View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by AIS Electronic Library (AISeL)

Journal of the Association for Information Systems

Research Paper ISSN: 1536-9323

Information Systems Control: A Review and Framework for Emerging Information Systems Processes

W. Alec Cram
Information and Process Management, Bentley University
wcram@bentley.edu

Kathryn Brohman
Management Information Systems, Queen's University, Canada
kbrohman@business.queensu.ca

R. Brent Gallupe
Management Information Systems, Queen's University, Canada
bgallupe@business.queensu.ca

Abstract:

A major stream of information systems (IS) research examines the topic of control, which focuses on attempts to affect employee behavior as a means to achieve organizational objectives. Despite a rich history of IS control research, approximately 90 percent of the publications focus on only three IS processes: managing information systems development, managing IS outsourcing, and managing security. However, the emergence of new IS processes and technologies with distinct control challenges, such as managing enterprise architecture and managing innovation, highlights a need to consider the wider applicability of past control insights. In this paper, we first integrate existing IS control constructs and relationships into a comprehensive IS control model. Second, we apply this model to emerging IS processes to guide future research and practice. We review 65 influential IS control-related journal papers and identify five control dimensions. We then consolidate these dimensions into a single, integrated model to apply past IS control findings to the challenges of emerging information systems by posing a series of related propositions. With this paper, we position current IS control research to be increasingly applicable and relevant to tomorrow's emerging IS opportunities and challenges.

Keywords: Control, Information Systems Development, IS Management, IS Process, Enterprise Architecture.

Dorothy Leidner was the accepting senior editor. This paper was submitted on April 25, 2014 and went through four revisions.

1 Introduction

Organizations have come to recognize the fundamental role that information systems (IS) processes play in contemporary business. To better achieve company objectives and to influence employee behavior (Davis, 1940; Flamholtz, Das, & Tsui, 1985; Tannenbaum, 1962), organizations are embedding controls in all organizational processes (including IS processes, such as systems development). For nearly a century, researchers have studied control phenomena in a variety of fields, such as marketing, economics, sociology, strategy, and accounting. More recently, technological advancements and significant control system failures have stimulated a distinct and valuable body of IS control research examining how organizations seek to balance their growing investment in technology with the achievement of organizational objectives (Harris, Collins, & Hevner, 2009; Rao, Brown, & Perkins, 2007).

However, despite the recognition that IS control challenges are a key concern to organizations (Gregory, Beck, & Keil, 2013; Kirsch, Ko, & Haney, 2010), our study finds that the vast majority of the research conducted to date focuses on only a small number of IS processes (such as IS development) and on relationships between only a subset of the relevant control constructs. Although there is little doubt that IS control research on these specific processes has made an important contribution to improving how practitioners and researchers understand the associated concepts, we believe that a notable gap exists in applying this knowledge to other important IS processes, such as managing enterprise architecture and managing innovation. This gap is a key problem because advances in technology result in emerging organizational processes that have not been used or experienced before. Along with these new technology-based processes comes the need for new controls, which drive performance towards organizational objectives. Where research does not clearly articulate the most effective approaches to design and implement controls in these new processes, organizations are at an increased risk of investing in promising new IS initiatives that fail to live up to performance expectations.

We follow ISACA's popular control framework, COBIT, in defining the term "process" as a collection of organizational practices that take inputs and produce outputs in the form of IS products and services (ISACA, 2012)[1]. COBIT views each IS process as having a clear business reason for existing, as containing clear roles and responsibilities, and as being assessable for performance (ISACA, 2012). COBIT's most recent version defines 37 IS processes; however, in analyzing 65 influential IS control-related journal papers, we found that 90 percent consider only three IS processes: managing systems development, managing IS outsourcing, and managing information security[2]. We argue that the nature of technology is changing and the growing existence of control challenges outside of these core IS processes demands that the field more widely apply and expand the insights of past IS control research to emerging IS processes where little control research has been conducted[3].

In this paper, we develop a new, integrated control framework that scholars and practitioners can use to help them control emerging information systems processes. We identify five control dimensions (and eighteen underlying sub-dimensions) that represent the constructs that IS control studies have examined: the control environment, control mechanisms, control outcomes, control execution, and control experiences. Much of the past research focuses on the specific relationships amongst these constructs, which provides valuable insights into why organizations employ controls, how controls change over time, and to what extent controls impact employees. We draw on these observations to propose an organizing framework that recognizes the inter-relationships between the five control dimensions and approaches IS control from a holistic perspective. By examining the findings that have already emerged, we also seek to uncover what we have left to understand and how we can apply any insights to future research on the control challenges of emerging information systems processes. As a result, we address the following research question:

[1] In previous versions of the framework, COBIT stood for Control OBjectives for Information and related Technology. The most recent version (COBIT 5) uses only the acronym. Similarly, ISACA previously stood for the Information Systems Audit and Control Association but now uses only the acronym. We distinguish an IS process, such as "managing security", from a business process, such as "manage payroll". We focus only on IS processes.

[2] COBIT 5 divides the traditional view of the system- development process that considers the overall development lifecycle across the BAI01 (manage programs and projects), BAI02 (manage requirements definition), and BAI03 (manage solutions—identification and build) processes. COBIT contains the management of IS outsourcing process in the APO09 (manage service agreements) and APO10 (manage suppliers) processes. The manage security process is APO13.

[3] In the context of this research, we define emerging IS processes as those processes in COBIT that differ from the traditional IS processes of managing systems development, security, and outsourcing on the basis that they add value through processing power and data assets, are rapidly evolving, require significant integration with other processes, and have an uncertain future direction. We further explain each of these elements in Section 4.

RQ: How can existing IS control constructs and relationships be applied to emerging IS processes to guide future research and practice?

