
    - external pressures, or
    - the technology characteristics themselves (advantage or disadvantage of technology itself over alternatives)

Regarding nonadoption:

8. How would you rank the following influences on your decision in instances where you did not adopt cloud computing? Please briefly explain why.
    - internal organizational characteristics
    - external pressures, or
    - the technology characteristics themselves (advantage or disadvantage of technology itself over alternatives)

INFLUENCE STRENGTH

9. Using a rating scale (1, *very little*; 5, *very much*), describe how your perception of infrastructure technology has been shaped by the following:
    - Supplier marketing efforts
    - Social network influences
    - Other environmental pressures? (government policy, competition/adoption of others, etc.)

10. Using a rating scale (1, *very little*, 5, *very much*), describe how your school district's adoption of cloud computing has been impacted by the following:
    - Supplier marketing efforts
    - Social network
    - Environmental influences
    - Perceived innovation characteristics
    - Adopter characteristics (size, structure, organizational innovativeness)

    Please briefly explain why.

OVERALL IMPACT OF FACTORS

11. How would you rank the following in overall impact on your cloud computing adoption decision? Please briefly explain why.
    - Supplier marketing efforts
    - Social network
    - Environmental influences
    - Perceived innovation characteristics
    - Adopter characteristics (size, structure, organizational innovativeness)

PART D

Optional Questions for Additional Triangulation (Time Permitting)

12. Is there a district policy regarding school-level use of cloud computing by teachers and/or students? (E.g. Google Drive, Skydrive, Dropbox?) (document support would be excellent)

13. Is there an IT accomplishment (infrastructure or other) you are proud of and would like to share?

Thank you for your participation in this study.

APPENDIX E: IT ROLES, TITLES, AND REPORTING STRUCTURES

Table E1

IT Roles, Titles, and Reporting Organized by K-12 District Branches of Responsibility

Daft (2013) Hierarchy Levels	Jones (2013) Descriptors	Instruction and Innovative Learning	Services, Infrastructure, and Facilities	Information Technology	Finance	Human Resources
Level 1	Organization	• Board of Education • CEO • Director of Education • Superintendent of Schools	• Board of Trustees • CEO • Director of Education • Superintendent of Schools	• Board of Education • Superintendent of Schools	• Board of Education • Superintendent	• Board of Trustees • Superintendent of Schools
Level 2	Division	• Assistant Superintendent (Technology Services/Learning Support) • Assistant Superintendent Education Services • Assistant Superintendent of Learning Services • Associate Director of Instruction, Learning & Information Services • Associate Superintendent Learning Services • Associate Superintendent of Learning	• Acting Executive Director Infrastructure • Assistant Superintendent, District Operations and Information & Infrastructure Technology Services • Associate Superintendent of Communication and Technology Services • Deputy Director Division Services and Secretary Treasurer • Deputy Director Division Services/CFO	• Administrator of Information Technologies • Associate Superintendent (with Information Technology portfolio) • Director of Information Technology • Director of Technology and Chief Information Officer • District Vice-Principal Technology • Executive Director Capital Projects & Technology	• Assistant Superintendent, District Operations and Information & Infrastructure Technology Services • Associate Superintendent Business & Finance • Associate Superintendent, Finance/Secretary Treasurer • Chief Financial Officer • Deputy Director of Corporate Services/CFO • Secretary Treasurer • Superintendent of Business & Finance and Technology Services • Superintendent of Business Administration	• Associate Superintendent (Human Resources)

Daft (2013) Hierarchy Levels	Jones (2013) Descriptors	Instruction and Innovative Learning	Services, Infrastructure, and Facilities	Information Technology	Finance	Human Resources
		• Deputy Director (Education Portfolio) • Deputy Superintendent • Deputy Superintendent - Learning Services • Director of Innovative Learning • Director of Instruction • Director of Student Assessment & Curriculum Support • Director of Student Learning and Innovation • District Principal Instruction and Technology Services • Superintendent Learning Innovation and Chief Information Officer • Superintendent of Curriculum and Instruction • Superintendent of Education • Superintendent of Schools and Learning	• Superintendent of Division Services	• Manager of Information Services • Principal of Technology	• Superintendent, Finance & Business, Information Technology / Secretary-Treasurer • Superintendent, Finance/Technology Services, Chief Financial Officer, Corporate Treasurer	

Daft (2013) Hierarchy Levels	Jones (2013) Descriptors	Instruction and Innovative Learning	Services, Infrastructure, and Facilities	Information Technology	Finance	Human Resources
Level 3	Function	• Director of Information Technology Services • Director of Information Technology/Director of Instruction • Director of Learning Technologies • Director of Technical Services • Director of Technology for Learning • District Principal Innovative Learning • District Principal, Information Technology • Education Technology Manager • Information and Communication Systems Manager • IT Coordinator • Learning Technologies Manager • Manager of Information Systems • Manager of Technology Services • Network Coordinator	• Director of Information Technology • District Technology • IT Director • Manager of Information Systems • Superintendent Information, Governance & Reporting • Supervisor of Communication Information & Technology	• Director of Information Technology • Manager of Technology	• Chief Technology Officer • Computer Services Manager • Coordinator of Information Services • Director Information Management Services • Director Information Technology • Director of Information Technology and Digital Communications • Manager of Information Services • Technology Director	• Director of Learning (Technology, Counselling Int. Students)

Daft (2013) Hierarchy Levels	Jones (2013) Descriptors	Instruction and Innovative Learning	Services, Infrastructure, and Facilities	Information Technology	Finance	Human Resources
		• Supervisor Schools and Learning (Technology) • Technology Integration Director				
Level 4	Sub-Function	• Coordinator Schools and Learning • Information and Communications Systems Assistant Manager	• Infrastructure Manager • Manager of IT Services • Supervisor Network Services • Supervisor Technology Support	• Head Network Systems Administrator • Network Manager	• IT Manager or System Analyst • Manager Information Management Services • Network Administrator • Programming Team • School Support Team • Server Administrator • SIS Team • Systems Team	• Technology Integration Specialist
Level 5	Role	• Computer Technician • Data System Analyst • Developer Analyst • Network Analyst • Network Technician • Technical Analyst	• Computer Technician • Data System Analyst • Developer Analyst • Network Analyst • Network Technician • Technical Analyst	• Computer Technician • Data System Analyst • Developer Analyst • Network Analyst • Network Technician • Technical Analyst	• Analyst • Programmer • Computer Technician • Data System Analyst • Developer Analyst • Network Analyst • Network Technician • Technical Analyst	• Computer Technician • Data System Analyst • Developer Analyst • Network Analyst • Network Technician • Technical Analyst

APPENDIX F: REPRESENTATIVE QUOTATIONS

Table F1

Elements of Districts' Decision-Making Processes for IT Infrastructure: Awareness of IT Needs

Province	Representative quotation
BC	There's also a service desk, consists of five people. So service desk and field people report to the supervisor, and then the infrastructure team reports to me and we both report to the CIO. (Brooklyn, p. 9)
BC	I mean really, the majority of it comes from the service calls we take. As we're taking service calls, we're constantly being asked for different things people need within the district, so it's pretty obvious when things like wireless and kind of that - we see that right away, we know there's a need for it. (Bo, p. 2)
BC	We take calls, we're talking with the teachers all the time, so that's where the majority of it comes from - is from what the teachers want and what's needed in the school. So that's what we base our plans on. (Bo, p. 2)
AB	So I guess the fires and the immediate concern, they're brought up by the analysts, and more the proactive long-term decisions are brought forth by the director and the lead team. (Ali, p. 3)
AB	Their job I would say, the elevated job, is to go into a classroom that's having a technology problem and say to the teacher, 'don't worry, I'll take care of it'. And they take responsibility for that problem. So really, they're the Tier 1, and they know whether to engage the line techs, the Tier 2, or whether they need to go straight to the core team, or if it's a problem that should come straight to myself or the assistant superintendent. Their job is just to know who does what and make sure the right person is taking care of that issue as quickly as possible. (Ari, p. 3)
AB	The IT peoples know which servers are older, smaller, slower, running out of space, et cetera, so we kind of go around the table and go 'which schools - do we need anything this year?'. You know, switches. 'Ok, well we've got to replace a few more of these switches because they're the old 100 series and we need gig ports on everything now. We need power for those switches for the new Wi-Fi we're putting in' - so it's kind of a priority-need based on age, school needs, capacity, and that's a very collaborative approach I'd say. (Austen, p. 2)
SK	We meet for an afternoon, once every two months, with the whole IT team, and before anything happens, . . . we say this is what's, you know, going on, this is what we're thinking of doing, and . . . we just seek input, has anyone used this before, did you work at another school district where this was tried, so there is that opportunity, (Saffi, p. 6).
SK	So it's really a combination of listening to feedback from the field, that review process, guys in my department who are very tech-savvy and have their ear to the ground on any new technology coming out, so by the time they're like hey, we have to start paying attention to this, wireless charging through air technology is probably out in the next two years, type of things, so we have to get our good old PCs and wireless AC technology has just been ratified so we have make sure we're preparing some money for that. We just bought our teachers all-new devices, through all the feedback, what's going out this summer, we made sure that they have all the latest technology for the wireless we don't have yet. It's a combination of a bunch of different things. And on the outside of that too is just paying attention to what's going on in the industry, talking to other school divisions, talking to other companies, trade shows, what the trends are, what the things are that we should be looking for with our technology. (Sasha, p. 4)
SK	We have, well, for repairing we have a ticket system, basically, where people log information into the repair database and get fixed that way. From the network and an application standpoint, from the network standpoint we're all planning to you know, keep our information current, and keep our networks current. (Skylar, p. 2)

Table F2

Decision-Making Processes for IT Infrastructure: Technology Advisory Committees

Province	Representative quotation
BC	In terms of the needs, it's a collaboration, let's see. There's, I guess, what we tend to do is we have weekly meetings and that's the team of 3 that I just told you, along with an elementary and secondary principal in that team. And occasionally, almost on a monthly basis, we will involve our IT foreman who can give a report of what's happening. So that's one level. The other level we also have is a, what we call a district technology committee, and that's a group of stakeholders, our teachers, our support staff, our management staff, our parents, all except for students in that group. And that group meets 3-4 times per year. (Blair, p. 2)
BC	Essentially - we all essentially put together what we thought was needed, and we queried our principals to make sure we're kind of in line with what they wanted, and we put together something. (Bo, p. 1)
BC	Yeah, so typically we want our advisory committees to make a recommendation, so I will have to lead that group to make a decision. That decision will then go to our senior leadership team for approval and then it will go to our trustees for information. Not for decision, but for information. (Brighton, p. 3)
AB	We also have a technology council which I chair, and the technology council is an advisory group to the superintendent's team, and the advisory council is made up of representatives from all the major stakeholders in the organization, so it's an internal advisory and it's made up of members of the 5 areas of our schools, principals sit on that advisory, from our elementary, middle, and senior high schools, and then we have representatives through all of our superintendents and service unit teams. So it's a table of about 16 people and all major technology decisions, we have a process for bringing them forward, a project approval process, and a discussion format. We meet twice a month and all technology decisions go through - initially - that advisory council. (Ami, p. 1)
AB	Well that consultation process that we have with our education committee is critical in that process, so when we considered Office 365 versus Google Cloud for instance, that conversation was vetted at the learning technology advisory committee, and the decision went back and forth about the impact on kids and the technology and whether we were meeting that shift from consumer to creator and all those types of pieces. So definitely the advisory committee, their advice holds a lot of weight. (Amari, p. 3)
AB	We have a committee come together and evaluate software. We do our process, committee comes together, and then a recommendation is made forward. (Alva, p. 1)
SK	We also have a committee, we call it the hardware and software committee; that's an elected committee, so I think they elect one person every year so they keep changing and that can be pretty much anybody in the school division who can participate, usually it's one person from each of the big departments so it'll be like, you know, transportation, and so on, and then there would be teachers, principals, and support staff. (Sheridan, p. 2)
SK	We would have had committee meetings where it was comprised of myself, my supervisor, the director, CFO, there was some learning representatives on that committee, so there was a learning representative from the principals group, from elementary teachers' group, high school, so everybody sort of had some input at that point. (Sinclair, p. 2)
SK	Oh the tech groups. The one that we have that we can call upon. They kind of signed up for a multi - year deal, where we where we're going to call upon you for a web meeting or a physical meeting, or just e-mail and survey. We have 22 people sitting on that committee, so that's our main go-to, and then we'll also pull in, not like focus groups but if we need to get feedback from k-3, we'll pull in 15-20 K-3 teachers and get some feedback directly from them to work on that piece too. (Sasha, p. 4)
SK	We have a technology focus group that we put together that's made up of principals, teachers from multiple grade levels from multiple schools. And we rely on them a couple times a year just to get their feedback on different type of things that we're doing. (Sasha, p. 3)

(table continues)

Province	Representative quotation
SK	We do have a director of technology advisory committee that meets on a regular basis with our director of education and they kind of set forth the higher level goals that have to align with what the school division is wanting to do and that's the direction of what we're doing. (Sam, p. 2)
SK	For IT decisions, we have a technical needs committee, and the technical needs committee is essentially made up of various people at the top end of the organization, hopefully trying to touch the various sub-organizations within the organization. That tech committee essentially helps to spear for example how many desktops, how many laptops, how many iPads, how much, should we spend more on this thing or that thing or less, stop buying that or start buying something else. That's kind of the first phase of most of the decision-making. (Sidney, p. 1)

Table F3

Decision-Making Processes for IT Infrastructure: Collaboration of Senior Leadership

Province	Representative quotation
BC	The manager of technology reports to the assistant superintendent. It's an interesting arrangement, but the decisions are usually made almost on a team basis, so even though on the chart we have the assistant superintendent on the top who ultimately has the decision making powers, but the way we operate here, the team of usually the three of us will make the decision as a group. (Blair, p. 1)
BC	Now, if we talk about IT type projects, that affect the district, we do have an advisory committee, and we may get to that later, but that's the district technology advisory committee, DTAC, is what we call it. And that includes the superintendent, secretary treasurer, director and myself, but also director of Ed Services, educational services. So that committee really brings in all areas of business and the educational side of the district. (Brook, p. 1)
BC	Now we have a technology committee that meets maybe a couple times a year that consists of the assistant superintendent, the one I report to, the CFO, a handful of principals, one from every family school group, so one elementary principal, one middle school principal, one secondary school principal. Our tech coordinator that works out of our department, and probably one of the people, one of our programmer analysts or systems analysts from our own department, so maybe 7 people maximum. All with a very good overview of the system. (Brandyn, p. 4)
AB	We like to work to a consensus model at the superintendent's team, and superintendents are made up of 7 corporate decision-makers who bring a variety of perspective to the decision-making role. So we have legal services, communications, finance and supply chain, facilities and environmental services, education - we have two educational superintendents who look after programs, and program requirements, and ... I'm missing one. Oh! Superintendent of HR, and then we have our chief and we have a deputy chief. So that superintendent's team is a multiple perspective team made up of a variety of those stakeholders. (Ami, p. 1)
AB	We have a fairly flat hierarchy in our division and in our department anyways, in that in as often as possible we try to use collaborative decision-making to come up with answers to our needs. (Amari, p. 1)
AB	We try to work these processes very collaboratively, uh, I think in some organizations, that same committee that I just described would be meeting without IT people, and they would be bringing the decision to the IT team to say, now you design it and implement it. (Anstice, p. 5).
SK	And then there's the, there's also an admin council that I report to, and that's a group of ten superintendents and one director, and the priority there is also learning, and technology is, is . . . sometimes partly a solution and sometimes it's seen as not a solution as well. So, it's an area of debate, and it's . . . I think that's healthy, rather than people are just gung-ho to spend money on technology without addressing the learning. (Saffi, p. 1)
SK	Anything that would be impacting how we deliver our services would pretty much all go CIO to the secretary treasurer. One thing to just clarify, when we're looking at delivering something, say, a SIS, and we're looking at it being cloud-based type of thing where the parties who are going to be affected are going to be involved, so if we were to be looking at a new SIS and I'm not implying that we are, that would definitely involve the deputy director of schools, because the decision to make these moves would not be done in isolation without the parties that are involved. Not at all. (Sam, p. 4)
SK	We do have regular meetings as a group, about once every six weeks we'll all sit down again with our superintendent and just sort of round-table ideas and discussions, talk about what's been going on. I update them in terms of what we're doing as a department from the technology side in terms of infrastructure upgrades or whatever it might happen to be, and then they discuss ideas that they would like the IT department to look into in terms of, you know, some sort of possibility for execution on. (Stacey, p. 3)

Table F4

Decision-Making Processes for IT Infrastructure: The Cloud Computing Adoption Decision-Making Process is Consistent with Other IT Infrastructure Decision-Making Processes