Rather than focus on the broad managerial aspects of control or the specific, computer-aided technological controls, we focus on the controls used to influence the behavior of people or groups in IS processes. In doing so, we extend our initial descriptive model, which provides insights into "what is" toward a more insightful model that considers "what will be" by making predictions and establishing testable propositions (Gregor, 2006).

This paper proceeds as follows. In Section 2, we define key IS control terminology. In Section 3, focusing on key insights, we identify and present the core dimensions and underlying sub-dimensions that emerged from our analysis and gaps that exist related to relationships amongst the control dimensions. In Section 4, based on observations resulting from our findings, we propose an integrated model that encourages an awareness of all of the relevant control dimensions and that one can consider in planning future research directions in emerging information systems. To demonstrate the applicability of our model, we also consider the unique characteristics of emerging information systems processes and propose a series of related propositions in the context of one emerging process, managing enterprise architecture.

We make three key contributions to the literature. First, we formally define and differentiate the core dimensions and underlying sub-dimensions of existing IS control research. This synthesis of past literature represents a comprehensive view of the state of IS control research. Next, in identifying the integrated model, we articulate and extend the research framework used in the field by advocating for a more integrated, holistic approach to control research that recognizes the interdependencies of the control dimensions. Finally, our propositions provide a template for future research on emerging IS processes that can directly benefit practitioners and researchers by extending the topics addressed and the inter-dimensional elements that comprise studies of IS control.

2 Conceptual Foundations

One can define the term "control" in a variety of ways, but, in the context of this research, we use it broadly to refer to an attempt to affect the behavior of another person or group as a means to achieve goals (Davis, 1940; Flamholtz et al., 1985; Tannenbaum, 1962). We adapt this definition to define information systems control as an attempt to intentionally affect the behavior of another person or group as a means to achieve goals related to designing, developing, operating, using, and managing information systems. This conceptualization includes both managerial methods of controlling individual and group behavior using both formal (e.g., monitoring subordinate output, implementing a policy or procedure) and informal techniques (e.g., motivating individual and team performance by offering rewards) and technical methods (e.g., information security mechanisms, such as application passwords). Under this view, IS control encompasses not only the social and managerial techniques used to influence internal staff and third party employees to act in accordance with organizational aims but also the controls embedded in technology tools. This definition is consistent with past views on IS control that refer to the topic in both a behavioral and technical sense (Orlikowski, 1991); that is, IS control focuses on the relationship between the behavior of organizational actors as they conduct their day-to-day activities and pursue IS objectives (Kirsch, 1997)[4].

IS control research focuses on a range of information systems processes in organizations, including those processes involved in managing and developing IS projects (Kirsch, 1997; Mähring, 2002), global systems (Kirsch, 2004), outsourcing (Choudhury & Sabherwal, 2003), open sourcing (Stewart & Gosain, 2006), and information security (Boss, Kirsch, Angermeier, Shingler, & Boss, 2009). More recently, technological advancements have stimulated a growing interest in information systems control issues as organizations continue to struggle with how best to achieve their objectives (Harris et al., 2009; Rao et al., 2007). However, despite control-specific literature reviews conducted in other management fields (Berry, Coad, Harris, Otley, & Stringer, 2009; Ferreira & Merchant, 1992; Giglioni & Bedeian, 1974; Langfield-Smith, 1997; Sitkin, Cardinal, & Bijlsma-Frankema, 2010), we are unaware of any published reviews focused on control in an information systems context.

[4] We distinguish the concept of control from other related terms, such as governance, which refers to "the determination of the broad uses to which organizational resources will be deployed and the resolution of conflicts among the myriad participants in organizations" (Daily, Dalton, & Cannella, 2003, p. 371).

We argue that the research on IS control is distinct from other forms of control research (e.g., general management, accounting), which positions it as a unique academic contribution (Agarwal & Lucas, 2005). First, IS control is distinct because a technology artifact (e.g., application software, database, infrastructure) is being designed, built, and maintained. As a result, organizations use IS control not only to influence behavior in administrative matters (e.g., overseeing the creation of a new strategy or processing a series of bookkeeping entries) but also in developing tangible tools to support the broader business. This distinction opens IS control to a unique set of objectives and participants compared to control exercised in other business functions such as accounting, marketing, or manufacturing. Chua, Lim, Soh, and Sia (2012) suggest that controlees in IS processes come from a range of backgrounds, such as IS (e.g., developers), business (e.g., end users), and external sources (e.g., consultants). This varied collection of team members may regularly work with new colleagues, and the project-centric nature of IS initiatives places a significant focus on social, team-based interactions. Similarly, IS processes can commonly involve a significant number of staff, take an extended period of time to complete, be non-repetitive, and cross departmental boundaries; these characteristics can make using some control types problematic when compared to non-IS processes (Mähring, 2002). Past research, such as Halpern (1992), Mähring (2002), and Van Maanen (2010), has also shown that different types of professionals—including those in IT—employ and experience control in different ways. Overall, this collection of differences presents a unique opportunity to examine and theorize IS control issues.

Research has used a variety of terms when referring to IS control concepts. Table 1 outlines commonly used control terminology, including practical examples. Appendix A provides some additional terminology that the control literature both in IS and in other fields that study control uses.

Table 1. Control Terminology

Term and definition	Example	References
Information systems control: the attempt to intentionally affect the behavior of another person or group as a means to achieve objectives related to designing, developing, operating, using, and managing information systems.	Management in an organization undertaking a systems-development project may attempt to affect the behavior of employees by instituting a formal development methodology to require them to complete specific tasks and by providing a bonus to developers for error-free coding. The organization implements the controls to generate high-quality systems.	Choudhury & Sabherwal (2003), Kirsch (2004), Tiwana and Keil (2009)
Control mechanisms: the specific actions in an IS process that aid management in achieving organizational objectives. Control mechanisms specify particular actions (e.g., who will do what, when they will do it, what they will do, etc.).	Developers can use control mechanisms such as user storytelling to validate the requirements of a new information system. The control mechanism will specify who is involved (e.g., users and developers), when the control will be employed (e.g., at the point that requirements for a new system are being gathered and confirmed), and what the control entails (e.g., a comparison of user stories to the documented system requirements to identify inconsistencies).	ISACA (2012), Tiwana & Keil (2009)
Control modes: a framework to categorize control mechanisms. Control modes includes four modes of control that each represent a unique collection of actors and techniques used to achieve control. **Behavioral control** refers to the process of a supervisor overseeing the actions of subordinates. **Outcome/output control** refers to the managerial monitoring of an employee's level of output. **Clan control** uses social mechanisms and perspectives to influence the behavior of employee groups. **Self-control** refers to individuals who control their own actions outside of managerial directions.	Behavioral control: a manager that requires systems developers to submit daily reports on their project progress. Outcome control: a manager that requires each systems developer to submit a specific number of lines of code. Clan control: systems developers that work overtime so their peers do not think of them as lazy. Self-control: systems developers who take personal pride in developing high-quality, elegant code.	Kirsch (1996), Jaworski (1988), Ouchi (1978, 1979)

3 Results

By first mapping out the current state of the art of IS control research, we establish a baseline for what the field has discovered so far and what we have left to investigate. In Appendix B, we describe our approach to identify and analyze the collected IS control publications and the review's scope and boundaries in detail. We reviewed 65 publications (see Appendix C).

Our analysis resulted in our identifying five control dimensions and 18 sub-dimensions. We present each of these elements below (see Table 2) and overview the relationships identified between the dimensions (see Figure 1), which we refer to as the model of information systems control (MISC).

Table 2. IS Control Dimensions and Sub-dimensions

IS control dimensions	IS control sub-dimensions	Representative sub-dimension example
Control environment: the range of organizational and contextual factors that can influence the choice of IS controls.	**Strategy:** the influence of business and IS strategy employed in an organization on the nature of IS controls.	Where one implements formal control, a corresponding increase in the strategic role of a subsidiary will occur (Rao et al., 2007).
	Structure: the organizational structures that relate to the types of control chosen.	The design of organizational structures influences the types of controls that clients and systems-development vendors use (Choudhury & Sabherwal, 2003).
	Process: the characteristics of an IS process that influence the choice of IS controls.	One selects controls based on task characteristics and role expectations (Kirsch, 1997).
	Culture: the national or organizational culture characteristics that influence the choice of IS controls.	When formulating controls, managers should carefully consider the cultural aspects of the organization (Kulp, Randall, Brandyberry, & Potts, 2006; Stewart & Gosain, 2006).
	People: the characteristics of individuals participating in an IS process that influences the choice of IS controls.	Social capital (Kirsch et al., 2010), trust (Rustagi, King, & Kirsch, 2008), and ongoing social interactions (Choudhury & Sabherwal, 2003) play a role in driving the choice of IS controls.
Control mechanisms: the tools, activities, and initiatives used in an IS process that attempt to influence the behavior of individuals or groups. Includes policies, procedures, methodologies, audits, and management supervision.	**Category:** logical groupings of control mechanisms that exhibit similar high-level characteristics (e.g., control modes).	Outcome controls tend to be objective and clear (e.g., a manager sets a defined productivity target for employees to achieve), while clan control are associated with more complex factors such as ideology (Stewart & Gosain, 2006).
	Activity: specific control mechanisms designed and implemented at a specific point in an IS process (e.g., security policy, software testing tool).	Different systems development methodologies employ markedly different types of control activities (e.g., stage gates, pair programming, shared code ownership), which one can adapt to fit the circumstances of a particular project (Baskerville & Stage, 1996; Fitzgerald, 1996; Harris et al., 2009).
Control outcomes: the desired objectives of an IS process for which one implemented the IS controls.	**Quality:** receiving either process or product quality benefits through IS control.	Outcome control drives quality (e.g., bug severity) into the systems-development process to a greater extent than behavioral or self-control (Gopal & Gosain, 2010; Maruping, Venkatesh, & Agarwal, 2009).
	Profit and cost: increasing profits and reducing costs through IS control.	Achieving profit/cost objectives are linked to both behavioral and outcome control categories (Gopal & Gosain, 2010).
	Speed and schedule: delivering an IS initiative on time.	A link exists between IS controls and maintaining a set schedule for a process (Jiang, Klein, Hwang, Huang, & Hung, 2004; Orlikowski, 1991; Sia & Neo, 1997).