Province	Representative quotation
BC	It would essentially be the same, although we've had certain applications that are coming to the district - I mean web-based applications - that, whether they're in the cloud or not really, doesn't really affect us because they're usually supplied by a vendor of some kind, and we're not in that part of the decision making, we're more interested in what we have on-site. (Bo, p. 3)
BC	It definitely would. It would stay the same, yeah. (Brook, p. 2)
BC	Absolutely, if we were to look at Google Docs, for instance, deploying Google Docs or Google Apps, if it has to involve other people because of privacy concerns—particularly in BC we have very strong FOIPA laws, so that would involve the CFO who's our privacy officer as well, as well as our education group. So there may be a recommendation from our tech coordinator and myself, saying that Google Apps would be a huge benefit to teachers and students, however saying that, we need to concern ourselves with if it doesn't fit our privacy laws, can we make it secure and manage it, and the educators: is it going to work educationally, so there's a lot of collaboration that goes on. A recommendation may come forward from the school saying we really want Google Docs, or Microsoft Live 365 or something, can we do it? And so we'll go through an actual process for integrating technology in the system and it involves a lot of things like can we support it, can we sustain it, and can we make it equitable. There's a set of criteria that we try and fit to everything to ensure that we can actually manage it, so. (Brandyn, p. 3)
BC	No [difference], I guess the only thing that would get [additionally] involved is we would also involve our senior team and that's more for information, because stuff to move to public cloud or we have those discussions obviously about security, privacy, that kind of stuff, so that's FYIs for the senior management team. (Blair, p. 2)
AB	For the most part it would stay the same. (Ali, p. 2)
AB	Pretty much the same process. Of course Edmonton public was one of the first major adopters of the cloud and we kind of followed right behind Edmonton public. When they were moving to cloud we were months behind them. Being a large division as they are of course they can employ many different people to look at the policies and procedures that can be affected as far as FOIP is concerned and of course our cloud environments and so we followed very closely what they were doing. Of course being a much smaller division we can implement in a much shorter period of time. They had a two year goal to get all staff onto the Google environment; we had a two month goal. So you know, we were just able to implement much faster than Edmonton public. And I tease them about it all the time. [chuckles] (Adal, p. 3)
AB	I think it stays the same. (Adair, p. 2)
AB	We follow the same process almost to a T except that we are doing the presentation for the board on it, especially for Google Apps For Education (GAFE), because they need to know, like for purposes and stuff like that, they need to know what we're doing and because the parents, all the parents are going to be involved in this. So you're right because of that it went to the board as well. Just a general presentation, while obviously, you know, if they got huge concerns we'd reconsider some things, but we just want to keep them in the information loop with that, but the decision pretty much is already made. (Ailin, p. 2)
SK	Yeah it is very similar. So we are moving towards cloud in a lot of different areas. (Sasha, p. 4)
SK	Yeah, it would be [similar]. (Sidney, p. 5)
SK	It's very much the same process. (Stacey, p. 3)

Table F5

The Strong Influence of a Regulatory Environment on IT Infrastructure in Western Canadian K-12 Districts

Province	Representative quotation
BC	Okay, well FOIPA is probably one of the bigger ones, that's government policy. So, it, other than that it's not like if we see a district doing something… we're not bandwagon type people… (Bentley, p. 12).
BC	It's such a challenge, obviously legislation you can't mess around with but at the same time it really is a barrier to adoption and a barrier to, you know, the Patriot Act, all legislation is important for us to honour, but the chances of the US Government seizing a database of student data I believe is very low. (Brook, p. 11)
BC	Actually, if anything, in terms of us [government policy is] preventing more explicit move to cloud. If I could move my entire infrastructure to Office 365 right now and wipe out all of my similar servers here in the school district, I would. (Berkeley, p. 12)
BC	Well FOIPA certainly impacts us in a big way, for what we may or may not do, because it's a big roadblock. So I would say, if FOIPA is in that list, more so than worrying about losing to other jurisdictions, FOIPA is a big driver as far as what we can utilize… (Beverley, p. 8)
BC	Well obviously if government mandates it, we do it. We do work for the government. I would say if we're talking government, then we are subject to whatever they determine. (Brandyn, p. 12)
BC	Well, I mean, it's not whether I go with cloud, it's whether I go with private cloud or public cloud. But yeah I still use cloud, so the pressure that comes from the government is [significant]. If it won't pass privacy, then I'm going to take a private cloud solution, but it's still going to be in the cloud. (Blakeley, p. 10)
AB	More so on the government side then on other… uh… peers, so, I mean, that one, I don't know if you wanna denote… that influence would be exclusively government, not, not by… peers around. (Anstice, p. 17).
AB	The government in particular is what tends to keep us kind of scared of moving all of our stuff in there [public cloud]. So I would say that they are a pretty heavy-handed influence on that one. (Alva, p. 8)
AB	I can't say that we've ever had a discussion in all of the IT meetings that we've had that said that such-and-such district is offering a service and we have to do that... The government policy does weigh in a bit; it's not something you can totally ignore. (Ade, p. 10)
AB	We're definitely willing to learn from others, but we won't… chase something just because somebody else is doing it… again, back to, if the government flat out, you know, legislates that we can't, well that's going to influence our decisions, right. (Adrian, p. 12)
AB	I'd bump that [environmental influences] up a bit, specifically when talking about public cloud. I'd bump that up to a 4, just because we have to be very cognizant of what the government is telling us as far as privacy and stuff like that. (Abayomi, p. 11)
AB	…government policy would trump all of it, if it worked against it. (Addison, p. 9)
AB	…well government policy is a big one, cuz you can't. I think that's essentially the bottom line (Alex, p. 12)
AB	We have to adhere to government policies, so I mean, it's important. But, as for other environmental pressures, sometimes there's advantages to swimming against the current. (Ari, p. 10)
AB	Yeah the privacy we're very conscious of, so yeah, it's very influential, probably a five. (Ansley, p. 11)
AB	Oh man. That, depending on what it is, it could be very important to not important at all… Privacy is definitely looked at … We wait for others to get out all the kinks and then we jump in. (Andrea, p. 8)

(table continues)

Province	Representative quotation
SK	Well, I mean we have to be legal. Nobody wants to go to jail, nobody wants to lose their job. (Sage, p. 15)
SK	It would really depend on that environment… Your environmental pressures would probably depend province by province [based on legislation], I would imagine. (Saffi, p. 18)
SK	We do have these regulations or mandates or things like that that are prescribed. But lots of times they're not completely thought through, or not practical. So while we recognize them and try to honor the spirit of them, they're not always practical. (Shawn, p. 16)
SK	Probably the policy one would be ahead of the other [competition]. (Sam, p. 10)
SK	That one is quite high as well, too. Again, when the Ministry says they need something, we tend to have to really jump, so I would put that at around a 4 as well. (Stacey, p. 9)
SK	Oh, sometimes that [government policy] has a lot more weight than we all like to admit. If 5 is the highest, I'd say 4 or 5. Because typically when we get some sort of mandate from government. It's "do it now", right? We don't have much say in saying "no, we're not going to do that." (Sinclair, p. 10)

APPENDIX G: DIRECTORY OF SOFTWARE PROVIDERS

Table G1

Software Products and Providers

	Products	Organizations	Websites	Headquarters
STUDENT INFORMATION SYSTEM (SIS)	BCeSIS and/or MyEducation BC	British Columbia Ministry of Education, in partnership with Follett School Solutions and Fujitsu Ltd.	myeducationbc.info	Victoria, BC
	CIMS	Take Two Inc.	taketwoinc.com	La Salle, MB
	Genius SIS	Genius SIS, Inc.	geniussis.com	Plantation, FL
	Maplewood Student Information System	Maplewood Computing Ltd.	maplewood.com	London, ON
	PowerSchool	PowerSchool Group LLC (owned by Vista Equity Partners)	powerschool.com	Folsom, CA
	SchoolLogic	SRB Education Solutions, a division of StarDyne Technologies, Inc.	srbeducationsolutions.com/SchoolLogic.php	Kelowna, BC
	Turbo-School	TCS Developments, Inc.	turboschool.com	Vancouver, BC
	Windsor	Harts Systems Ltd	pwise.ca	North Vancouver, BC
LEARNING MANAGEMENT SYSTEM (LMS)	Blackboard	Blackboard Inc.	blackboard.com	Washington, DC
	CIMS	Take Two Inc.	taketwoinc.com	La Salle, MB
	custom/other/own	N/A	N/A	N/A
	Desire2Learn (now Brightspace)	D2L Ltd.	d2l.com	Kitchener, ON
	Edmodo	Edmodo, Inc.	edmodo.com	San Mateo, CA
	FirstClass LMS	FirstClass LMS	firstclasslms.com	Durham, NC
	Google Apps for Education (GAFE) (now G Suite for Education)	Google Inc.	google.com/intl/en:ca/edu/products/productivity-tools/	Mountain View, CA
	Moodle	Moodle	moodle.org	Perth, Australia
	Office 365 (aka. Office 365 Education, O365)	Microsoft Corporation	microsoft.com/en-ca/education/default.aspx	Redmond, WA
	PowerSchool	PowerSchool Group LLC (owned by Vista Equity Partners)	powerschool.com	Folsom, CA
	Scholantis and/or SharePoint	Scholantis Learning Systems Inc., Microsoft Corporation	scholantis.com/ products.office.com/en-us/sharepoint/	Vancouver, BC Redmond, WA

	Products	Organizations	Websites	Headquarters
	SchoolConnect	International Business Machines Corp. (IBM Canada Ltd.)	ibm.com/smarterplanet/ca/en/education: technology/	Armonk, NY
	WordPress	Automattic, Inc.	wordpress.org	San Francisco, CA
LIBRARY SOFTWARE	Alberta Regional Library Systems	Government of Alberta, Municipal Affairs	municipalaffairs.alberta.ca/library:systems	Edmonton, AB
	Alexandria	COMPanion Corporation LLC	goalexandria.com/using-alexandria/k12-library-software/	Salt Lake City, UT
	Destiny	Follett Corporation	follettlearning.com	Westchester, IL
	Insignia Library System	Insignia Software	insigniasoftware.com/insignia/ILS.aspx	Edmonton, AB
	Koha (Koha Integrated Library Management System)	Horowhenua Library Trust Koha Community	koha-community.org	N/A
	L4U	SRB Education Solutions, a division of StarDyne Technologies, Inc.	srbeducationsolutions.com/Library-Management.php	Kelowna, BC
	Lexwin	LEX Systems Inc.	lex.sk.ca	Lucky Lake, SK
	Librarian Pro	Koingo Software, Inc.	koingosw.com/products/librarianpro/	Kamloops, British Columbia,
	LibraryWorld	LibraryWorld, Inc.	libraryworld.com	San Jose, CA
	LS2	The Library Corporation	tlcdelivers.com	Inwood, WV
	Mandarin	Mandarin Library Automation, Inc.	mlasolutions.com	Boca Raton, FL
	Maplewood Library	Maplewood Computing Ltd.	maplewood.com	London, ON
	OPALS (Open-source Automated Library System)	Media Flex Inc.	mediaflex.net	Champlain, NY
	OverDrive	OverDrive, Inc.	overdrive.com	Cleveland, OH
	Symphony (aka. Symphony Integrated Library System, Horizon Integrated Library System, and/or BLUEcloud Library Services Platform)	SirsiDynix Corporation	sirsidynix.com	Lehi, UT
FINANCIAL SOFTWARE	Altus Dynamics	Altus Dynamics Ltd.	altusdynamics.com	Toronto, ON
	atrieveERP (aka. atrieveFinance)	SRB Education Solutions, a division of StarDyne Technologies, Inc.	srbeducationsolutions.com/People-Services-and-Finance-Financials.php	Kelowna, BC
	Bellamy	Bellamy Software, a division of Sylogist Ltd.	bellamysoftware.com	Edmonton, AB
	Cayenta	Cayenta, a division of N. Harris Computer Corporation	cayenta.com	Burnaby, BC

	Products	Organizations	Websites	Headquarters
	CIMS	Take Two Inc.	taketwoinc.com	La Salle, MB
	Dynamics NAV (formerly Navision)	Microsoft Corporation	microsoft.com/en-ca/dynamics/erp-nav-overview.aspx	Redmond, WA
	MyBudgetFile	MyBudgetFile Inc.	mybudgetfile.com	Stony Plain, AB
	PeopleSoft Financial Management	Oracle Corporation	oracle.com/us/products/applications/peoplesoft-enterprise/financial-management/overview/index.html	Redwood City, CA
	QuickBooks	Intuit, Inc.	quickbooks.intuit.ca	Mountain View, CA
	School Cash Suite	KEV Group	kevgroup.com	Toronto, ON
	SDS	Harris School Solutions	harrisschoolsolutions.com/financial-solutions/sds/	Vancouver, BC
	Simply Accounting (now Sage 50)	The Sage Group plc	sage.com/ca/sage-50-accounting	Newcastle Upon Tyne, United Kingdom
AUTHENTICATION SOFTWARE	Active Directory	Microsoft Corporation	technet.microsoft.com/en-us/library/dd448614.aspx	Redmond, WA
	eDirectory	Novell, a division of Micro Focus International plc	novell.com/support/kb/doc.php?id=3800907	Berkshire, United Kingdom
	ExtremeZ-IP (now Acronis Access Connect)	GroupLogic, Inc., a division of Acronis International GmbH	acronis.com/en-us/mobility/mac-windows-compatibility/	Arlington, VA, Schaffhausen, Switzerland
	LemonLDAP:NG	OW2 Consortium	lemonldap-ng.org	Paris, France
	OpenLDAP	The OpenLDAP Foundation	openldap.org	Minden, NV
	ownCloud	ownCloud, Inc.	owncloud.org	Lexington MA
	Samba	Samba Team	samba.org	N/A
E-MAIL SOFTWARE	DeskNow	Ventia Holdings Pty Ltd	desknow.com	New South Wales, Australia
	Exchange (includes versions: Exchange 2007, Exchange 2010, and Exchange 2013)	Microsoft Corporation	products.office.com/en-ca/exchange/e-mail	Redmond, WA
	FirstClass	Open Text Corporation	firstclass.com	Waterloo, ON,
	Google Apps for Education (GAFE) (now G Suite for Education)	Google Inc.	google.com/intl/en:ca/edu/products/productivity-tools/	Mountain View, CA
	GroupWise	Novell, a division of Micro Focus International plc	novell.com/products/groupwise/	Berkshire, UK
	IceWarp	IceWarp Inc.	icewarp.com	Prague, Czech Republic

	Products	Organizations	Websites	Headquarters
	Office 365 (aka. Office 365 Education)	Microsoft Corporation	microsoft.com/en-ca/education/default.aspx	Redmond, WA
	Zimbra	Synacor, Inc.	zimbra.com	Buffalo, NY
SOCIAL MEDIA	Facebook	Facebook, Inc.	Facebook.com	Menlo Park, CA
	Twitter	Twitter Inc.	Twitter.com	San Francisco, CA

APPENDIX H: INFRASTRUCTURE FINDINGS IN TABLE FORM

Table H1

Student Information System (SIS) Infrastructure Platform and Software

		Number of districts	Public cloud			Private cloud - district					Private cloud - outsourced	Traditional		Community cloud
			Maplewood Student Information System	PowerSchool	SchoolLogic	CIMS	Genius SIS	Maplewood Student Information System	PowerSchool	SchoolLogic	PowerSchool	Turbo-School	Windsor	BCeSIS/MyEducation BC
Combined	**ALL**	75	7%	1%	1%	5%	1%	5%	25%	16%	1%	1%	1%	39%
	XL	8	0%	0%	0%	0%	0%	0%	38%	13%	0%	0%	0%	50%
	L	14	0%	0%	0%	7%	0%	14%	21%	0%	0%	0%	0%	57%
	M	9	0%	0%	0%	0%	11%	0%	33%	0%	0%	0%	0%	67%
	S	44	11%	2%	2%	7%	0%	5%	23%	25%	2%	2%	2%	25%
BC	**BC**	33	0%	0%	0%	12%	0%	0%	0%	0%	0%	3%	3%	88%
	BC-XL	4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	BC-L	9	0%	0%	0%	11%	0%	0%	0%	0%	0%	0%	0%	89%
	BC-M	6	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
	BC-S	14	0%	0%	0%	21%	0%	0%	0%	0%	0%	7%	7%	79%
AB	**AB**	29	10%	0%	3%	0%	3%	0%	62%	24%	3%	0%	0%	0%
	AB-XL	4	0%	0%	0%	0%	0%	0%	75%	25%	0%	0%	0%	0%
	AB-L	2	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%
	AB-M	3	0%	0%	0%	0%	33%	0%	100%	0%	0%	0%	0%	0%
	AB-S	20	15%	0%	5%	0%	0%	0%	50%	30%	5%	0%	0%	0%
SK	**SK**	13	15%	8%	0%	0%	0%	31%	8%	38%	0%	0%	0%	0%
	SK-XL													
	SK-L	3	0%	0%	0%	0%	0%	67%	33%	0%	0%	0%	0%	0%
	SK-M													
	SK-S	10	20%	10%	0%	0%	0%	20%	0%	50%	0%	0%	0%	0%