Table 2. IS Control Dimensions and Sub-dimensions

IS control dimensions	IS control sub-dimensions	Representative sub-dimension example
	Innovation: the degree of creativity, exploration and learning that is generated through the use of IS controls.	IS controls can stifle creativity and adaptability (Fitzgerald, 1996; Orlikowski, 1991).
	Compliance: the verification and fulfillment of relevant internal (e.g., management policies) or external (e.g., governmental guidelines) regulations, such as those established related to auditing and accounting.	Organizations typically pursue internal compliance to achieve other forms of IS control outcomes (e.g., quality, cost) and external compliance to conform with the law (e.g., Sarbanes-Oxley Act) (Jiang et al., 2004; Kulp et al., 2006; Spears & Barki, 2010).
	Hybrid: the achievement of multiple performance-related objectives resulting from employing IS controls.	IS controls in the systems-development process can simultaneously relate to achieving cost efficiency, quality, and speed (Nidumolu & Subramani, 2003; Tiwana, 2010; Tiwana & Keil, 2009).
Control execution: the operation and alteration of IS controls over time.	**Control effectiveness:** the extent that one perceives an implemented control to achieve objectives specific to the IS process.	Poor project performance such as implementation failures or limited cost reductions point managers to the ineffectiveness of project controls (Kraut & Streeter, 1995; Sia & Neo, 1997).
	Control evolution: the incremental adjustments that occur to implemented controls because of their ongoing use, interpretation, and adaption by controllers and controlees.	The phase of the project and the experience of controlees is associated with changes in how IS control is exercised (Kirsch, 2004; Orlikowski, 1991).
Control experiences: the social and emotional consequences of IS controls on employees.	**Motivation and satisfaction:** the intrinsic and extrinsic motivations that an individual or group has to participate on an IS initiative and their satisfaction with the initiative as it relates to IS control.	IS controls can encourage intrinsic and extrinsic motivations that researchers have shown to influence an individual's participation in an IS initiative and cultivate feelings of satisfaction, which can work to reinforce the related controls in organizational processes (Roberts, Hann, & Slaughter, 2006; Santana & Robey, 1995; Sia & Neo, 1997).
	Psychological and cognitive structures: an individual's psychological state stemming from the existence of IS controls.	IS processes can result in employee feelings of stress, uncertainty, and oppression (Baronas & Louis, 1988; Olson, 1982; Orlikowski, 1991).
	Socialization: the interactions and relationships between or in controller and controlee groups that result from IS controls.	Effective clan control requires building social capital and reinforcing a team's shared beliefs and values to influence the team's communication quality, trust, and expectations (Chua et al., 2012; Kohli & Kettinger, 2004; Stewart & Gosain, 2006).

Although the theory contribution from this initial exercise is limited to Gregor's (2006) type I (analysis) category, we argue that we need such a contribution to "identify critical knowledge gaps and thus motivate researchers to close this breach" (Webster & Watson 2002, p. xix). By first mapping out the territory of past IS control research, we develop a model that one can subsequently apply to the future IS control challenges that the current literature does not yet address. We present this model in Figure 1 and examine it in more detail in Section 4. In Section 5, we also examine a series of propositions in the context of a specific emerging IS control process. By completing this second activity, we extend the theory contribution beyond the initial type I category to a more insightful type III (prediction) level per Gregor's (2006) taxonomy.

In this section, we synthesize insights from the IS control literature that extend from our identified control dimensions in Table 2 to examine the relationships among the five control dimensions and their underlying sub-dimensions that emerged from our analysis. We structure this overview in terms of four sets of relationships (indicated by the numerals in Figure 1) between the control dimensions that we found to be most prominent: 1) control environment and control mechanisms, 2) control mechanisms and control outcomes, 3) control execution and control environment/control mechanisms/control outcomes, and 4) control experiences and control environment/control mechanisms/control outcomes [5]. We map the dimensions to each paper reviewed in Appendix D. The arrows noted in Figure 1 represent the causal relationships that the literature has identified.

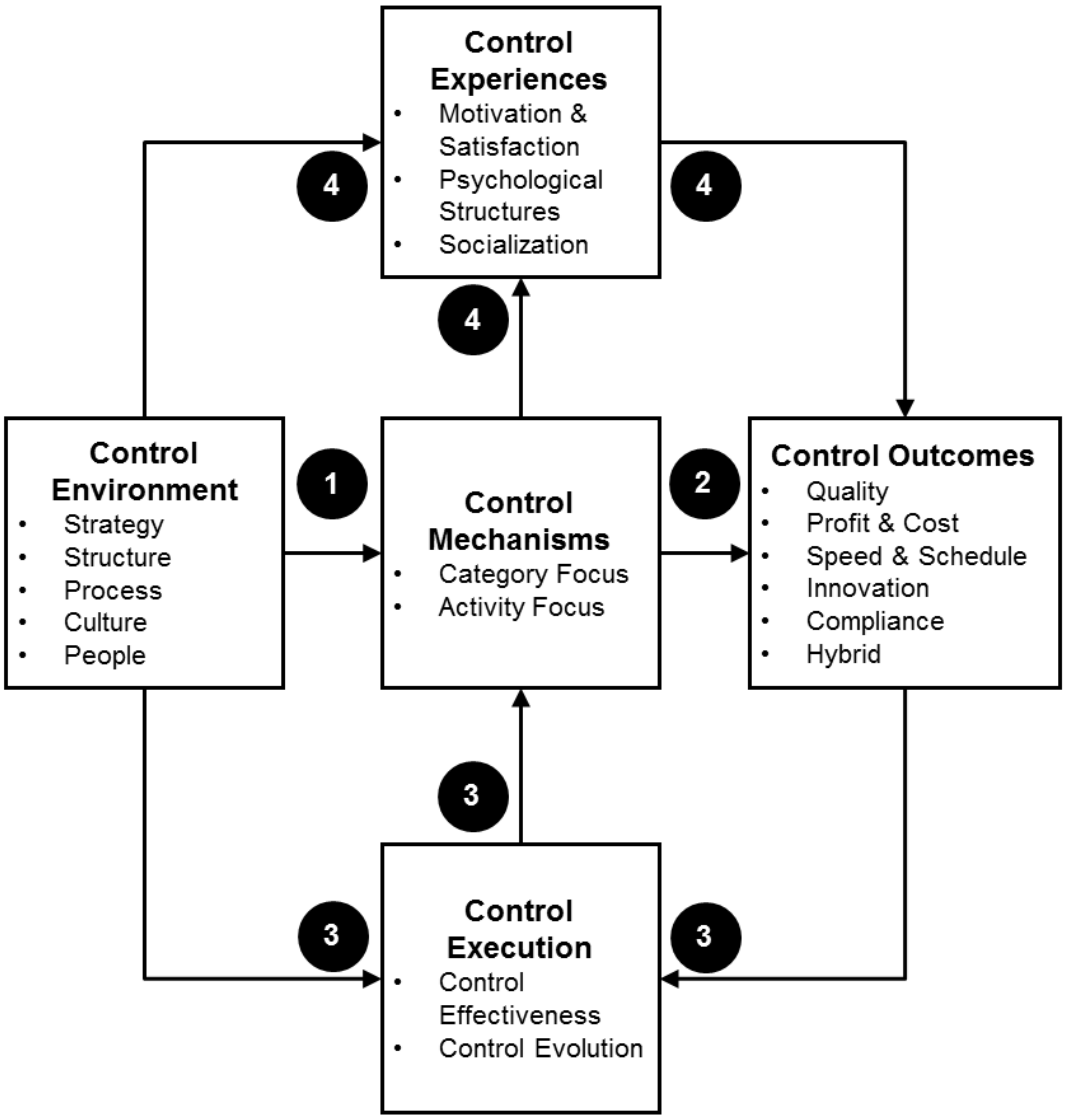

Figure 1. Model of Information Systems Control (MISC)

[5] We group the control environment, control mechanisms, and control outcomes dimensions together when examining their relationships with the control execution and control experiences dimensions rather than the individual links (e.g., control execution-control environment, control execution-control mechanisms) because of similarities and overlaps in the noted relationships. Our analysis suggested that dividing the relationships would not significantly alter the results.

3.1 The Relationship between the Control Environment and Control Mechanisms Dimensions

This area of the IS control literature examined fundamental questions related to how circumstances in the control environment influence the choice of IS control mechanisms that are put into place (see Figure 2). Of the 65 papers in our review, 28 focused on the links between the control environment and control mechanisms dimensions. We highlight key findings from this body of literature below.

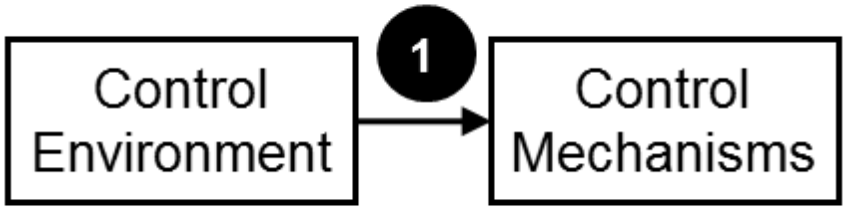

Figure 2. The Control Environment and Control Mechanisms Relationship

3.1.1 What We Know from the IS Control Literature: Control Environment and Control Mechanisms

Much of the research in this subset of the IS control literature examined the five control environment sub-dimensions that contribute to the choice of IS control mechanisms: strategy, structure, process, culture, and people. For example, studies found that strategic considerations such as the competitive environment and strength of global markets influence control mechanism choices (Harris et al., 2009; Karimi & Konsynski, 1991). Driven by the nature of such strategic considerations, managers react by implementing control mechanisms that are consistent with their strategic vision (Orlikowski, 1991). In situations where markets are uncertain, research has found that systems development approaches that include a carefully bounded scope and ongoing feedback outperform both a pure, plan-driven approach and an ad hoc approach (Harris et al., 2009). Such control decisions initiated from strategic considerations can have notable consequences elsewhere in the organization. For example, research has found that, where one implements formal controls, a corresponding increase in the strategic role of a subsidiary occurs (Rao et al., 2007). However, research has highlighted the ability to implement controls in a timely and flexible manner as being a key strategic consideration (Karimi & Konsynski, 1991). Control impediments such as a lack of system flexibility and insufficient time moderate the link between the strategy sub-dimension and control mechanisms (Duh, Chow, & Chen, 2006).

Research has found other control environment sub-dimensions, such as structural characteristics including organizational design and project size, to influence how organizations exercise control mechanisms (Choudhury & Sabherwal, 2003; Kling & Iacono, 1984; Orlikowski, 1991). Findings suggest that one should match controls employed in a development project to an organization's structural characteristics while also considering the project's extent of technology use and size (McFarlan, 1981). Traditionally, control research has focused on structures in a single organization; however, because of the rise of IS processes being outsourced, the focus has expanded to inter-organizational structures as well (Choudhury & Sabherwal, 2003; Tiwana & Keil, 2009).

At a more micro level, other research has considered the inter-personal structures embedded within IS processes that drive decisions about control mechanisms. Research has found the nature of the structures in place between controllers and controlees (Tiwana & Keil, 2009), developers and users (Baskerville & Stage, 1996), and clients and vendors (Choudhury & Sabherwal, 2003) to influence the types of control mechanisms that organizations select. This finding has important implications for new projects and large, long-term projects where one would expect the structures to evolve and change over time and, thus, drive a need for ongoing control monitoring and change.

Other research on the links between the control environment and control mechanisms has found that process characteristics are a critical driver for managers to decide on what IS control mechanisms to implement. A contingency approach is common in this subset of the literature: in this approach, one considers the behavior observability and outcome measurability of a process (Kirsch, 1996; Kirsch, Sambamurthy, Ko, & Purvis, 2002; Tiwana & Keil, 2009), task characteristics and role expectations (Kirsch, 1997), and the degree of requirements certainty for a project (Nidumolu, 1996; Rustagi et al.,

2008). Depending on the characteristics present in the process under examination, the research findings point to connections with either formal or informal categories of control mechanisms. Although the early literature focusing on the process environment considered control selection in a static, point-in-time perspective, more recent research has increasingly recognized the IS process changes that can result in corresponding control changes. In one example, research found that organizations relied on outcome controls at the beginning of projects but added behavior and self-controls in subsequent project stages (Choudhury & Sabherwal, 2003).