Table H2

Authentication Infrastructure Platform and Software

		Number of districts	Public cloud			Private cloud - district					Private cloud - outsourced
			Maplewood Student Information System	PowerSchool	SchoolLogic	CIMS	Genius SIS	Maplewood Student Information System	PowerSchool	SchoolLogic	PowerSchool
Combined	**ALL**	75	7%	1%	1%	5%	1%	5%	25%	16%	1%
	XL	8	0%	0%	0%	0%	0%	0%	38%	13%	0%
	L	14	0%	0%	0%	7%	0%	14%	21%	0%	0%
	M	9	0%	0%	0%	0%	11%	0%	33%	0%	0%
	S	44	11%	2%	2%	7%	0%	5%	23%	25%	2%
BC	**BC**	33	0%	0%	0%	12%	0%	0%	0%	0%	0%
	BC-XL	4	0%	0%	0%	0%	0%	0%	0%	0%	0%
	BC-L	9	0%	0%	0%	11%	0%	0%	0%	0%	0%
	BC-M	6	0%	0%	0%	0%	0%	0%	0%	0%	0%
	BC-S	14	0%	0%	0%	21%	0%	0%	0%	0%	0%
AB	**AB**	29	10%	0%	3%	0%	3%	0%	62%	24%	3%
	AB-XL	4	0%	0%	0%	0%	0%	0%	75%	25%	0%
	AB-L	2	0%	0%	0%	0%	0%	0%	100%	0%	0%
	AB-M	3	0%	0%	0%	0%	33%	0%	100%	0%	0%
	AB-S	20	15%	0%	5%	0%	0%	0%	50%	30%	5%
SK	**SK**	13	15%	8%	0%	0%	0%	31%	8%	38%	0%
	SK-XL										
	SK-L	3	0%	0%	0%	0%	0%	67%	33%	0%	0%
	SK-M										
	SK-S	10	20%	10%	0%	0%	0%	20%	0%	50%	0%

Table H3

E-mail Infrastructure Platform and Software

		Number of districts	Public cloud		Private cloud							
			GAFE	**Office 365**	**Desknow**	**Exchange 2007**	**Exchange 2010**	**Exchange 2013**	**Firstclass**	**Groupwise**	**Icewarp**	**Zimbra**
Combined	**ALL**	75	40%	23%	1%	3%	41%	21%	7%	4%	1%	5%
	XL	8	38%	63%	0%	13%	50%	13%	0%	0%	0%	0%
	L	14	14%	43%	0%	0%	43%	29%	14%	7%	0%	7%
	M	9	44%	0%	0%	0%	44%	22%	11%	0%	0%	11%
	S	44	48%	14%	2%	2%	39%	20%	5%	5%	2%	5%
BC	**BC**	33	6%	24%	0%	3%	52%	18%	12%	3%	3%	6%
	BC-XL	4	0%	75%	0%	25%	50%	25%	0%	0%	0%	0%
	BC-L	9	0%	56%	0%	0%	33%	33%	22%	0%	0%	11%
	BC-M	6	17%	0%	0%	0%	50%	17%	17%	0%	0%	17%
	BC-S	14	7%	0%	0%	0%	64%	7%	7%	7%	7%	0%
AB	**AB**	29	90%	10%	0%	3%	31%	10%	3%	7%	0%	3%
	AB-XL	4	75%	50%	0%	0%	50%	0%	0%	0%	0%	0%
	AB-L	2	100%	0%	0%	0%	50%	0%	0%	50%	0%	0%
	AB-M	3	100%	0%	0%	0%	33%	33%	0%	0%	0%	0%
	AB-S	20	90%	5%	0%	5%	25%	10%	5%	5%	0%	5%
SK	**SK**	13	15%	46%	8%	0%	38%	54%	0%	0%	0%	8%
	SK-XL											
	SK-L	3	0%	33%	0%	0%	67%	33%	0%	0%	0%	0%
	SK-M											
	SK-S	10	20%	50%	10%	0%	30%	60%	0%	0%	0%	10%

Table H4

Learning Management System (LMS) Infrastructure Platform and Software

		Number of districts	Public cloud					Private cloud										Outsourced		Traditional
			Blackboard	**Desire2learn**	**Edmodo**	**GAFE**	**Office 365**	**Blackboard**	**CIMS**	**Custom/other/own**	**Desire2learn**	**Firstclass LMS**	**Moodle**	**Powerschool**	**Scholantis and/or Sharepoint**	**Schoolconnect**	**Wordpress**	**Blackboard**	**Moodle**	**Moodle**
Combined	**ALL**	75	1%	3%	1%	15%	1%	8%	1%	3%	3%	1%	64%	3%	9%	1%	3%	1%	13%	4%
	XL	8	0%	0%	0%	13%	13%	13%	0%	13%	25%	0%	13%	0%	25%	13%	0%	0%	38%	25%
	L	14	0%	7%	0%	0%	0%	0%	0%	7%	0%	0%	64%	0%	0%	0%	7%	0%	21%	7%
	M	9	11%	11%	0%	11%	0%	11%	0%	0%	0%	0%	67%	0%	11%	0%	0%	0%	11%	0%
	S	44	0%	0%	2%	20%	0%	9%	2%	0%	0%	2%	73%	5%	9%	0%	2%	2%	7%	0%
BC	**BC**	33	3%	6%	0%	0%	0%	6%	3%	3%	0%	0%	70%	0%	15%	0%	6%	0%	18%	6%
	BC-XL	4	0%	0%	0%	0%	0%	25%	0%	0%	0%	0%	25%	0%	25%	0%	0%	0%	50%	25%
	BC-L	9	0%	11%	0%	0%	0%	0%	0%	11%	0%	0%	67%	0%	0%	0%	11%	0%	22%	11%
	BC-M	6	17%	17%	0%	0%	0%	17%	0%	0%	0%	0%	83%	0%	17%	0%	0%	0%	0%	0%
	BC-S	14	0%	0%	0%	0%	0%	0%	7%	0%	0%	0%	79%	0%	21%	0%	7%	0%	14%	0%
AB	**AB**	29	0%	0%	0%	34%	3%	0%	0%	3%	7%	3%	52%	7%	7%	3%	0%	3%	14%	3%
	AB-XL	4	0%	0%	0%	25%	25%	0%	0%	25%	50%	0%	0%	0%	25%	25%	0%	0%	25%	25%
	AB-L	2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	50%	0%
	AB-M	3	0%	0%	0%	33%	0%	0%	0%	0%	0%	0%	33%	0%	0%	0%	0%	0%	33%	0%
	AB-S	20	0%	0%	0%	40%	0%	0%	0%	0%	0%	5%	65%	10%	5%	0%	0%	5%	5%	0%
SK	**SK**	13	0%	0%	8%	8%	0%	31%	0%	0%	0%	0%	77%	0%	0%	0%	0%	0%	0%	0%
	SK-XL																			
	SK-L	3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%
	SK-M																			
	SK-S	10	0%	0%	10%	10%	0%	40%	0%	0%	0%	0%	80%	0%	0%	0%	0%	0%	0%	0%

Table H5

Library Infrastructure Platform and Software

			Public cloud									Private cloud								Outsourced		Traditional			Community cloud
		Number of districts	**Destiny**	**L4u**	**Libraryworld**	**Ls2**	**Mandarin**	**Maplewood Library**	**Opals**	**Overdrive**	**Symphony**	**Alexandria**	**Destiny**	**Insignia Library System**	**L4u**	**Lexwin**	**Librarian Pro**	**Mandarin**	**Symphony**	**Insignia Library System**	**Koha**	**Alexandria**	**Destiny**	**L4u**	**Alberta Regional Library Systems**
Combined	**ALL**	5%	5%	1%	1%	1%	1%	1%	1%	1%	1%	40%	11%	9%	1%	1%	3%	8%	1%	1%	3%	3%	8%	3%	5%
	XL	13%	0%	0%	0%	0%	0%	0%	0%	13%	0%	50%	0%	13%	0%	0%	0%	38%	0%	0%	0%	13%	13%	0%	13%
	L	7%	0%	0%	7%	0%	0%	0%	0%	0%	0%	57%	7%	7%	0%	7%	0%	14%	0%	7%	0%	0%	0%	0%	7%
	M	0%	11%	0%	0%	0%	0%	0%	0%	0%	0%	44%	0%	11%	0%	0%	0%	11%	0%	0%	11%	11%	11%	11%	0%
	S	5%	7%	2%	0%	2%	2%	2%	2%	0%	2%	32%	16%	9%	2%	0%	5%	0%	2%	0%	2%	0%	9%	2%	5%
BC	**BC**	6%	3%	0%	3%	0%	0%	3%	0%	0%	3%	42%	9%	6%	0%	3%	0%	12%	0%	0%	6%	3%	9%	0%	6%
	BC-XL	25%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	25%	0%	0%	0%	0%	0%	0%	25%
	BC-L	11%	0%	0%	11%	0%	0%	0%	0%	0%	0%	56%	11%	0%	0%	11%	0%	22%	0%	0%	0%	0%	0%	0%	11%
	BC-M	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	33%	0%	17%	0%	0%	0%	17%	0%	0%	17%	17%	17%	0%	0%
	BC-S	0%	7%	0%	0%	0%	0%	7%	0%	0%	7%	36%	14%	7%	0%	0%	0%	0%	0%	0%	7%	0%	14%	0%	0%
AB	**AB**	0%	7%	0%	0%	0%	3%	0%	3%	3%	0%	45%	17%	7%	3%	0%	3%	7%	3%	3%	0%	3%	7%	7%	0%
	AB-XL	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	50%	0%	25%	0%	0%	0%	50%	0%	0%	0%	25%	25%	0%	0%
	AB-L	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%
	AB-M	0%	33%	0%	0%	0%	0%	0%	0%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	33%	0%
	AB-S	0%	5%	0%	0%	0%	5%	0%	5%	0%	0%	40%	25%	5%	5%	0%	5%	0%	5%	0%	0%	0%	5%	5%	0%
SK	**SK**	15%	8%	8%	0%	8%	0%	0%	0%	0%	0%	23%	0%	23%	0%	0%	8%	0%	0%	0%	0%	0%	8%	0%	15%
	SK-XL																								
	SK-L	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	67%	0%	33%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SK-M																								
	SK-S	20%	10%	10%	0%	10%	0%	0%	0%	0%	0%	10%	0%	20%	0%	0%	10%	0%	0%	0%	0%	0%	10%	0%	20%

Table H6

Financial Infrastructure Platform and Software

		Number of districts	Public cloud				Private cloud									Outsourced	Traditional	
			Atrieveerp	Bellamy	MyBudgetFile	School Cash Suite	Altus Dynamics	AtrieveERP	Bellamy	Cayenta	Cims	Dynamics NAV	Peoplesoft Financial Management	School Cash Suite	SDS	SDS	Quickbooks	Simply Accounting
Combined	**ALL**	75	12%	3%	1%	5%	1%	47%	4%	3%	3%	9%	7%	1%	13%	1%	3%	3%
	XL	8	0%	0%	0%	13%	0%	38%	0%	13%	0%	0%	50%	0%	0%	0%	0%	0%
	L	14	0%	0%	0%	14%	0%	57%	14%	7%	7%	14%	7%	0%	0%	0%	0%	7%
	M	9	0%	0%	11%	0%	0%	67%	11%	0%	0%	0%	0%	0%	22%	0%	0%	0%
	S	44	20%	5%	0%	2%	2%	41%	0%	0%	2%	11%	0%	2%	18%	2%	5%	2%
BC	**BC**	33	3%	0%	0%	9%	0%	52%	6%	0%	6%	3%	3%	0%	30%	0%	3%	3%
	BC-XL	4	0%	0%	0%	25%	0%	75%	0%	0%	0%	0%	25%	0%	0%	0%	0%	0%
	BC-L	9	0%	0%	0%	22%	0%	67%	22%	0%	11%	11%	0%	0%	0%	0%	0%	11%
	BC-M	6	0%	0%	0%	0%	0%	67%	0%	0%	0%	0%	0%	0%	33%	0%	0%	0%
	BC-S	14	7%	0%	0%	0%	0%	29%	0%	0%	7%	0%	0%	0%	57%	0%	7%	0%
AB	**AB**	29	21%	3%	3%	3%	3%	52%	3%	7%	0%	0%	10%	3%	0%	3%	0%	0%
	AB-XL	4	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%	75%	0%	0%	0%	0%	0%
	AB-L	2	0%	0%	0%	0%	0%	50%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%
	AB-M	3	0%	0%	33%	0%	0%	67%	33%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	AB-S	20	30%	5%	0%	5%	5%	60%	0%	0%	0%	0%	0%	5%	0%	5%	0%	0%
SK	**SK**	13	15%	8%	0%	0%	0%	23%	0%	0%	0%	46%	8%	0%	0%	0%	8%	8%
	SK-XL																	
	SK-L	3	0%	0%	0%	0%	0%	33%	0%	0%	0%	33%	33%	0%	0%	0%	0%	0%
	SK-M																	
	SK-S	10	20%	10%	0%	0%	0%	20%	0%	0%	0%	50%	0%	0%	0%	0%	10%	10%

Table H7

Website Infrastructure

		Number of districts	Private cloud: District	Private cloud: Outsourced	Private cloud: School level
Combined	**ALL**	75	75%	31%	3%
	XL	8	100%	13%	0%
	L	14	93%	7%	0%
	M	9	56%	44%	11%
	S	44	68%	39%	2%
BC	**BC**	33	88%	18%	3%
	BC-XL	4	100%	25%	0%
	BC-L	9	100%	0%	0%
	BC-M	6	83%	17%	17%
	BC-S	14	79%	29%	0%
AB	**AB**	29	48%	59%	3%
	AB-XL	4	100%	0%	0%
	AB-L	2	50%	50%	0%
	AB-M	3	0%	100%	0%
	AB-S	20	45%	65%	5%
SK	**SK**	13	100%	0%	0%
	SK-XL				
	SK-L	3	100%	0%	0%
	SK-M				
	SK-S	10	100%	0%	0%

Table H8

Social Media Policy

		Number of Districts	FACEBOOK			TWITTER		
			Facebook Use	Facebook Do Not Use	Facebook Block	Twitter Use	Twitter Do Not Use	Twitter Block
Combined	ALL	75	73%	12%	15%	84%	11%	5%
	XL	8	75%	13%	13%	88%	13%	0%
	L	14	71%	21%	7%	79%	14%	7%
	M	9	78%	11%	11%	89%	11%	0%
	S	44	73%	9%	18%	84%	9%	7%
BC	BC	33	70%	18%	12%	73%	21%	6%
	BC-XL	4	75%	25%	0%	75%	25%	0%
	BC-L	9	78%	22%	0%	78%	22%	0%
	BC-M	6	67%	17%	17%	83%	17%	0%
	BC-S	14	64%	14%	21%	64%	21%	14%
AB	AB	29	83%	7%	10%	97%	0%	3%
	AB-XL	4	75%	0%	25%	100%	0%	0%
	AB-L	2	50%	50%	0%	100%	0%	0%
	AB-M	3	100%	0%	0%	100%	0%	0%
	AB-S	20	85%	5%	10%	95%	0%	5%
SK	SK	13	62%	8%	31%	85%	8%	8%
	SK-XL							
	SK-L	3	67%	0%	33%	67%	0%	33%
	SK-M							
	SK-S	10	60%	10%	30%	90%	10%	0%

APPENDIX I: SUMMARY AND RANK OF INFRASTRUCTURE FINDINGS

Table I1

Findings Summary by Size

			ALL		XL		L		M		S	
		Rank	**Name**	**Percent**	**Name**	**Percent**	**Name**	**Percent**	**Name**	**Percent**	**Name**	**Percent**
SIS	**Platform**	**1**	Private Cloud - District	51%	Private Cloud - District & Community Cloud (tie)	50%	Community Cloud	57%	Community Cloud	67%	Private Cloud District	57%
		2	Community Cloud	39%			Private Cloud - District	43%	Private Cloud - District	33%	Community Cloud	25%
		3	Public Cloud	9%							Public Cloud	16%
		4	Outsourced & Traditional (tie)	1%							Outsourced & Traditional (tie)	2%
	Software	**1**	BCeSIS or MyEducation B C	39%	BCeSIS or MyEducation B C	50%	BCeSIS or MyEducation B C	57%	BCeSIS or MyEducation B C	67%	PowerSchool & SchoolLogic (tie)	27%
		2	Powerschool	28%	PowerSchool	38%	PowerSchool	21%	PowerSchool	33%	BCeSIS or MyEducation B C	25%
		3	SchoolLogic	17%	SchoolLogic	13%	Mapleood	14%	Other (Four)	11%	Maplewood	16%
		4	MapleWood	12%			Other (Four)	7%			Other (Four)	11%
LMS	**Platform**	**1**	Private Cloud - District	83%	Private Cloud - District	88%	Private Cloud - District	71%	Private Cloud - District	67%	Private Cloud - District	89%
		2	Public Cloud	21%	Private Cloud - Outsourced	38%	Private Cloud - Outsourced	21%	Public Cloud	33%	Public Cloud	23%
		3	Private Cloud - Outsourced	13%	Public Cloud & Traditional (tie)	25%	Public Cloud & Traditional (tie)	7%	Private Cloud - Outsourced	11%	Private Cloud - Outsourced	7%
		4	traditionaal	4%								
	Software	**1**	Moodle	81%	Moodle	75%	Moodle	93%	Moodle	78%	Moodle	80%
		2	Other	20%	Other	63%	Other	21%	Blackboard	22%	GAFE	20%
		3	GAFE	15%	Sharepoint	25%			GAFE, Sharepoint, Other (tie)	11%	Other	14%
		4	Blackboard	11%	GAFE & Blackboard (tie)	13%					Blackboard	11%
Library	**Platform**	**1**	Private Cloud - District	68%	Private Cloud - District	88%	Private Cloud - District	71%	Private Cloud - District	67%	Private Cloud - District	64%
		2	Public Cloud	20%	Public Cloud & Traditional (tie)	25%	Public Cloud	14%	Traditional	22%	Public Cloud	23%
		3	Traditional	11%	Traditional	13%	Private Cloud - Outsourced	7%	Public Cloud & Community Cloud (tie)	11%	Traditional	11%

			ALL		XL		L		M		S	
		Rank	**Name**	**Percent**	**Name**	**Percent**	**Name**	**Percent**	**Name**	**Percent**	**Name**	**Percent**
		4	Private Cloud - Outsourced & Community Cloud (tie)	3%							Private Cloud - Outsourced, Community Cloud (tie)	2%
	Software	**1**	Destiny	48%	Destiny	75%	Destiny	64%	Destiny	56%	Destiny	36%
		2	L4U	23%	Symphony	50%	Other	21%	L4U	33%	L4U & Other (tie)	25%
		3	Other	21%	L4U	25%	Insignia, L4U, Symphony (tie)	7%	Other (Four)	22%	Insignia	18%
		4	Insignia	12%					Symphony	11%		
Authentication	**Platform**	**1**	Private Cloud - District	95%	Private Cloud - District	100%	Private Cloud - District	100%	Private Cloud - District	100%	Private Cloud - District	91%
		2	Traditional	9%					Traditional	11%	Traditional	14%
		3										
		4										
	Software	**1**	Active Directory	95%	Active Directory	100%	Active Directory	86%	Active Directory	89%	Active Directory	98%
		2	OpenLDAP and other	5%	Other	13%	eDirectory&OpenLDAP	7%	Other (Four)	22%	eDirectory, GAFE,OpenLDAP	5%
		3	eDirectory	4%					OpenLDAP	11%	Other	2%
		4	GAFE portal	3%								
E-mail	**Platform**	**1**	Private Cloud - District	81%	Public Cloud	88%	Private Cloud - District	100%	Private Cloud - District	89%	Private Cloud - District	75%
		2	Public Cloud	61%	Private Cloud - District	75%	Public Cloud	57%	Public Cloud	44%	Public Cloud	61%
		3										
		4										
	Software	**1**	Exchange	65%	Exchange	75%	Exchange	71%	Exchange	67%	Exchange	61%
		2	GAFE	40%	Office365	63%	Office365	43%	GAFE	44%	GAFE	48%
		3	Office365	23%	GAFE	38%	Other, GAFE, FirstClass (tie)	14%	FirstClass and Other (tie)	11%	Office365 and Other (tie)	14%
		4	Other	12%							FirstClass	5%
Financial	**Platform**	**1**	Private Cloud - District	85%	Private Cloud - District	100%	Private Cloud - District	100%	Private Cloud - District	100%	Private Cloud - District	75%
		2	Public Cloud	21%	Public Cloud	13%	Public Cloud	14%	Public Cloud	11%	Public Cloud	27%
		3	Traditional	5%			Traditional	7%			Traditional	7%
		4	Private Cloud - Outsourced	1%							Private Cloud - Outsourced	2%
	Software	**1**	atrieveERP	59%	Peoplesoft	50%	atrieveERP	57%	atrieveERP	67%	atrieveERP	61%
		2	SDS	15%	atrieveERP	38%	Other	21%	SDS	22%	SDS	20%
		3	Other	13%	SchoolCAshSuite and Other (tie)	13%	Bellamy, Dynamics, PeopleSoft (tie)	14%	Bellamy & Other (tie)	11%	Dynamics & Other (tie)	11%
		4	Dynamics	9%			PeopleSoft	7%			Bellamy & School Cash Suite (tie)	5%

			ALL		XL		L		M		S	
		Rank	**Name**	**Percent**	**Name**	**Percent**	**Name**	**Percent**	**Name**	**Percent**	**Name**	**Percent**
Website	**Platform**	**1**	Private Cloud - District	75%	Private Cloud - District	100%	Private Cloud - District	93%	Private Cloud - District	56%	Private Cloud - District	68%
		2	Private Cloud - Outsourced	31%	Public Cloud and Private Cloud - Outsourced (tie)	13%	Public Cloud and Private Cloud - Outsourced (tie)	7%	Private Cloud - Outsourced	44%	Private Cloud - Outsourced	39%
		3	Public Cloud	7%					school level	11%	Public Cloud	7%
		4	School Level	3%							School Level	2%

Table I2

Findings Summary, by Province

			BC		AB		SK	
		Rank	**Name**	**Percent**	**Name**	**Percent**	**Name**	**Percent**
SIS	**Platform**	**1**	Community Cloud	88%	District	83%	Private Cloud	77%
		2	Private Cloud - District	12%	Public	14%	Public Cloud	23%
		3	Traditional	3%	Private Cloud - Outsourced	3%		
		4						
	Software	**1**	BCeSIS or MyEducation BC	88%	Powerschool	66%	Maplewood	46%
		2	Other (Four)	18%	SchoolLogic	28%	SchoolLogic	38%
		3			MapleWood	10%	PowerSchool	15%
		4			Other (Four)	3%		
LMS	**Platform**	**1**	Private Cloud - District	85%	Private Cloud - District	76%	Private Cloud - District	92%
		2	Private Cloud - Outsourced	18%	Public Cloud	38%	Public Cloud	15%
		3	Public Cloud	9%	Private Cloud - Outsourced	14%		
		4	Traditional	6%	Traditional	3%		
	Software	**1**	Moodle	94%	Moodle	69%	Moodle	77%
		2	Other (Four)	18%	GAFE	34%	Blackboard	31%
		3	Sharepoint	15%	Other (Four)	28%	GAFE,Other (tie)	8%
		4	Blackboard	9%	Sharepoint	7%		
Library	**Platform**	**1**	Private Cloud - District	67%	Private Cloud - District	76%	Private Cloud - District	54%
		2	Public Cloud & Traditional (tie)	15%	Public Cloud	17%	Public Cloud	38%
		3			Private Cloud - Outsourced, Traditional, community (tie)	7%	Traditional	8%
		4						
	Software	**1**	Destiny	52%	Destiny	48%	Destiny & L4U (tie)	38%
		2	L4U & Other (tie)	18%	Other	24%	Other	23%
		3	Insignia & Symphony	9%	Insignia & L4U (tie)	21%		
		4			Symphony	10%		
Authentication	**Platform**	**1**	Private Cloud - District	100%	Private Cloud - District	90%	Private Cloud - District	92%
		2	Traditional	9%	Traditional	10%	Traditional	8%
		3						
		4						
	Software	**1**	Active Directory	97%	Active Directory	90%	Active Directory	100%
		2	Other (Four)	12%	eDirectory & GAFE (tie)	7%	OpenLDAP	8%
		3	OpenLDAP	9%				
		4	eDirectory	3%				

			BC		AB		SK	
			Name	**Percent**	**Name**	**Percent**	**Name**	**Percent**
E-mail	**Platform**	**1**	Private Cloud - District/	97%	Public Cloud	97%	Private Cloud - District	100%
		2	Public Cloud	30%	Private Cloud - District	55%	Public Cloud	62%
		3						
		4						
	Software	**1**	Exchange	73%	GAFE	90%	Exchange	92%
		2	Office365	24%	Exchange	45%	Office365	46%
		3	FirstClass and Other (tie)	12%	Office365 and Other (tie)	10%	GAFE and Other (tie)	15%
		4	GAFE	6%	FirstClass	3%		
Financial	**Platform**	**1**	Private Cloud - District	97%	Private Cloud - District	76%	Private Cloud - District	77%
		2	Public Cloud	12%	Public Cloud	31%	Public Cloud	23%
		3	Traditional	6%	Private Cloud - Outsourced	3%	Traditional	15%
		4						
	Software	**1**	atrieveERP	55%	atrieveERP	72%	Dynamics	46%
		2	SDS	30%	Other	14%	atrieveERP	38%
		3	Other	12%	PeopleSoft	10%	Other	15%
		4	SchoolCashSuite	9%	Bellamy and SchoolCAshsuite (tie)	7%	Bellamy and PeopleSoft (tie)	8%
Website	**Platform**	**1**	Private Cloud - District	88%	Private Cloud - Outsourced	59%	Private Cloud - District	100%
		2	Private Cloud - Outsourced	18%	Private Cloud - District	48%		
		3	Public Cloud	6%	Public Cloud	10%		
		4	School Level	3%	School Level	3%		

APPENDIX J: SUMMARY AND RANK OF INFLUENCES/PRIORITIES

Table J1

Summary of Influences/Priorities Findings by Size Category

			ALL		XL		L		M		S	
		Rank	**Name**	**Value**	**Name**	**Value**	**Name**	**Value**	**Name**	**Value**	**Name**	**Value**
Priorities	**Strength**	**1**	Perceived Innovation Characteristics	4.10	Perceived Innovation Characteristics	3.75	Perceived Innovation Characteristics	4.14	Perceived Innovation Characteristics	4.22	Perceived Innovation Characteristics	4.12
		2	Adopter Characteristics	3.87	Environmental Influences	3.69	Adopter Characteristics	3.79	Adopter Characteristics	3.78	Adopter Characteristics	3.98
		3	Environmental Influences	3.68	Adopter Characteristics	3.50	Environmental Influences & Social Network	3.50	Environmental Influences	3.56	Environmental Influences	3.77
		4	Social Network	3.51	Social Network	3.31			Social Network	3.33	Social Network	3.58
		5	Supplier Marketing Efforts	2.45	Supplier Marketing Efforts	2.44	Supplier Marketing Efforts	2.93	Supplier Marketing Efforts	1.78	Supplier Marketing Efforts	2.44
	Rank	**1**	Perceived Innovation Characteristics	2.26	Perceived Innovation Characteristics	2.25	Adopter Characteristics	2.14	Perceived Innovation Characteristics	1.67	Adopter Characteristics	2.27
		2	Adopter Characteristics	2.32	Environmental Influences	2.44	Perceived Innovation Characteristics	2.43	Adopter Characteristics	2.22	Perceived Innovation Characteristics	2.34
		3	Environmental Influences	2.83	Social Network & Adopter Characteristics	3.00	Environmental Influences & Social Network	2.93	Environmental Influences	3.00	Environmental Influences	2.84
		4	Social Network	3.14			Social Network	3.36	Social Network	3.22	Social Network	3.08
		5	Supplier Marketing Efforts	4.45	Supplier Marketing Efforts	4.31	Supplier Marketing Efforts	4.14	Supplier Marketing Efforts	4.89	Supplier Marketing Efforts	4.48

Table J2

Summary of Influences/Priorities Findings by Province

			ALL		BC		AB		SK		BC	
		Rank	**Name**	**Value**	**Name**	**Value**	**Name**	**Value**	**Name**	**Value**	**Name**	**Value**
Priorities	**Strength**	**1**	Perceived Innovation Characteristics	4.10	Perceived Innovation Characteristics	4.15	Adopter Characteristics	4.18	Adopter Characteristics	4.08	Perceived Innovation Characteristics	4.15
		2	Adopter Characteristics	3.87	Environmental Influences	3.73	Perceived Innovation Characteristics	4.11	Perceived Innovation Characteristics & Environmental Influences	3.92	Environmental Influences	3.73
		3	Environmental Influences	3.68	Adopter Characteristics	3.52	Social Network	3.61			Adopter Characteristics	3.52
		4	Social Network	3.51	Social Network	3.44	Environmental Influences	3.52	Social Network	3.46	Social Network	3.44
		5	Supplier Marketing Efforts	2.45	Supplier Marketing Efforts	2.42	Supplier Marketing Efforts	2.40	Supplier Marketing Efforts	2.62	Supplier Marketing Efforts	2.42
	Rank	**1**	Perceived Innovation Characteristics	2.26	Perceived Innovation Characteristics	1.97	Adopter Characteristics	S	Adopter Characteristics	1.62	Perceived Innovation Characteristics	1.97
		2	Adopter Characteristics	2.32	Environmental Influences	2.58	Perceived Innovation Characteristics	2.30	Environmental Influences	2.85	Environmental Influences	2.58
		3	Environmental Influences	2.83	Adopter Characteristics	2.73	Social Network	2.99	Perceived Innovation Characteristics & Environmental Influences	2.92	Adopter Characteristics	2.73
		4	Social Network	3.14	Social Network	3.17	Environmental Influences	3.12	Social Network	3.38	Social Network	3.17
		5	Supplier Marketing Efforts	4.45	Supplier Marketing Efforts	4.56	Supplier Marketing Efforts	4.42	Supplier Marketing Efforts	4.23	Supplier Marketing Efforts	4.56

APPENDIX K: LEADERSHIP RELATIONSHIPS

Leadership Relationships: Hierarchy Level Relationships

	Relationship Item								
Leadership-Level2 (28)	Financial-District-DynamicsNAV (7)					All (-0.24)	S (-0.34)		
	Leadership-Branch-Financial (26)						S (-0.35)	BC (-0.52)	
	Leadership-Branch-Technology (10)		BC (0.55)	All (0.34), S (0.45)					
	SIS-Combined-PowerSchool (21)	SK (0.77), L (0.78)							
	SIS-District-PowerSchool (19)	L (0.78)							
	Website-District (56)						BC (-0.49), S (-0.32), All (-0.31)		
	Website-Outsourced (23)		BC (0.62)	S (0.36)					
Leadership-Level3 (44)	Authentication-Combined-ActiveDirectory (69)					All (-0.24)			
	Authentication-District-ownCloud (1)							All (-0.65)	
	E-mail-District (61)				All (0.22)				
	E-mail-District-Exchange2013(16)	All (0.70)							
	Financial-Combined-atrieveERP (43)		L (0.60)						
	Financial-District-atrieveERP (35)		L (0.60)						
	Financial-District-DynamicsNAV (7)			S (0.35)	All (0.26)				
	Leadership-Branch-Financial (26)		BC (0.56)		S (0.29)				
	Leadership-Branch-Technology (10)						S (-0.43), All (-0.30)	BC (-0.52)	
	SIS-Combined-PowerSchool (21)					All (-0.26)	S (-0.30)		SK (-0.77)
	SIS-CommunityCloud (29)		L (0.60)						
	SIS-CommunityCloud-BCeSISMyEducationBC (29)		L (0.60)						
	SIS-District- (38)							L (-0.60)	
	Website-District (56)			BC (0.46)	All (0.25), S (0.29)				
	Website-Outsourced (23)						S (-0.32), All (-0.32)	BC (-0.58)	
Leadership-Level4 (3)	Leadership-Branch-ServicesInfrastructureFacilities (6)	BC (1)		All (0.44)					
	LMS-District-customotherown (2)	BC (1)							
	LMS-District-Moodle (47)					All (-0.26)			
	LMS-District-SchoolConnect (1)		All (0.56)						
	LMS-PublicCloud-Office365 (1)		All (0.56)						

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure K1. Leadership relationships: Hierarchy level relationships.

Leadership Relationships–Financial Branch Relationships 1

	Relationship Item								
Leadership-Branch-Financial (26)	Authentication-District (71)							AB (-0.66)	AB-S (-0.72)
	Authentication-District-ActiveDirectory (66)						S (-0.37)	AB (-0.53)	AB-S (-0.72)
	Authentication-Traditional (7)	AB-S (0.72)	AB (0.66)						
	Authentication-Traditional-ActiveDirectory (6)		AB (0.53), AB-S (0.57)						
	Authentication-Traditional-GAFEportal (2)		AB (0.53), AB-S (0.57)						
	Demographics-Province:Alberta (29)					AB (-0.23)			
	Financial-Combined-atrieveERP (43)			BC (0.41)					
	Leadership-Level2 (28)						S (-0.35)	BC (-0.52)	
	Leadership-Level3 (44)		BC (0.56)		S (0.29)				
	LMS-Combined-Moodle (54)						AB (-0.47)	AB-S (-0.54)	
	LMS-District (62)					All (-0.25)	S (-0.37)	AB-S (-0.57)	
	SIS-Combined-PowerSchool (21)					All (-0.26)			
	SIS-District-PowerSchool (19)					All (-0.23)			
	Social-Facebook-Block (11)	SK (0.72), SK-S (0.80)							
	Website-District (56)				All (0.23)				
	Website-Outsourced (23)					All (-0.24)	BC (-0.40)		

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure K2. Leadership relationships: Financial branch relationships 1.