Although research has examined links between cultural elements of the control environment and control mechanisms only occasionally, research has viewed factors such as ideology, geographic location, and the value placed on formality by a culture as influencing the choice of particular controls (Kirsch, 2004; Kirsch et al., 2002; Kling & Iacono, 1984). This research suggests that, when formulating control mechanisms, managers should carefully consider the cultural aspects of the organization, particularly when cultural characteristics differ from traditional models, such as in open source software teams (Kulp et al., 2006; Stewart & Gosain, 2006). Importantly, this subset of the control environment literature also considers how cultural assumptions, values, and norms contribute to establishing IS controls that become deeply embedded in an organization's processes (Orlikowski, 1991; Stewart & Gosain, 2006). This research is particularly relevant to understanding the growing pervasiveness of technology in organizations and the role that this growth plays in entrenching controls that can subsequently be difficult to alter.

Various studies have examined how individual employee characteristics impact the choice of control mechanisms. Findings suggest that both individual characteristics and interpersonal relationships drive the selection of particular types of IS controls. Much of the work at an individual level focuses on the role that differing skills and knowledge, both for controllers and controlees, can have on the selection of controls (Kirsch, 1996, 1997, 2004; Kirsch et al., 2002). This work is particularly relevant in an outsourcing environment where research has identified different trends relative to traditional internal IS processes (Rustagi et al., 2008; Tiwana & Keil, 2009).

In examining the role of interpersonal characteristics, the research has found that social capital (Kirsch et al., 2010), trust (Rustagi et al., 2008), and ongoing social interactions (Choudhury & Sabherwal, 2003) all play a role in driving the choice of IS control mechanisms. Particularly in light of the rise of new systems-development approaches such as agile development, which rely on autonomy and team responsibility rather than traditional formal controls, these findings have wide-ranging implications for practitioners.

3.1.2 What We Don't Yet Know From the IS Control Literature: Control Environment and Control Mechanisms

The control research concerned with the strategic environment has focused largely on intermittently interpreting strategic cues from external sources. As researchers conduct more work in this area, it will be valuable to uncover how organizations can become more agile in altering their controls based on market, customer, and competitive data that is increasingly becoming available. Emerging areas such as big data and analytics may be able to provide powerful strategic insights to organizations that can allow control decision making to become more dynamic.

As most control research considering structural and process elements of the environment focused on systems-development projects, we have yet to uncover interesting insights related to other IS processes, such as managing enterprise architecture. However, despite calls for more control work in organizational processes that span business and IS departments (Kirsch et al., 2002), researchers have scarcely conducted research to examine controls in these other processes. As IS-business process integration becomes more important in today's organizations (e.g., enterprise architecture processes), shedding light on this link between the control environment and control mechanisms will become increasingly important.

As for the relationship between the culture sub-dimension and control mechanisms, an opportunity exists to further investigate the implications of the new generation of employees currently entering organizations in which control expectations are evolving due to issues such as environmental sustainability, leadership transparency, and social interaction. As researchers conduct more work in this area, we will need to uncover if these evolving cultural norms contribute to control mechanism adjustments in the IS processes that underpin many of the changes (e.g., environmental sustainability tools).

Although a proportion of the past research examining the people sub-dimension has considered the impact of changing personal/interpersonal characteristics over time (e.g., Choudhury et al. 2003), additional areas worthy of investigation exist. Because of the extensive links that research has found

between employee characteristics and the control mechanisms managers use to influence their behavior, an opportunity exists to further examine how controls can be dynamically adjusted to compensate for changes in characteristics such as employee knowledge. Such insights may be particularly important in emerging IS processes such as data analytics, where employees are quickly developing new skills and capabilities.

3.2 The Relationship between the Control Mechanisms and Control Outcomes Dimensions

This subset of the IS control literature examined fundamental questions related to how the choice of IS control mechanisms leads to particular outcomes (see Figure 3). Of the 65 papers in our review, 30 focused on the links between the control mechanisms and control outcome control dimensions. We highlight key findings from this body of literature below.

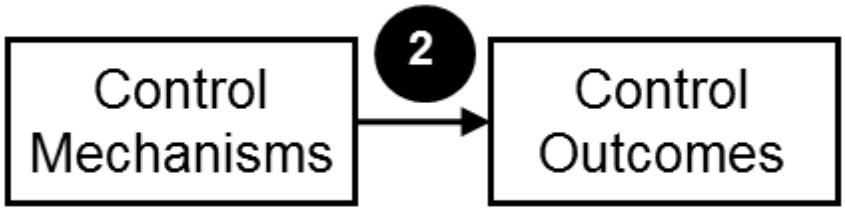

Figure 3. The Control Mechanisms and Control Outcomes Relationship

3.2.1 What We Know From the IS Control Literature: Control Mechanisms and Control Outcomes

Past studies of IS control have established links between the choice of control mechanisms and a variety of possible outcomes. For example, research has found that mechanisms that specify a desired outcome drive quality into the systems-development process to a greater extent than behavioral or self-control modes (Gopal & Gosain, 2010; Maruping et al., 2009). Such findings are particularly useful to managers in guiding their control mechanism selection.