Leadership Relationships: Financial Branch Relationships 2

	Relationship Item								
Leadership-Level2-Branch-	Authentication-District (71)						All (-0.36)	AB (-0.62), S (-0.54)	AB-S (-0.79)
	Authentication-District-ActiveDirectory (66)						S (-0.47)	AB (-0.52)	AB-S (-0.79)
	Authentication-Traditional (7)	AB-S (0.79)	AB (0.62)	S (0.41)					
	Authentication-Traditional-ActiveDirectory (6)	AB (0.80), AB-S (1)		S (0.47)					
	Financial-District-PeopleSoft FinancialManagement (5)			All (0.31)					
	LMS-Combined-Moodle (54)						AB (-0.43)		
	LMS-District (62)						S (-0.47)	AB-S (-0.66)	
	Website-PublicCloud (5)		AB (0.62)	All (0.31)					
Leadership-Level3-Branch-Financial (19)	Authentication-Combined-ActiveDirectory (69)					All (-0.28)	S (-0.40)		
	Demographics-Province:Alberta (29)						AB (-0.33)		
	Demographics-Province:British (33)				BC (0.28)				
	E-mail-PublicCloud-GAFE (30)					All (-0.28)			
	Financial-Combined-atrieveERP (43)		L (0.64)	BC (0.36)					
	Financial-District-atrieveERP (35)		L (0.64)						
	SIS-Combined-PowerSchool (21)						All (-0.36), S (-0.33)		
	SIS-CommunityCloud (29)				All (0.22)				
	SIS-CommunityCloud-BCeSISMyEducationBC (29)				All (0.22)				
	SIS-District-Maplewood StudentInformationSystem (4)		SK (0.63)	S (0.40)	All (0.27)				
	SIS-District-PowerSchool (19)						All (-0.33)		
	Social-Facebook-Block (11)		SK (0.63)						
	Social-Twitter-DoNotUse (8)			S (0.39)					
	Social-Twitter-Use (63)						S (-0.35)		
	Website-Outsourced (23)					All (-0.25)			
Leadership-Level4-	LMS-District-PowerSchool (3)		All (0.56)						

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure K3. Leadership relationships: Financial branch relationships 2

Leadership Relationships: Instructional Branch Relationships

	Relationship Item								
Leadership-Branch-Instructional (32)	Financial-District (64)								SK (-0.82), SK-S (-0.80)
	Financial-PublicCloud (16)	SK-S (0.80), SK (0.82)							
	LMS-PublicCloud (16)						AB (-0.38)		
	SIS-District- (38)								SK (-0.82), SK-S (-0.80)
	SIS-PublicCloud (7)	SK (0.82), SK-S (0.80)							
	Social-Facebook-Use (55)						AB (-0.44)		XL (-1)
	Website-PrivateCloud-District (56)						BC (-0.46)		BC-S (-0.70)
Leadership-Level2-Branch-	SIS-Combined-SchoolLogic (13)						S (-0.33)		
	SIS-District-SchoolLogic (12)						S (-0.31)		
	Social-Facebook-DoNotUse (9)		AB (0.53)						
	Social-Facebook-Use (55)							AB (-0.66)	
	Website-Outsourced (23)		BC (0.59)						
	Website-PrivateCloud-District (56)						All (-0.30)		BC (-0.78), BC-S (-0.70)
Leadership-Level3-	Financial-Combined-atrieveERP (43)			AB (0.45)					
	SIS-Combined-Maplewood (9)			S (0.39)					
	SIS-PublicCloud (7)			S (0.39)					
	SIS-PublicCloud-MaplewoodStudent InformationSystem (5)	SK (0.77)	All (0.61), S (0.52)	All (0.33)					

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure K4. Leadership relationships: Instructional branch relationships.

Leadership Relationships: Other Branch Relationships

	Relationship Item								
Leadership-Branch-OtherHR (1)	Library-District-Lexwin (1)	AB-S (1), AB (1), All (1), S (1)							
	LMS-Combined-Blackboard (7)	AB-S (1), AB (1)							
	LMS-District-PowerSchool (3)		All (0.56)						
	LMS-Outsourced (10)	AB-S (1)							
	LMS-Outsourced-Blackboard (1)	AB-S (1), AB (1), All (1), S (1)							
	LMS-Outsourced-Moodle (10)	AB-S (1)							
Leadership-Level2-Branch-OtherHR (1)	Library-District-Lexwin (1)	AB-S (1), AB (1), All (1), S (1)							
	LMS-Combined-Blackboard (7)	AB-S (1), AB (1)							
	LMS-District-PowerSchool (3)		All (0.56)						
	LMS-Outsourced	AB-S (1)							
	LMS-Outsourced-Blackboard (1)	AB-S (1), AB (1), All (1), S (1)							
	LMS-Outsourced-Moodle (10)	AB-S (1)							

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.
	+.50 to +.69	Substantial positive relationship.
	+.30 to +.49	Moderate positive relationship.
	+.10 to +.29	Low positive relationship.

	-.10 to -.29	Low negative relationship.
	-.30 to -.49	Moderate negative relationship.
	-.50 to -.69	Substantial negative relationship.
	-.70 or lower	Very strong negative relationship.

Figure K5. Leadership relationships: Other branch relationships.

Leadership Relationships: Services Branch Relationships

	Relationship Item								
Leadership-Branch-ServicesInfrastructureFacilities (6)	E-mail-Combined- MicrosoftExchangeO365 (50)	All (0.78)							
	Financial-District-DynamicsNAV (7)			S (0.47)					
	Leadership-Level4 (3)	BC (1)		All (0.44)					
	LMS-District-customotherown (2)	BC (1)	All (0.56)						
	LMS-PublicCloud (16)	XL (1)		AB (0.43)					
	SIS-Combined-SchoolLogic (13)			S (0.44)					
	SIS-District- (38)				All (0.29)				
	SIS-District-SchoolLogic (12)			S (0.46)	All (0.27)				
Leadership-Level3-Branch-ServicesInfrastructureFac	Financial-District-DynamicsNAV (7)			All (0.33), S (0.47)					
	Library-PublicCloud (16)			All (0.32)					
	Library-PublicCloud-Mandarin (1)			All (0.48)					
	Library-PublicCloud-Symphony (1)			All (0.48)					
	SIS-Combined-SchoolLogic (13)			All (0.36), S (0.44)					
	SIS-District-SchoolLogic (12)			All (0.38), S (0.46)					
Leadership-Level4-Branch-ServicesInfrastructureFacilities (2)	Financial-District-Cayenta (2)			All (0.48)					
	Financial-District-CIMS (2)			All (0.48)					
	Library-Traditional-Destiny (2)	AB (1)		All (0.48)					
	LMS-District-customotherown (2)	BC (1)		All (0.48)					
	LMS-District-SchoolConnect (1)	All (0.70), AB (1)							
	LMS-District-WordPress (2)			All (0.48)					
	LMS-PublicCloud-Office365 (1)	All (0.70), AB (1)							
	LMS-Traditional (3)	AB (1)							
	LMS-Traditional-Moodle (3)	AB (1)							

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure K6. Leadership relationships: Services branch relationships

Leadership Relationships: Technology Branch Relationships

	Relationship Item								
Leadership-Branch-Technology (10)	Leadership-Level2 (28)		BC (0.55)	All (0.34), S (0.45)					
	Leadership-Level3 (44)						S (-0.43), All (-0.30)	BC (-0.52)	
	Library-District-InsigniaLibrarySystem (7)			S (0.37)	All (0.27)				
Leadership-Level2-Branch-Technology (8)	Library-Combined-Insignia (8)			All (0.30)					
	Library-District-InsigniaLibrarySystem (7)		AB (0.52)	All (0.33), S (0.37)					
	Website-Outsourced (23)				All (0.23)				
Leadership-Level3-Branch-Technology (2)	Financial-District-Bellamy (3)	AB (1)							

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		-.10 to -.29	Low negative relationship.
	+.50 to +.69	Substantial positive relationship.		-.30 to -.49	Moderate negative relationship.
	+.30 to +.49	Moderate positive relationship.		-.50 to -.69	Substantial negative relationship.
	+.10 to +.29	Low positive relationship.		-.70 or lower	Very strong negative relationship.

Figure K7. Leadership relationships: Technology branch relationships.

APPENDIX L: PLATFORM TO SOFTWARE RELATIONSHIPS

Infrastructure Relationships: SIS

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
STUDENT INFORMATION SYSTEM					
SIS-Community Cloud (29)	Financial-Combined-atrieveERP (43)			BC (0.40)	
	Financial-Combined-SDS (11)			S (0.48)	All (0.28)
	Financial-District-atrieveERP (35)			BC (0.38)	
	Financial-District-SDS (10)		S (0.54)	All (0.33)	
	SIS-CommunityCloud-BCeSISMyEducationBC	BC-S (1), BC (1), All (1), M (1), L (1), XL (1), S (1)			
SIS-District-(38)	E-mail-PublicCloud-GAFE (30)	M (0.79)	AB-S (0.57)	All (0.47), S (0.37)	
	Financial-District-CIMS (2)		BC (0.68)		
	LMS-PublicCloud-GAFE (11)				All (0.25)
	SIS-Combined-PowerSchool (21)	M (1)	L (0.60)	All (0.49), AB (0.43), S (0.32)	
	SIS-Combined-SchoolLogic (13)			S (0.43), All (0.38)	
	SIS-District-CIMS (4)	BC-S (1), BC (1)			
	SIS-District-PowerSchool (19)	M (1)	L (0.60), AB (0.58), AB-S (0.57), All (0.57)	S (0.47)	
	SIS-District-SchoolLogic (12)		S (0.50)	All (0.43)	
SIS-Outsourced (1)	E-mail-Combined-NonGoogleNonMicrosoft (12)	AB-S (1)			
	E-mail-District-FirstClass (5)	AB (1), AB-S (1)	S (0.69)		
	E-mail-District-Zimbra (4)	AB (1), AB-S (1)	S (0.69)	All (0.48)	
	Financial-Combined-SchoolCashSuite (5)		S (0.69)		
	Financial-PublicCloud-SchoolCashSuite (4)	AB (1), S (1), AB-S (1)		All (0.48)	
	Library-District-L4U (7)	AB-S (1)			
	SISOutsourced-PowerSchool (1)	AB (1), All (1), S (1), AB-S (1)			
SIS-PublicCloud (7)	Financial-PublicCloud-atrieveERP (9)	SK (0.77)		All (0.44), S (0.39)	
	Library-Combined-Destiny (37)	SK-S (1)	SK (0.69)		
	Library-PublicCloud-Destiny (4)	SK (0.77)	S (0.50)	All (0.33)	
	SIS-Combined-Maplewood (9)	AB (0.84), AB-S (0.84)	S (0.66), All (0.58)		
	SIS-PublicCloud-Maplewood StudentInformationSystem (5)	AB (0.84), AB-S (0.84), All (0.83), S (0.82), SK (0.77)			
SIS-Traditional (1)	Authentication-District-eDirectory (2)	BC (1), S (1), All (0.70)			
	E-mail-District-GroupWise (2)	BC (1), S (1), All (0.70)			
	SIS-Traditional-TurboSchool (1)	BC (1), All (1), S (1)			
	SIS-Traditional-Windsor (1)	BC (1), All (1), S (1)			

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

Figure L1. SIS platform to software relationships.

Infrastructure Relationships: LMS

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
LEARNING MANAGEMENT SYSTEM (LMS)					
LMS-District (62)	Authentication-Combined-ActiveDirectory (69)		S (0.60)		
	Authentication-District-ActiveDirectory (66)	AB-S (0.84), S (0.77)		AB (0.47)	All (0.26)
	E-mail-Combined-ExchangeAll (49)			S (0.45)	
	E-mail-Combined-MicrosoftExchangeO365 (50)			S (0.45)	
	LMS-Combined-Moodle (54)		AB-S (0.68), S (0.58)	All (0.42), BC (0.40)	
	LMS-District-Moodle (47)	M (1), L (0.84)	BC (0.64), AB-S (0.61), All (0.59), S (0.55), AB (0.54)		
LMS-Outsourced (10)	E-mail-District-Exchange2010 (31)		L (0.60)		
	Financial-District-Cayenta (2)		AB (0.68)	All (0.42)	
	Library-District-Lexwin (1)	AB-S (1)			
	LMS-Combined-Blackboard (7)	AB-S (1)			
	LMS-Combined-Moodle (54)				All (0.24)
	LMS-Outsourced-Blackboard (1)	AB-S (1)			
	LMS-Outsourced-Moodle (10)	BC-L (1), BC-S (1), AB (1), BC (1), All (1), L (1), XL (1), S (1), AB-S (1)			
	LMS-Traditional-Moodle (3)		BC (0.53), All (0.52)		
LMS-PublicCloud (16)	Authentication-Traditional-GAFEportal (2)			S (0.40), All (0.31)	
	E-mail-PublicCloud-GAFE (30)			S (0.35), All (0.30)	
	Library-District-L4U (7)	SK-S (1), SK (0.77)			
	LMS-Combined-Desire2Learn (4)	BC (0.80)			
	LMS-PublicCloud-Desire2Learn (2)	BC (0.80)		All (0.31)	
	LMS-PublicCloud-GAFE (11)	AB-S (1), S (0.93), AB (0.92), All (0.79)			
LMS-Traditional (3)	E-mail-PublicCloud-Office365 (17)			BC (0.44), All (0.37)	
	Library-District-LibrarianPro (1)		All (0.56)		
	Library-Traditional-Destiny (2)	AB (1)			
	LMS-District-SchoolConnect (1)	AB (1)	All (0.56)		
	LMS-Outsourced-Moodle (10)		BC (0.53), All (0.52)		
	LMS-PublicCloud-Office365 (1)	AB (1)	All (0.56)		
	LMS-Traditional-Moodle (3)	AB (1), BC (1), All (1), XL (1)			

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

Figure L2. LMS platform to software relationships.

Infrastructure Relationships: Library

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
LIBRARY					
Library-CommunityCloud (2)	Library-CommunityCloud-ABRegionalLibrarySystems (2)	AB (1), All (1), S (1), AB-S (1)			
	SIS-District-GeniusSIS (1)	All (0.70)			
Library-District (52)	Authentication-Traditional-ActiveDirectory (6)	All (0.79)			
	Library-Combined-Destiny (37)		AB (0.58), AB-S (0.52)	S (0.40), All (0.36)	
	Library-District-Destiny (31)		L (0.60), BC (0.56), All (0.55), AB (0.54), S (0.54), AB-S (0.52)		
Library-Outsourced (2)	Authentication-District-eDirectory (2)			All (0.48)	
	E-mail-District-Exchange2007 (2)	S (1), AB-S (1)		All (0.48)	
	E-mail-District-GroupWise (2)			All (0.48)	
	Financial-Combined-SchoolCashSuite (5)		S (0.69)		
	Financial-District-SchoolCashSuite (1)	S (1), AB-S (1), All (0.70)			
	Library-Outsourced-InsigniaLibrarySystem (1)	S (1), AB-S (1), All (0.70)			
	Library-Outsourced-Koha (1)	All (0.70)			
Library-PublicCloud (15)	E-mail-District-Exchange2013 (16)			BC (0.45)	
	Financial-Combined-atrieveERP (43)			BC (0.38)	
	Financial-District-atrieveERP (35)			BC (0.40)	
	Library-PublicCloud-Destiny (4)		BC (0.60)	All (0.47)	
	Library-PublicCloud-L4U (4)		AB (0.59)	S (0.49), All (0.47)	
	LMS-PublicCloud-GAFE (11)		AB-S (0.51)	AB (0.43)	
Library-Traditional (8)	Financial-Combined-SDS (11)			BC (0.45), S (0.35), All (0.34)	
	Financial-District-SDS (10)			BC (0.45), S (0.38), All (0.37)	
	Library-Combined-Alexandria (3)			BC (0.45), All (0.37)	
	Library-Combined-L4U (16)		AB (0.59)	BC (0.45), S (0.45), All (0.45)	
	Library-Traditional-Alexandria (2)		BC (0.60)	All (0.47)	
	Library-Traditional-Destiny (2)			All (0.47)	
	Library-Traditional-L4U (6)	AB (1), AB-S (1), S (0.88), All (0.85), BC-S (0.78), BC (0.74)			
	LMS-District-ScholantisandorSharePoint (7)			All (0.33)	
	SIS-District-CIMS (4)			S (0.47), All (0.30)	

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

Figure L3. Library platform to software relationships.

Infrastructure Relationships: Authentication

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
AUTHENTICATION					
Authentication-District (71)	Authentication-District-ActiveDirectory (66)	S (1), AB-S (1), AB (0.84)	All (0.64)		
	Financial-Combined-atrieveERP (43)		AB-S (0.60)		
	LMS-Combined-Moodle (54)		AB-S (0.57)	AB (0.43)	
	LMS-District-Moodle (47)		AB-S (0.51)		
	SIS-Combined-PowerSchool (21)			AB (0.46)	
	SIS-District-PowerSchool (19)			AB (0.43)	
Authentication-Traditional (7)	Authentication-Traditional-ActiveDirectory (6)	BC-S (1), BC (1), BC-S (1),			
	Authentication-Traditional-ActiveDirectory (6)	BC (1)			
	Authentication-Traditional-ActiveDirectory (6)	BC-S (1), All (0.91), S (0.90), AB (0.80), AB-S (0.79)			
	Authentication-Traditional-GAFEportal (2)	AB (0.80), AB-S (0.79)	S (0.54), All (0.51)		
	Financial-Combined-Bellamy (5)		S (0.54)		
	Financial-PublicCloud-Bellamy (2)		S (0.54), All (0.51)		

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

Figure L4. Authentication platform to software relationships.

Infrastructure Relationships: Website

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
WEBSITE					
Website-District (56)	E-mail-Combined-NonGoogleNonMicrosoft (12)				All (0.25)
	E-mail-District-Exchange2013 (16)			S (0.34)	
	E-mail-PublicCloud-Office365 (17)				All (0.24)
	LMS-PublicCloud-Blackboard (1)	All (1.00)			
	SIS-CommunityCloud-BCeSISMyEducationBC (29)	M (0.79)			
Website-Outsourced (23)	E-mail-PublicCloud-GAFE (30)			All (0.40), S (0.36)	
	Library-Traditional-Alexandria (2)		BC (0.53)		
	LMS-Outsourced-Moodle (10)			S (0.34)	
	LMS-PublicCloud-GAFE (11)				All (0.29)
	SIS-Combined-PowerSchool (21)	M (0.79)			All (0.22)
	SIS-Combined-SchoolLogic (13)		AB-S (0.53)		
	SIS-District-PowerSchool (19)	M (0.79)			All (0.27)
	SIS-District-SchoolLogic (12)			AB-S (0.48)	
Website-PrivateCloudSchoolLevel (2)	Authentication-District-Samba (1)	BC (1), All (0.70)			
Website-PublicCloud (5)	LMS-PublicCloud-GAFE (11)	All (1.00)			

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

Figure L5. Website platform to software relationships.

Infrastructure Relationships: Financial

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
FINANCIAL					
Financial-District (64)	Financial-District-atrieveERP (35)	AB-S (0.89)	AB (0.58)	S (0.48), All (0.38)	
	Library-Combined-Destiny (37)			AB (0.42)	
	SIS-CommunityCloud-BCeSISMyEducationBC (29)				All (0.25)
Financial-Outsourced (1)	Authentication-Traditional-GAFEportal (2)	All (0.70)	S (0.69)		
	Financial-Combined-SDS (11)	AB (1), AB-S (1)			
	Financial-Outsourced-SDS (1)	AB (1), All (1), S (1), AB-S (1)			
	Library-PublicCloud-MaplewoodLibrary (1)	AB (1), All (1), S (1), AB-S (1)			
Financial-PublicCloud (16)	E-mail-PublicCloud-Office365 (17)			BC (0.43)	
	Financial-Combined-atrieveERP (43)			All (0.31)	
	Financial-Combined-SchoolCashSuite (5)	BC-L (1), L (1), BC (0.85)		All (0.38)	
	Financial-PublicCloud-atrieveERP (9)	S (0.82), AB-S (0.80), SK (0.77), AB (0.76), All (0.70)			
	Financial-PublicCloud-Bellamy (2)			All (0.31)	
	Financial-PublicCloud-SchoolCashSuite (4)	BC-L (1), L (1), BC (0.85)		All (0.45)	
	Library-Combined-Destiny (37)	SK-S (1)	SK (0.69)		
	Library-Combined-L4U (16)		AB-S (0.51)		
	Library-PublicCloud-Destiny (4)	SK (0.77)			
	SIS-PublicCloud-MaplewoodStudentInformationSystem (5)	SK (0.77)			
Financial-Traditional (4)	E-mail-PublicCloud-GAFE (30)	All (0.94)			
	Financial-District-DynamicsNAV (7)			All (0.33)	
	Financial-Traditional-QuickBooks (2)	S (0.80)	All (0.69)		
	Financial-Traditional-SimplyAccounting (2)		All (0.69)		
	SIS-District-MaplewoodStudentInformationSystem (4)	SK-S (1), S (0.80)		All (0.47)	

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

Figure L6. Financial platform to software relationships.

Infrastructure Relationships: E-mail

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
E-MAIL					
		+.70 or higher	+.50 to +.69	+.30 to +.49	+.10 to +.29
E-mail-PublicCloud (46)	Authentication-Traditional-GAFEportal (2)	All (0.78)			
	E-mail-Combined-ExchangeAll (49)	BC-L (0.79)			
	E-mail-Combined-MicrosoftExchangeO365 (50)	BC-L (0.79)			
	E-mail-PublicCloud-GAFE (30)	M (1), S (0.75)	All (0.64)		
	E-mail-PublicCloud-Office365 (17)	BC-L (1), BC (0.85), L (0.75), SK (0.73)		All (0.42)	
	Financial-Combined-SchoolCashSuite (5)			BC (0.47)	
	Financial-PublicCloud-SchoolCashSuite (4)			BC (0.47)	
	LMS-PublicCloud-GAFE (11)				All (0.25)
	SIS-Combined-PowerSchool (21)	M (0.79)		S (0.38), All (0.37)	
	SIS-Combined-SchoolLogic (13)			S (0.38)	All (0.29)
	SIS-District-PowerSchool (19)	M (0.79)		S (0.43), All (0.39)	
	SIS-District-SchoolLogic (12)			S (0.34)	All (0.27)

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

Figure L7. E-mail platform to software relationships.

Infrastructure Relationships: Social Media

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
SOCIAL					
Social-Facebook-Block (11)	Financial-District-atrieveERP (35)	SK (0.82)			
	SIS-Combined-Maplewood (9)			All (0.31)	
	SIS-District-MaplewoodStudentInformationSystem (4)		SK (0.63)	S (0.46), All (0.40)	
Social-Facebook-DoNotUse (9)	Authentication-District-ActiveDirectory (66)	All (0.88)			
	E-mail-Combined-NonGoogleNonMicrosoft (12)	AB-S (1)			All (0.28)
	E-mail-District-FirstClass (5)	AB-S (1)		All (0.39)	
	E-mail-District-Zimbra (4)	AB-S (1)			
	Financial-PublicCloud-SchoolCashSuite (4)	AB-S (1)			
	Library-District-L4U (7)	AB-S (1)			
	SISOutsourced-PowerSchool (1)	AB-S (1)			
Social-Facebook-Use (55)	Authentication-Combined-ActiveDirectory (69)	M (1)			
	Authentication-District-ActiveDirectory (66)	M (1)			
	LMS-Combined-Moodle (54)	BC-L (1), L (0.82)			
	LMS-District-Moodle (47)	L (0.84)			
Social-Twitter-Block	Financial-District-AltusDynamics (1)	AB (1), AB-S (1)		All (0.48)	
	LMS-District-CIMS (1)			All (0.48)	
Social-Twitter-DoNotUse (8)	Financial-Combined-atrieveERP (43)	BC-S (0.70)			
	SIS-CommunityCloud-BCeSISMyEducationBC (29)			S (0.36)	All (0.25)
Social-Twitter-Use (63)	LMS-Combined-Moodle (54)	BC-L (1), L (1)			
	LMS-District-Moodle (47)	L (0.70)			

PHI COEFFICIENT RELATIONSHIP LEGEND

	+.70 or higher	Very strong positive relationship.		+.30 to +.49	Moderate positive relationship.
	+.50 to +.69	Substantial positive relationship.		+.10 to +.29	Low positive relationship.

Figure L8. Social media platform to software relationships.

APPENDIX M: SOFTWARE TO SOFTWARE RELATIONSHIPS

SIS Software Relationships

Table M1

SIS Software to Software Relationships

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
STUDENT INFORMATION SYSTEM (SIS) SOFTWARE TO SOFTWARE RELATIONSHIPS					
		Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)
SIS-CommunityCloud-BCeSISMyEducationBC (29)	Financial-Combined-atrieveERP (43)			BC (0.40)	
	Financial-Combined-SDS (11)			S (0.48)	All (0.28)
	Financial-District-atrieveERP (35)			BC (0.38)	
	Financial-District-SDS (10)		S (0.54)	All (0.33)	
SIS-District-CIMS (4)	E-mail-District-FirstClass (5)			All (0.41)	
	Financial-District-CIMS (2)		All (0.69), BC (0.68)		
	LMS-District-CIMS (1)			All (0.48)	
SIS-District-GeniusSIS (1)	Library-CommunityCloud-Alberta RegionalLibrarySystems (2)	All (0.70)			
	Library-PublicCloud-L4U (4)			All (0.48)	
SIS-District-Maplewood StudentInformationSystem (4)	Financial-District-DynamicsNAV (7)			All (0.33)	
	Financial-Traditional-SimplyAccounting (2)		S (0.69)		
	SIS-Combined-Maplewood (9)	L (1), SK (0.72)	All (0.64), S (0.50)		
SIS-District-PowerSchool (19)	E-mail-PublicCloud-GAFE (30)	M (0.79), L (0.78)	All (0.58), S (0.56)		
	Financial-Combined-atrieveERP (43)			S (0.34)	
	LMS-District-PowerSchool (3)			S (0.49), All (0.35)	
	SIS-Combined-PowerSchool (21)	M (1), L (1), XL (1), All (0.93), AB (0.92), AB-S (0.90), S (0.88)			
SIS-District-SchoolLogic (12)	E-mail-PublicCloud-Office365 (17)			S (0.38)	
	Financial-District-DynamicsNAV (7)			S (0.45), All (0.36)	
	SIS-Combined-SchoolLogic (13)	SK-S (1), SK (1), All (0.95), S (0.94), AB (0.91), AB-S (0.89)			
SISOutsourced-PowerSchool (1)	E-mail-Combined-NonGoogleNonMicrosoft (12)	AB-S (1)			
	E-mail-District-FirstClass (5)	AB (1), AB-S (1)	S (0.69)		
	E-mail-District-Zimbra (4)	AB (1), AB-S (1)	S (0.69)	All (0.48)	
	Financial-Combined-SchoolCashSuite (5)		S (0.69)		
	Financial-PublicCloud-SchoolCashSuite (4)	AB (1), S (1), AB-S (1)		All (0.48)	
	Library-District-L4U (7)	AB-S (1)			
SIS-PublicCloud-Maplewood StudentInformationSystem (5)	Authentication-Traditional-ActiveDirectory (6)			All (0.31)	
	Library-District-InsigniaLibrarySystem (7)		AB (0.52)		
	SIS-Combined-Maplewood (9)	AB-S (1), AB (1), S (0.82), All (0.72)			

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
STUDENT INFORMATION SYSTEM (SIS) SOFTWARE TO SOFTWARE RELATIONSHIPS					
		Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)
SIS-PublicCloud-PowerSchool (1)	Library-PublicCloud-Destiny (4)		S (0.69)	All (0.48)	
SIS-PublicCloud-SchoolLogic (1)	E-mail-PublicCloud-Office365 (17)	AB-S (1)			
SIS-Traditional-TurboSchool (1)	Authentication-District-eDirectory (2)	BC (1), S (1), All (0.70)			
	E-mail-District-GroupWise (2)	BC (1), S (1), All (0.70)			
	SIS-Traditional-Windsor (1)	BC (1), All (1), S (1)			
SIS-Traditional-Windsor (1)	Authentication-District-eDirectory (2)	BC (1), S (1), All (0.70)			
	E-mail-District-GroupWise (2)	BC (1), S (1), All (0.70)			
	SIS-Traditional-TurboSchool (1)	BC (1), All (1), S (1)			
SIS-Combined-PowerSchool (21)	Financial-Combined-atrieveERP (43)			S (0.40)	

LMS Software Relationships

Table M2

LMS Software to Software Relationships

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
LEARNING MANAGEMENT SYSTEM (LMS) SOFTWARE TO SOFTWARE RELATIONSHIPS					
		Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationshi p (+.10 to +.29)
LMS-District-Blackboard (6)	E-mail-PublicCloud-Office365 (17)		S (0.56)	All (0.30)	
	Library-District-L4U (7)			S (0.45)	
	LMS-Combined-Blackboard (7)	SK-S (1), BC (1), SK (1), All (0.91), S (0.88)			
LMS-District-Desire2Learn (2)	LMS-Combined-Desire2Learn (4)	AB (1), XL (1)	All (0.69)		
LMS-District-Moodle (47)	Authentication-District-ActiveDirectory (66)		AB-S (0.51)	S (0.39)	
	E-mail-Combined-ExchangeAll (49)			S (0.30), AB (0.41)	All (0.23)
	E-mail-Combined-MicrosoftExchangeO365 (50)			S (0.30)	
	LMS-Combined-Moodle (54)	BC-S (1), SK-S (1), SK (1), S (0.94), AB-S (0.89), All (0.80), BC (0.78), AB (0.75), L (0.70)			
LMS-District-PowerSchool (3)	Library-District-Lexwin (1)		All (0.56)		
	LMS-Outsourced-Blackboard (1)		All (0.56)		
LMS-District-ScholantisandorSharePoint (7)	Library-Traditional-Destiny (2)		All (0.51)		
LMS-District-SchoolConnect (1)	Financial-District-Cayenta (2)	All (0.70)			
	Library-Traditional-Destiny (2)	AB (1), All (0.70)			
	LMS-PublicCloud-Office365 (1)	AB (1), All (1)			
	LMS-Traditional-Moodle (3)	AB (1)	All (0.56)		
LMS-Outsourced-Blackboard (1)	Library-District-Lexwin (1)	AB (1), All (1), S (1), AB-S (1)			
	LMS-Combined-Blackboard (7)	AB (1), AB-S (1)			
	LMS-Outsourced-Moodle (10)	AB-S (1)			
LMS-Outsourced-Moodle (10)	Financial-District-Cayenta (2)		AB (0.68)	All (0.42)	
	Library-District-Lexwin (1)	AB-S (1)			
	LMS-Combined-Blackboard (7)	AB-S (1)			
	LMS-Combined-Moodle (54)				All (0.24)
	LMS-Outsourced-Blackboard (1)	AB-S (1)			
	LMS-Traditional-Moodle (3)		BC (0.53), All (0.52)		
LMS-PublicCloud-Desire2Learn (2)	LMS-Combined-Desire2Learn (4)	BC (1)	All (0.69)		
LMS-PublicCloud-GAFE (11)	Authentication-Traditional-GAFEportal (2)			S (0.43), All (0.39)	

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
LEARNING MANAGEMENT SYSTEM (LMS) SOFTWARE TO SOFTWARE RELATIONSHIPS					
		Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)
	E-mail-PublicCloud-GAFE (30)			All (0.43), S (0.41)	
LMS-PublicCloud-Office365 (1)	Financial-District-Cayenta (2)	All (0.70)			
	Library-Traditional-Destiny (2)	AB (1), All (0.70)			
	LMS-District-SchoolConnect (1)	AB (1), All (1)			
	LMS-Traditional-Moodle (3)	AB (1)	All (0.56)		
LMS-Traditional-Moodle (3)	E-mail-PublicCloud-Office365 (17)			BC (0.44), All (0.37)	
	Library-District-LibrarianPro (1)		All (0.56)		
	Library-Traditional-Destiny (2)	AB (1)			
	LMS-District-SchoolConnect (1)	AB (1)	All (0.56)		
	LMS-Outsourced-Moodle (10)		BC (0.53), All (0.52)		
	LMS-PublicCloud-Office365 (1)	AB (1)	All (0.56)		