In contrast, research has linked achieving profit/cost outcomes to both behavioral modes and outcome modes (Gopal & Gosain, 2010). Because cost drivers are a prime consideration for outsourcing IS services, this research includes a notable proportion of outsourcing-focused publications in addition to the typical focus on systems-development processes. Studies in this area share characteristics with the project management literature in that they have focused on topics such as staff workload (Sia & Neo, 1997) and efficiency (Gopal & Gosain, 2010). An associated subset of the literature examining speed and schedule has confirmed the link between IS control mechanisms and the improved speed/schedule adherence of a process (Jiang et al., 2004; Orlikowski, 1991; Sia & Neo, 1997). Similar to the profit/cost sub-dimension, research has found that both behavioral and outcome control mechanisms are associated with improved process efficiency. However, a key distinction in the speed/schedule sub-dimension is the finding that, where organizations linked outcome controls to quality objectives (e.g., project goals focus on quality, employee rewards were based on quality), a negative impact on speed and schedule outcomes for that project occurred (Gopal & Gosain, 2010). This finding suggests that pursuing some control outcome sub-dimensions may be incompatible with others and that managers should carefully consider how controls selected to achieve one objective may be working at cross-purposes with another.

In contrast to findings outside of an IS-specific context that suggest controls can positively influence both radical and incremental innovations (Cardinal, 2001), the findings related to the links between control mechanisms and innovation outcomes predominantly note the stifling of creativity and limiting of adaptability that flow from using controls (Fitzgerald, 1996; Orlikowski, 1991).

With regard to compliance, the IS literature has found a positive relationship between control mechanisms and compliance outcomes. Organizations typically pursue internal compliance to achieve other forms of IS control outcomes (e.g., quality, cost) and external compliance to conform to the law (e.g., Sarbanes-Oxley Act) (Jiang et al., 2004; Kulp et al., 2006; Spears & Barki, 2010).

3.2.2 What We Don't Yet Know from the IS Control Literature: Control Mechanisms and Control Outcomes

This area of research has focused predominantly on systems-development projects. As a result, studies have generated useful insights into the quality, costs, and speed of software products. However, the growing role of IS departments has not only created new software but also facilitated a range of organizational processes via technology. As such, there is an increasing importance on understanding how control mechanisms enable outcomes in other IS processes.

Because many quantitative studies have measured the extent of control outcomes (e.g., profit and cost results), much of the literature in this area has considered the role of formal control mechanisms. Relatively little research has investigated informal, team-based controls, such as how clan and self-control categories relate to control outcomes (e.g., quality). Such research is of particular interest in light of the trend in IS processes to employ autonomous teams.

Some studies have examined the extent that control mechanisms categories complement each other in attempting to achieve an integrated collection of objectives (Tiwana, 2010), but such work stops short of determining the extent that control outcomes (e.g., quality, cost, speed) complement each other. Future studies could extend this line of inquiry by considering the control mechanisms that are associated with one or more of the control outcome sub-dimensions. Such insights could aid mangers in "hitting two birds with one stone" by employing controls that improved cost *and* speed rather than cost *or* speed.

We found limited research focusing on the control mechanism-innovation linkage, and additional research on uncovering if circumstances of IS control and innovation can co-exist would be useful and interesting to many forward-thinking organizations in the midst of adopting new technologies and IS processes. In these situations, managers commonly implement controls in pursuit of other control outcomes (e.g., quality) but do not wish to inhibit the creative benefits that may be generated in the process.

Finally, despite the growing focus on internal controls stemming from recent business failures (e.g., Enron, WorldCom), we found few IS control-based studies on compliance. Closer interdisciplinary collaboration with accounting researchers and practitioners could provide a useful contribution to the field. Particularly in industries such as banking where highly complex systems and processes are subject to external regulation, challenges may exist in designing control mechanisms that effectively achieve compliance outcomes. Future research may uncover useful approaches to better facilitate the process of complying with these internal and external guidelines.

3.3 The Relationship between the Control Execution and Control Environment/ Mechanisms/Outcomes Dimensions

The third set of control dimension relationships examined in the literature focused on how the control execution dimension relates to the control environment, control mechanisms, and control outcomes (see Figure 4). This body of research focused on examining how effective controls are in practice and how managers modify them over time. Research in this area draws links between the control execution dimension and the control environment (i.e., environmental factors lead to control changes), control mechanisms (i.e., tweaking control characteristics over time to be more effective), and control outcomes (i.e., poor performance leads to control adjustments). However, we found few studies in this area despite the potential to enhance the practical, day-to-day oversight of IS controls. Of the 65 papers examined in this review, 13 considered the relationships between control execution and one or more of the control environment, control mechanisms, and control outcomes dimensions. In Sections 3.3.1 and 3.3.2, we outline the findings related to the control execution dimension.

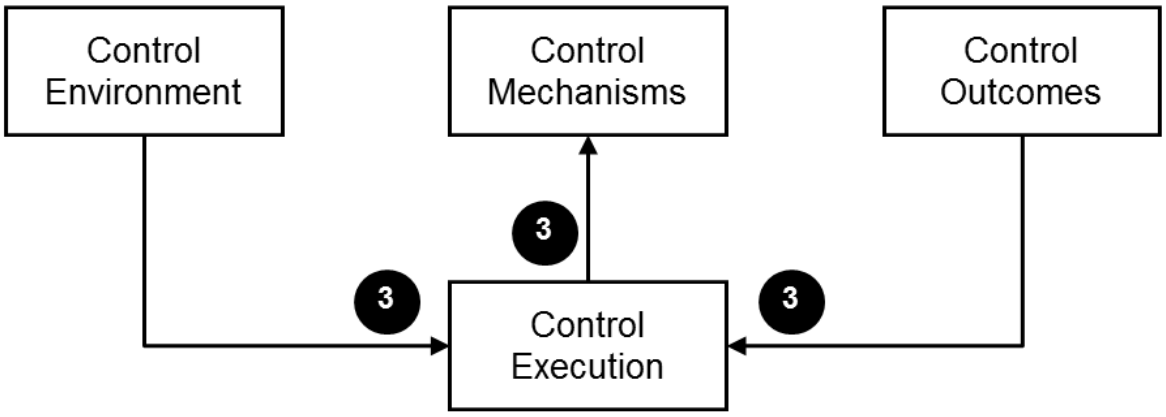

Figure 4. Relationships with the Control Execution Dimension

3.3.1 What We Know from the IS Control Literature: Control Execution and Control Environment/Mechanisms/Outcomes

Past studies of IS control have established that evaluations of control effectiveness commonly stem from control outcome observations such as identifying performance problems (e.g., a project is behind schedule) and confirming that controls are operating as intended (e.g., software quality has improved since a new policy was implemented) (Choudhury & Sabherwal, 2003; Gregory et al., 2013). In circumstances where an organization perceives control outcomes as being achieved, it also tends to view control mechanisms as being effective; where an organization perceives control outcomes as inadequate, it commonly views control mechanisms as ineffective.