Library Software Relationships

Table M3

Library Software to Software Relationships

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
LIBRARY SOFTWARE TO SOFTWARE RELATIONSHIPS					
		Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)
Library-District-Alexandria (1)	Financial-PublicCloud-atrieveERP (9)	BC (1)			
	Library-Combined-Alexandria (3)	S (0.70)	All (0.57)		
Library-District-Destiny (31)	Library-Combined-Destiny (37)	AB-S (1), BC-S (1), AB (0.93), S (0.90), L (0.86), All (0.85), BC (0.83), M (0.8), BC-L (0.79)	SK (0.69)		
Library-District-InsigniaLibrarySystem (7)	Financial-PublicCloud-atrieveERP (9)		AB (0.53)	All (0.30)	
	Library-Combined-Insignia (8)	BC-S (1), BC (1), All (0.92), S (0.91), AB (0.87), AB-S (0.86)			
	SIS-Combined-Maplewood (9)		AB (0.52)		
Library-District-L4U (7)	Authentication-Combined-Unix/LinuxAll (6)		BC (0.60)		
	E-mail-Combined-NonGoogleNonMicrosoft (12)	AB-S (1)		BC (0.44)	
	E-mail-District-FirstClass (5)	AB-S (1)			
	E-mail-District-Zimbra (4)	AB-S (1)		All (0.33)	
	Financial-PublicCloud-SchoolCashSuite (4)	AB-S (1)			
	Library-Combined-L4U (16)		SK (0.69), All (0.61), AB (0.59), S (0.54), BC (0.53)		
Library-District-Lexwin (1)	LMS-Combined-Blackboard (7)	AB (1), AB-S (1)			
Library-District-LibrarianPro (1)	Financial-PublicCloud-SchoolCashSuite (4)			All (0.48)	
Library-District-Mandarin (2)	E-mail-District-Exchange2013 (16)			S (0.43), All (0.31)	
	Library-Combined-Mandarin (3)	AB (1), AB-S (1), All (0.81), S (0.80)			
Library-District-Symphony (6)	E-mail-District-FirstClass (5)			All (0.31)	
	Financial-District-PeopleSoftFinancialManagement (5)	AB (0.80)	All (0.51)		
	Library-Combined-Symphony (7)	BC-L (1), AB (1), BC (1), All (1), L (1), XL (1)			
Library-Outsourced-InsigniaLibrarySystem (1)	E-mail-District-Exchange2007 (2)	AB (1), S (1), AB-S (1), All (0.70)			
	Financial-Combined-SchoolCashSuite (5)		S (0.69)		
	Financial-District-SchoolCashSuite (1)	AB (1), All (1), S (1), AB-S (1)			
Library-Outsourced-Koha (1)	Authentication-District-eDirectory (2)	AB (1), All (0.70)			
	E-mail-District-GroupWise (2)	AB (1), All (0.70)			
Library-PublicCloud-Destiny (4)	Financial-PublicCloud-atrieveERP (9)	SK-S (1), SK (1)		S (0.43)	
	Library-Combined-Destiny (37)				All (0.24)
Library-PublicCloud-L4U (4)	Library-Combined-L4U (16)		AB (0.59)	S (0.46), All (0.45)	
Library-PublicCloud-LibraryWorld (1)	E-mail-District-DeskNow (1)	All (1), S (1)			
Library-PublicCloud-Mandarin (1)	Library-Combined-Mandarin (3)		All (0.56)		
Library-PublicCloud-MaplewoodLibrary (1)	Authentication-Traditional-GAFEportal (2)	All (0.70)	S (0.69)		
	Financial-Combined-SDS (11)	AB-S (1), AB (1)			
	Financial-Outsourced-SDS (1)	AB (1), All (1), S (1), AB-S (1)			

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
LIBRARY SOFTWARE TO SOFTWARE RELATIONSHIPS					
		Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)
Library-PublicCloud-OPALS (1)	Financial-Combined-atrieveERP (43)	All (0.75)			
Library-Traditional-Alexandria (2)	Authentication-District-OpenLDAP (4)		S (0.69)		
	E-mail-District-FirstClass (5)		S (0.69)		
	Library-Combined-Alexandria (3)	All (0.81), BC (0.80), S (0.70)			
Library-Traditional-Destiny (2)	Financial-District-Cayenta (2)			All (0.48)	
	Library-Traditional-Alexandria (2)			All (0.48)	
Library-Traditional-L4U (6)	Financial-Combined-SDS (11)			BC (0.47)	All (0.29)
	Financial-District-SDS (10)			BC (0.47), All (0.31)	
	Library-Combined-L4U (16)		BC (0.67), AB (0.59), All (0.56), S (0.54)		
Library-Combined-L4U (16)	Financial-Combined-SDS (11)			BC (0.37)	
	LMS-Combined-Blackboard (7)				All (0.28)

Authentication Software Relationships

Table M4

Authentication Software to Software Relationships

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
AUTHENTICATION SOFTWARE TO SOFTWARE RELATIONSHIPS					
		Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)
Authentication-District-ActiveDirectory (66)	Authentication-Combined-ActiveDirectory (69)	BC (1), M (1), L (1), All (0.79)			
	Authentication-Combined-ActiveDirectory (69)		AB (0.68), S (0.60)		
	E-mail-Combined-ExchangeAll (49)		BC (0.60)	All (0.42)	
	E-mail-Combined-MicrosoftExchangeO365 (50)		BC (0.60)	All (0.43)	
	E-mail-District-Exchange2010 (31)			BC (0.38), All (0.30)	
	Financial-Combined-atrieveERP (43)		AB-S (0.60)		
	LMS-Combined-Moodle (54)		AB-S (0.57)	S (0.42)	
Authentication-District-eDirectory (2)	E-mail-Combined-NonGoogleNonMicrosoft (12)			All (0.37)	
	E-mail-District-GroupWise (2)	AB (1), BC (1), All (1), S (1)			
Authentication-District-ExtremeZIP (1)	Financial-PublicCloud-SchoolCashSuite (4)			All (0.48)	
Authentication-District-LemonLDAPNG (1)	Authentication-District-OpenLDAP (4)			All (0.48)	
	E-mail-District-Zimbra (4)			All (0.48)	
Authentication-District-OpenLDAP (4)	Authentication-Combined-Unix/LinuxAll (6)	S (0.80), All (0.80), BC (0.74)			
	E-mail-Combined-NonGoogleNonMicrosoft (12)		BC (0.55), S (0.54), All (0.54)		
	E-mail-District-Zimbra (4)	BC (0.80), All (0.73)			
Authentication-District-ownCloud (1)	E-mail-District-IceWarp (1)	BC (1), All (1), S (1)			
Authentication-Traditional-GAFEportal (2)	Financial-Outsourced-SDS (1)	All (0.70)	S (0.69)		
	Financial-PublicCloud-Bellamy (2)			All (0.48)	
Authentication-Combined-ActiveDirectory (69)	E-mail-Combined-ExchangeAll (49)		BC (0.60)	All (0.40)	
	E-mail-Combined-MicrosoftExchangeO365 (50)		BC (0.60)	All (0.41)	
Authentication-Combined-Unix/LinuxAll (6)	E-mail-Combined-NonGoogleNonMicrosoft (12)	M (1), BC-S (0.78), BC (0.74)	S (0.68), All (0.67)		
	Financial-Combined-SDS (11)				All (0.29)

Financial Software Relationships

Table M5

Financial Software to Software Relationships

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
FINANCIAL SOFTWARE TO SOFTWARE RELATIONSHIPS					
		Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)
Financial-District-atrieveERP (35)	Financial-Combined-atrieveERP (43)	BC-L (1), M (1), L (1), XL (1), BC (0.94), BC-S (0.84), All (0.80)			
	Financial-Combined-atrieveERP (43)		AB (0.69), SK (0.69), S (0.69), AB-S (0.51)		
	Financial-Combined-SchoolCashSuite (5)				All (0.28)
	Financial-PublicCloud-SchoolCashSuite (4)				All (0.25)
	Library-Combined-Destiny (37)			BC (0.39)	
	SIS-CommunityCloud-BCeSISMyEducationBC (29)			BC (0.38)	
Financial-District-Bellamy (3)	Financial-Combined-Bellamy (5)	BC-L (1), BC (1), L (1), All (0.76)			
Financial-District-Cayenta (2)	Library-Traditional-Destiny (2)			All (0.48)	
	LMS-District-SchoolConnect (1)	All (0.70)			
	LMS-Outsourced-Moodle (10)		AB (0.68)	All (0.42)	
	LMS-PublicCloud-Office365 (1)	All (0.70)			
Financial-District-CIMS (2)	LMS-District-customotherown (2)			All (0.48)	
	LMS-District-WordPress (2)			All (0.48)	
	SIS-District-CIMS (4)		All (0.69), BC (0.68)		
Financial-District-DynamicsNAV (7)	E-mail-District-Exchange2013 (16)			S (0.35)	
	E-mail-PublicCloud-Office365 (17)			S (0.48)	
	Financial-Traditional-SimplyAccounting (2)	BC (1)			
	LMS-Combined-Blackboard (7)		S (0.54)	All (0.36)	
	LMS-District-Blackboard (6)		S (0.63)	All (0.41)	
	SIS-Combined-SchoolLogic (13)			S (0.42), All (0.33)	
	SIS-District-MaplewoodStudentInformationSystem (4)			All (0.33)	
	SIS-District-SchoolLogic (12)			S (0.45), All (0.36)	
Financial-District-PeopleSoftFinancialManagement (5)	Library-Combined-Symphony (7)	AB (0.80)	All (0.51)		
	Library-District-Symphony (6)	AB (0.80)	All (0.51)		
	LMS-Combined-Desire2Learn (4)	AB (0.80)		All (0.41)	
	LMS-District-customotherown (2)			All (0.38)	

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
FINANCIAL SOFTWARE TO SOFTWARE RELATIONSHIPS					
		Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)
	LMS-District-Desire2Learn (2)	AB (0.80)	All (0.61)		
Financial-District-SchoolCashSuite (1)	E-mail-District-Exchange2007 (2)	AB (1), S (1), AB-S (1), All (0.70)			
	Financial-Combined-SchoolCashSuite (5)		S (0.69)		
	Library-Outsourced-InsigniaLibrarySystem (1)	AB (1), All (1), S (1), AB-S (1)			
Financial-District-SDS (10)	Authentication-Combined-Unix/LinuxAll (6)			All (0.31)	
	Financial-Combined-SDS (11)	BC-S (1), BC (1), M (1), All (0.94), S (0.92)			
	Library-Combined-L4U (16)			BC (0.37)	
	Library-Traditional-L4U (6)			BC (0.47), All (0.31)	
	SIS-CommunityCloud-BCeSISMyEducationBC (29)		S (0.54)	All (0.33)	
Financial-Outsourced-SDS (1)	Authentication-Traditional-GAFEportal (2)	All (0.70)	S (0.69)		
	Financial-Combined-SDS (11)	AB (1), AB-S (1)			
	Library-PublicCloud-MaplewoodLibrary (1)	AB (1), All (1), S (1), AB-S (1)			
Financial-PublicCloud-atrieveERP (9)	Financial-Combined-atrieveERP (43)			S (0.42), All (0.31)	
	Library-Combined-Insignia (8)			AB (0.44)	All (0.27)
	Library-District-Alexandria (1)	BC (1)			
	Library-District-InsigniaLibrarySystem (7)		AB (0.53)	All (0.30)	
	Library-PublicCloud-Destiny (4)	SK-S (1), SK (1)		S (0.43)	
Financial-PublicCloud-Bellamy (2)	Authentication-Traditional-GAFEportal (2)			All (0.48)	
	Financial-Combined-Bellamy (5)	S (1), AB-S (1)	All (0.61)		
Financial-PublicCloud-SchoolCashSuite (4)	Authentication-District-ExtremeZIP (1)			All (0.48)	
	E-mail-Combined-NonGoogleNonMicrosoft (12)	AB-S (1)			
	E-mail-District-FirstClass (5)	AB (1), AB-S (1)	S (0.69)		
	E-mail-District-Zimbra (4)	AB (1), AB-S (1)	S (0.69)		
	E-mail-PublicCloud-Office365 (17)		BC (0.55)		All (0.29)
	Financial-Combined-SchoolCashSuite (5)	BC-L (1), BC (1), L (1), All (0.88)	S (0.69)		
	Financial-District-atrieveERP (35)				All (0.25)
	Library-District-L4U (7)	AB-S (1)			
	Library-District-LibrarianPro (1)			All (0.48)	
	SISOutsourced-PowerSchool (1)	AB (1), S (1), AB-S (1)		All (0.48)	
Financial-Traditional-SimplyAccounting (2)	Financial-District-DynamicsNAV (7)	BC (1)			
	SIS-District-MaplewoodStudentInformationSystem (4)		S (0.69)		

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
FINANCIAL SOFTWARE TO SOFTWARE RELATIONSHIPS					
		Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)
Financial-Combined-atrieveERP (43)	Authentication-District-ActiveDirectory (66)		AB-S (0.60)		
	E-mail-PublicCloud-GAFE (30)			S (0.33)	
	Financial-District-atrieveERP (35)	BC-L (1), M (1), L (1), XL (1), BC (0.94), BC-S (0.84), All (0.80)	AB (0.69), SK (0.69), S (0.69), AB-S (0.51)		
	Financial-PublicCloud-atrieveERP (9)			S (0.42), All (0.31)	
	Library-PublicCloud-OPALS (1)	All (0.75)			
	SIS-Combined-PowerSchool (21)			S (0.40)	
	SIS-CommunityCloud-BCeSISMyEducationBC (29)			BC (0.40)	
	SIS-District-PowerSchool (19)			S (0.34)	
Financial-Combined-Bellamy (5)	Financial-District-Bellamy (3)	BC-L (1), BC (1), L (1), All (0.76)			
	Financial-PublicCloud-Bellamy (2)	S (1), AB-S (1)	All (0.61)		
Financial-Combined-SchoolCashSuite (5)	E-mail-District-Exchange2007 (2)		S (0.69)		
	E-mail-PublicCloud-Office365 (17)		BC (0.55)		
	Financial-District-atrieveERP (35)				All (0.28)
	Financial-District-SchoolCashSuite (1)		S (0.69)		
	Financial-PublicCloud-SchoolCashSuite (4)	BC-L (1), BC (1), L (1), All (0.88)	S (0.69)		
	Library-Outsourced-InsigniaLibrarySystem (1)		S (0.69)		
	SISOutsourced-PowerSchool (1)		S (0.69)		
Financial-Combined-SDS (11)	Authentication-Combined-Unix/LinuxAll (6)				All (0.29)
	Financial-District-SDS (10)	BC-S (1), BC (1), M (1), All (0.94), S (0.92)			
	Financial-Outsourced-SDS (1)	AB (1), AB-S (1)			
	Library-Combined-L4U (16)			BC (0.37)	
	Library-PublicCloud-MaplewoodLibrary (1)	AB-S (1), AB (1)			
	Library-Traditional-L4U (6)			BC (0.47)	All (0.29)
	SIS-CommunityCloud-BCeSISMyEducationBC (29)			S (0.48)	All (0.28)

E-mail Software Relationships

Table M6

E-mail Software to Software Relationships

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
E-MAIL SOFTWARE TO SOFTWARE RELATIONSHIPS					
		Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)
E-mail-District-DeskNow (1)	Library-PublicCloud-LibraryWorld (1)	All (1), S (1)			
E-mail-District-Exchange2007 (2)	Financial-Combined-SchoolCashSuite (5)		S (0.69)		
	Financial-District-SchoolCashSuite (1)	AB (1), S (1), AB-S (1), All (0.70)			
	Library-Outsourced-InsigniaLibrarySystem (1)	AB (1), S (1), AB-S (1), All (0.70)			
E-mail-District-Exchange2010 (31)	Authentication-Combined-ActiveDirectory (69)			BC (0.38)	All (0.24)
	Authentication-District-ActiveDirectory (66)			BC (0.38), All (0.30)	
E-mail-District-Exchange2013 (16)	E-mail-PublicCloud-Office365 (17)			S (0.45), All (0.33)	
	Financial-District-DynamicsNAV (7)			S (0.35)	
	Library-District-Mandarin (2)			S (0.43), All (0.31)	
	LMS-Combined-Blackboard (7)			S (0.35)	
	LMS-District-Blackboard (6)			S (0.42)	
E-mail-District-FirstClass (5)	Authentication-Combined-Unix/LinuxAll (6)			All (0.31)	
	E-mail-District-Zimbra (4)	AB (1), AB-S (1)			
	Financial-PublicCloud-SchoolCashSuite (4)	AB (1), AB-S (1)	S (0.69)		
	Library-Combined-Symphony (7)			All (0.31)	
	Library-District-L4U (7)	AB-S (1)			
	Library-District-Symphony (6)			All (0.31)	
	Library-Traditional-Alexandria (2)		S (0.69)		
	SIS-District-CIMS (4)			All (0.41)	
	SISOutsourced-PowerSchool (1)	AB (1), AB-S (1)	S (0.69)		
E-mail-District-GroupWise (2)	Authentication-District-eDirectory (2)	AB (1), BC (1), All (1), S (1)			
	Library-Outsourced-Koha (1)	AB (1), All (0.70)			
	SIS-Traditional-TurboSchool (1)	BC (1), S (1), All (0.70)			
	SIS-Traditional-Windsor (1)	BC (1), S (1), All (0.70)			
E-mail-District-IceWarp (1)	Authentication-District-ownCloud (1)	BC (1), All (1), S (1)			

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
E-MAIL SOFTWARE TO SOFTWARE RELATIONSHIPS					
		Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)
	LMS-District-WordPress (2)	S (1), All (0.70)			
E-mail-District-Zimbra (4)	Authentication-Combined-Unix/LinuxAll (6)		BC (0.60), All (0.58)		
	Authentication-District-LemonLDAPNG (1)			All (0.48)	
	Authentication-District-OpenLDAP (4)	BC (0.80), All (0.73)			
	E-mail-District-FirstClass (5)	AB (1), AB-S (1)			
	Financial-PublicCloud-SchoolCashSuite (4)	AB (1), AB-S (1)	S (0.69)		
	Library-District-L4U (7)	AB-S (1)		All (0.33)	
	SISOutsourced-PowerSchool (1)	AB (1), AB-S (1)	S (0.69)	All (0.48)	
E-mail-PublicCloud-GAFE (30)	Financial-Combined-atrieveERP (43)			S (0.33)	
	Library-Combined-Insignia (8)			S (0.33)	All (0.24)
	LMS-PublicCloud-GAFE (11)			All (0.43), S (0.41)	
	SIS-Combined-PowerSchool (21)	M (0.79), L (0.78)	All (0.52)	S (0.43)	
	SIS-District-PowerSchool (19)	M (0.79), L (0.78)	All (0.58), S (0.56)		
E-mail-PublicCloud-Office365 (17)	E-mail-District-Exchange2013 (16)			S (0.45), All (0.33)	
	Financial-Combined-SchoolCashSuite (5)		BC (0.55)		
	Financial-District-DynamicsNAV (7)			S (0.48)	
	Financial-PublicCloud-SchoolCashSuite (4)		BC (0.55)		All (0.29)
	LMS-Combined-Blackboard (7)			S (0.48)	All (0.26)
	LMS-District-Blackboard (6)		S (0.56)	All (0.30)	
	LMS-Traditional-Moodle (3)			BC (0.44), All (0.37)	
	SIS-Combined-SchoolLogic (13)		S (0.50)		
	SIS-District-SchoolLogic (12)			S (0.38)	
	SIS-PublicCloud-SchoolLogic (1)	AB-S (1)			
E-mail-Combined-ExchangeAll (49)	Authentication-Combined-ActiveDirectory (69)		BC (0.60)	All (0.40)	
	Authentication-District-ActiveDirectory (66)		BC (0.60)	All (0.42)	
	E-mail-Combined-MicrosoftExchangeO365 (50)	AB-S (1), BC-L (1), BC-S (1), BC (1), M (1), L (1), S (1), All (0.97), AB (0.93)			
	E-mail-District-Exchange2010 (31)	BC-S (0.84), AB (0.74), AB-S (0.70)	BC (0.63), S (0.62), All (0.61)		
	E-mail-District-Exchange2013 (16)			S (0.40), All (0.37)	
	E-mail-PublicCloud-Office365 (17)	BC-L (0.79)		All (0.32)	

RELATIONSHIP ITEMS (NUMBER OF OCCURRENCES)		PHI COEFFICIENT RELATIONSHIP STRENGTH AND SIZE/PROVINCE INFORMATION			
E-MAIL SOFTWARE TO SOFTWARE RELATIONSHIPS					
		Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)
	LMS-Combined-Moodle (54)			AB (0.41)	All (0.23)
	LMS-District-Moodle (47)			S (0.30)	
E-mail-Combined-MicrosoftExchangeO365 (50)	Authentication-Combined-ActiveDirectory (69)		BC (0.60)	All (0.41)	
	Authentication-District-ActiveDirectory (66)		BC (0.60)	All (0.43)	
	E-mail-Combined-ExchangeAll (49)	AB-S (1), BC-L (1), BC-S (1), BC (1), M (1), L (1), S (1), All (0.97), AB (0.93)			
	E-mail-District-Exchange2010 (31)	BC-S (0.84), AB-S (0.70)	AB (0.69), BC (0.63), S (0.62), All (0.59)		
	E-mail-District-Exchange2013 (16)			S (0.40), All (0.36)	
	E-mail-PublicCloud-Office365 (17)	BC-L (0.79)		All (0.38)	
	LMS-District-Moodle (47)			S (0.30)	
E-mail-Combined-NonGoogleNonMicrosoft (12)	Authentication-Combined-Unix/LinuxAll (6)	M (1), BC-S (0.78), BC (0.74)	S (0.68), All (0.67)		
	Authentication-District-eDirectory (2)			All (0.37)	
	Authentication-District-OpenLDAP (4)		BC (0.55), S (0.54), All (0.54)		
	E-mail-District-FirstClass (5)	AB-S (1)	BC (0.65), All (0.61), S (0.54)		
	E-mail-District-GroupWise (2)		All (0.62)	All (0.37)	
	E-mail-District-Zimbra (4)	AB-S (1)	S (0.54), All (0.54)	BC (0.44)	
	Financial-PublicCloud-SchoolCashSuite (4)	AB-S (1)			
	Library-District-L4U (7)	AB-S (1)		BC (0.44)	
	LMS-District-WordPress (2)			BC (0.44), All (0.37)	
	SIS-Outsourced-PowerSchool (1)	AB-S (1)			

APPENDIX N: SUBJECTIVE RELATIONSHIPS

Decision Models

Table N1

Decision Model Relationships

	Relationship Item (Number of Occurrences)	Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)	Low negative relationship (-.10 to -.29)	Moderate negative relationship (-.30 to -.49).	Substantial negative relationship (-.50 to -.69)	Very strong negative relationship (-.70 or lower)
DecisionModel-Anarchy (1)	Library-PublicCloud-Destiny (4)			All (0.49)					
	Rank-SocialNetwork-First (4)	BC (1)		All (0.49)					
	Rank-SupplierEfforts-Third (6)	BC (1)							
	Strength-SocialNetwork-VeryMuchImpact (10)	BC (1)							
DecisionModel-Political (27)	Authentication-Traditional-ActiveDirectory (8)		AB-S (0.51)						
	E-mail-District-Exchange2013 (17)								SK-S (-0.80)
	Financial-District-atrieveERP (39)			AB-S (0.47)					
	Financial-PublicCloud (17)						AB (-0.42)		
	Leadership-Branch-Financial (29)						BC (-0.38)		
	Leadership-Branch-Instructional (33)						AB (-0.41)		
	Leadership-Level2-Branch-Financial (29)		AB-S (0.51)	AB (0.45)					
	Rank-SocialNetwork-Third (26)	BC-L (0.79)							
	Rank-TechnologyCharacteristics-First (26)						AB (-0.39)		
	Rank-TechnologyCharacteristics-Second (24)						BC (-0.43)	BC-S (-0.58)	
	Strength-EnvironmentalInfluences-LittleImpact (8)					All (-0.24)			
	Strength-SocialNetwork-Neutral (25)			BC (0.34)					
	Website-Outsourced (26)				S (0.29)				
	Website-PrivateCloudSchoolLevel (4)		AB-S (0.65)	AB (0.47), S (0.40)					
	Website-PublicCloud (5)				All (0.25)				
DecisionModel-Process (29)	Authentication-Combined-ActiveDirectory (73)							BC (-0.61)	
	Authentication-District-ActiveDirectory (68)							BC (-0.61)	
	E-mail-Combined-ExchangeAll (51)					All (-0.24)	BC (-0.40)		
	E-mail-Combined-MicrosoftExchangeO365 (52)					All (-0.26)	BC (-0.40)		
	E-mail-District-Exchange2010 (32)						All (-0.35), S (-0.45), BC (-0.48)		

	Relationship Item (Number of Occurrences)	Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)	Low negative relationship (-.10 to -.29)	Moderate negative relationship (-.30 to -.49).	Substantial negative relationship (-.50 to -.69)	Very strong negative relationship (-.70 or lower)
	E-mail-PublicCloud-Office365 (18)					All (-0.22)			
	Financial-PublicCloud (17)				S (0.29)				
	Province-Alberta (32)				AB (0.23)				
	Rank-AdopterCharacteristics-Fourth (13)			BC (0.40)					
	Rank-AdopterCharacteristics-Second (15)					All (-0.23)	AB (-0.43)		
	Rank-SocialNetwork-Second (19)			S (0.34), All (0.31)					
	Rank-TechnologyCharacteristics-Third (18)				All (0.21)				
	SIS-Combined-PowerSchool (21)				S (0.29)				
	Strength-EnvironmentalInfluences-LittleImpact (8)			BC (0.40)					
	Strength-EnvironmentalInfluences-Neutral (25)					All (-0.23)			
	Strength-TechnologyCharacteristics-MuchImpact (35)	SK-S (0.80)		S (0.45)					
	Strength-TechnologyCharacteristics-Neutral (9)	L (0.78)		BC (0.40)					
	Strength-TechnologyCharacteristics-VeryMuchImpact (30)					All (-0.26)			
DecisionModel-Rational (23)	E-mail-District-Exchange2010 (32)				S (0.29)				
	E-mail-PublicCloud-Office365 (18)	SK-S (0.81), SK (0.72)		S (0.31)					
	Financial-Combined-atrieveERP (47)						S (-0.32)		
	Financial-District-atrieveERP (39)					S (-0.29)			
	Leadership-Branch-Technology (11)							BC-S (-0.58)	
	Leadership-Level2-Branch-Technology (11)							BC-S (-0.58)	
	Library-District(56)		BC-S (0.66)	BC (0.39)					
	Library-District-Destiny (34)			BC (0.40)					
	LMS-District (65)								M (-0.79)
	LMS-District-Moodle (48)								M (-0.79)
	Rank-AdopterCharacteristics-Second (15)		AB (0.67), AB-S (0.67)						
	Rank-AdopterCharacteristics-Third (11)			BC (0.36)					
	Rank-SocialNetwork-Second (19)					All (-0.23)	S (-0.33)		
	Rank-TechnologyCharacteristics-First (26)			AB (0.46)					
	Rank-TechnologyCharacteristics-Second (24)	SK-S (0.80)	SK (0.63)	BC (0.49)	S (0.29), All (0.24)				

	Relationship Item (Number of Occurrences)	Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)	Low negative relationship (-.10 to -.29)	Moderate negative relationship (-.30 to -.49).	Substantial negative relationship (-.50 to -.69)	Very strong negative relationship (-.70 or lower)
	Rank-TechnologyCharacteristics-Third (18)					All (-0.28)			
	SIS-Combined-SchoolLogic (15)	SK (0.84), SK-S (0.81)							
	SIS-District-SchoolLogic (14)	SK (0.84), SK-S (0.81)							
	Strength-TechnologyCharacteristics-VeryMuchImpact (30)	SK-S (0.80)	SK (0.63)						

Priorities (First Rank)

Table N2

Relationships With Top Priorities

	Relationship Item (Number of Occurences)	Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)	Low negative relationship (-.10 to -.29)	Moderate negative relationship (-.30 to -.49).	Substantial negative relationship (-.50 to -.69)	Very strong negative relationship (-.70 or lower)
Rank-AdopterCharacteristics-First (34)	Demographics-Province-BritishColumbia (35)					BC (-0.25)			
	Financial-Combined-atrieveERP (47)			AB-S (0.47)					
	Financial-District (69)		AB-S (0.50)						
	Financial-District-atrieveERP (39)		AB-S (0.65)	AB (0.43)					
	LMS-District-Moodle (48)			AB (0.37)	All (0.23)				
	LMS-District-ScholantisandorSharePoint (7)					All (-0.26)			
	LMS-Outsourced (10)					All (-0.25)			
	LMS-Outsourced-Moodle (10)					All (-0.24)			
	SIS-Combined-SchoolLogic (15)				All (0.23)				
	SIS-CommunityCloud (31)					All (-0.22)			
	SIS-CommunityCloud-BCeSISMyEducationBC (31)					All (-0.21)			
	Social-Facebook-Block (12)					All (-0.22)	S (-0.33)		
	Social-Facebook-Use (59)				S (0.27)				
	Social-Twitter-DoNotUse (9)						S (-0.31)		
	Social-Twitter-Use (67)			S (0.41)	All (0.24)				
	Strength-AdopterCharacteristics-MuchImpact (36)						S (-0.30)		
	Strength-AdopterCharacteristics-Neutral (13)						All (-0.31)		L (-0.75)
	Strength-AdopterCharacteristics-VeryMuchImpact (23)	M (1), BC-S (0.82), BC (0.71)	S (0.64), AB (0.62), All (0.62), AB-S (0.58)						
	Strength-EnvironmentalInfluences-VeryMuchImpact (14)					All (-0.26)	S (-0.37)	SK (-0.69)	SK-S (-0.80)
	Strength-SupplierEfforts-LittleImpact (28)		AB-S (0.58), AB (0.57)						
	Strength-SupplierEfforts-Neutral (22)	BC-L (0.8)		BC (0.47)					
Rank-EnvironmentalInfluences-First (14)	E-mail-PublicCloud-GAFE (32)	SK (0.77)							
	Financial-District-Cayenta (2)		AB (0.68)	All (0.34)					
	Financial-Traditional (4)	SK (0.77)							
	Leadership-Level3-Branch-Financial (29)			S (0.36)					
	Library-District(56)		BC-S (0.57)						
	LMS-District-ScholantisandorSharePoint (7)	XL (1)	AB (0.68)	All (0.32)					
	SIS-Combined-Maplewood (9)	SK-S (0.80)		S (0.36)	All (0.25)				

	Relationship Item (Number of Occurences)	Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)	Low negative relationship (-.10 to -.29)	Moderate negative relationship (-.30 to -.49).	Substantial negative relationship (-.50 to -.69)	Very strong negative relationship (-.70 or lower)
	SIS-Combined-PowerSchool (21)					S (-0.29)			
	SIS-District-MaplewoodStudentInformationSystem (4)			S (0.40)					
	Social-Facebook-Block (12)				All (0.26)				
	Social-Facebook-DoNotUse (9)				All (0.25)				
	Social-Facebook-Use (59)						S (-0.38), All (-0.40), BC (-0.43)		
	Social-Twitter-DoNotUse (9)			S (0.32)	All (0.25)				
	Social-Twitter-Use (67)					All (-0.24)	S (-0.32)		
	Strength-AdopterCharacteristics-VeryMuchImpact (23)						S (-0.35)		
	Strength-EnvironmentalInfluences-Neutral (25)						All (-0.31), S (-0.31)		
	Strength-EnvironmentalInfluences-VeryMuchImpact (14)	SK-S (1), SK (1), XL (1), AB-S (0.79), S (0.74), All (0.74), AB (0.71)	BC (0.64)						
	Strength-SupplierEfforts-Neutral (22)		AB-S (0.58)						
Rank-SocialNetwork-First (4)	Authentication-District-ActiveDirectory (68)						S (-0.46)		
	Financial-Combined-atrieveERP (47)						AB (-0.47)	AB-S (-0.67)	
	Financial-Outsourced (1)	S (0.69)		All (0.49)					
	Financial-Outsourced-SDS (1)		S (0.69)	All (0.49)					
	Leadership-DecisionModel-Anarchy (1)	BC (1)		All (0.49)					
	Leadership-Level2-Branch-Financial (29)			All (0.30)					
	Library-PublicCloud-MaplewoodLibrary (1)		S (0.69)	All (0.49)					
	Strength-SocialNetwork-VeryMuchImpact (10)	BC (1)		All (0.43)					
	Website-PublicCloud (5)		AB (0.63)	All (0.41)					
Rank-SupplierEfforts-First (2)	Authentication-Traditional-ActiveDirectory (8)								All (-0.93)
	LMS-District-CIMS (1)	All (0.70), BC (1)	S (0.69)						
	LMS-District-FirstClassLMS (1)	All (0.70), AB (1), AB-S (1)	S (0.69)						
	Strength-AdopterCharacteristics-LittleImpact (4)	AB-S (1), AB (1)							
	Strength-SupplierEfforts-MuchImpact (12)			S (0.43), All (0.38)					
Rank-TechnologyCharacteristics-First (26)	Demographics-Province-BritishColumbia (35)				BC (0.24)				
	E-mail-PublicCloud (50)			BC (0.36)					
	E-mail-PublicCloud-Office365 (18)			BC (0.37)					
	Financial-District-atrieveERP (39)	BC-S (0.7)							
	Leadership-DecisionModel-Political (27)						AB (-0.39)		

	Relationship Item (Number of Occurences)	Very strong positive relationship (+.70 or higher)	Substantial positive relationship (+.50 to +.69)	Moderate positive relationship (+.30 to +.49).	Low positive relationship (+.10 to +.29)	Low negative relationship (-.10 to -.29)	Moderate negative relationship (-.30 to -.49).	Substantial negative relationship (-.50 to -.69)	Very strong negative relationship (-.70 or lower)
	Leadership-DecisionModel-Rational (23)			AB (0.46)					
	Library-PublicCloud (16)	BC-S (0.70)							
	LMS-Combined-Moodle (55)								SK (-0.77)
	LMS-District-Moodle (48)								SK (-0.77)
	SIS-CommunityCloud (31)	XL (0.8)			All (0.21)				
	SIS-CommunityCloud-BCeSISMyEducationBC (31)	XL (0.8)			All (0.21)				
	SIS-District- (41)								XL (-0.80)
	Strength-AdopterCharacteristics-VeryMuchImpact (23)						AB (-0.36), All (-0.38), BC (-0.42)		M (-0.79)
	Strength-EnvironmentalInfluences-LittleImpact (8)			AB (0.43), All (0.30)					
	Strength-EnvironmentalInfluences-VeryMuchImpact (14)					All (-0.25)	BC (-0.46)		
	Strength-SupplierEfforts-VeryLittleImpact (16)		AB-S (0.64)	AB (0.46), S (0.33), All (0.32)					
	Strength-TechnologyCharacteristics-MuchImpact (35)					All (-0.24)	BC (-0.45)	BC-S (-0.66)	
	Strength-TechnologyCharacteristics-VeryMuchImpact (30)	L (0.86), BC-L (0.8)	BC (0.53)	All (0.39), S (0.37)					