Research in this area has typically investigated control effectiveness in the context of failing systems-development projects (Choudhury & Sabherwal, 2003; Jin & Montague, 2003). In these cases, poor control outcomes such as implementation failures or limited cost reductions point managers to the ineffectiveness of control mechanisms (Kraut & Streeter, 1995; Sia & Neo, 1997). After investigating the IS control mechanisms that organizations consider to be inadequate, Choudhury and Sabherwal (2003) found that they commonly add supplementary or revised controls based on a renewed consideration of the control environment factors.

An alternative view is that evolving controls result from shifting control environment characteristics, such as controller-controlee interactions, transparency, expectations, and shared values (Choudhury & Sabherwal, 2003; Kohli & Kettinger, 2004). Research adopting this perspective has found control evolution to be a function of the changing nature of projects and people over time. For example, research has linked the phase of the project and the experience of controlees linked to changes in how organizations exercise IS control (Gregory et al., 2013; Kirsch, 2004; Orlikowski, 1991). Organizational structures also influence control changes over time. When an organization implements a new system or completes process reengineering, it results in IS control modifications (among other modifications) that better meet the organization's needs (Sia & Neo, 1997; Silva & Hirschheim, 2007).

3.3.2 What We Don't Yet Know From the IS Control Literature: Control Execution and Control Environment/Mechanisms/Outcomes

This collection of studies has highlighted the iterative, trial-and-error nature of designing, monitoring, and redesigning IS controls. Although past research recognizes that not all control mechanisms work as intended and that changing control environment circumstances may reduce the achievement of control outcomes, relatively few studies have considered these longitudinal, dynamic perspectives on IS control. Further examinations of the specific steps that managers take to evaluate control effectiveness in new and emerging IS processes and multi-level considerations of organizational, team, and individual variables would provide an interesting contrast to the current work that has primarily examined systems development initiatives at the project level. Because a relatively small collection of case studies primarily influence current views in the field, it remains unclear if identified patterns of dynamic control evaluation and adjustment exist across a broad range of organizations, industries, and IS processes. Better understanding and refining such control

improvement-oriented processes could contribute significantly to the effectiveness of controls in situations of rapid technical change and fluctuating control environment factors.

3.4 The Relationship between Control Experiences and Control Environment/Mechanisms/Outcomes Dimensions

The fourth set of control dimension relationships examined in the literature focused on the links between the control experiences dimension and the control environment, control mechanisms, and control outcomes dimensions (see Figure 5). Research in this area of the IS control literature focused on the social and emotional implications of attempting to influence employee behavior by considering links with the control environment (i.e., elements of the environment drive employee perceptions of control), control mechanisms (i.e., the consequence of a mechanism on employees), and control outcomes (i.e., the resulting organization impact of employees' reactions to control). Outside of this subset of the literature, most studies adopt a managerial viewpoint and examine the choices that managers need to make to control employees' activities. However, this research recognizes that control choices have implications, which can contribute to either positive or negative consequences for staff and process performance. Of the 65 papers we examined in this review, 16 considered the relationships between the control experiences dimension and one or more of the control environment, control mechanisms, and control outcomes dimensions. In Sections 3.4.1 to 3.4.2, we outline the research associated with the control experiences dimension.

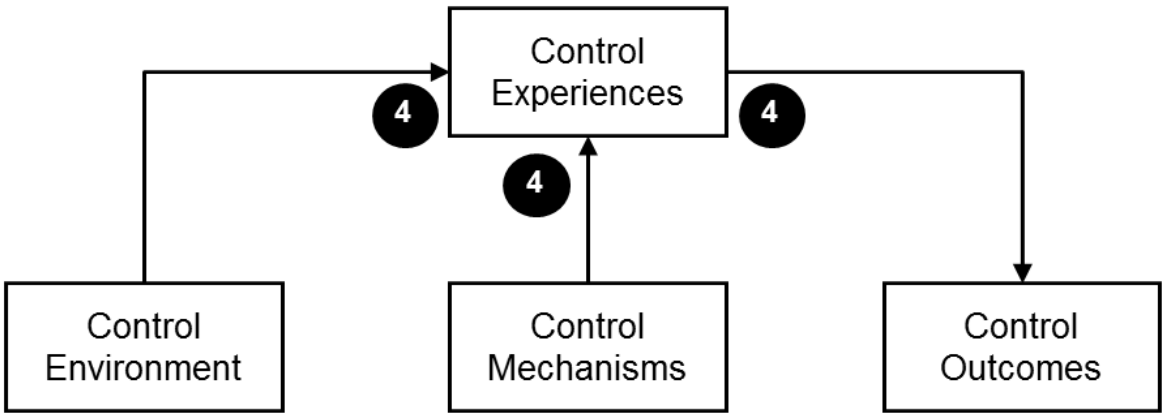

Figure 5. Relationships with the Control Experiences Dimension

3.4.1 What We Know from the IS Control Literature: Control Experiences and Control Environment/Mechanisms/Outcomes

Research has established a series of important links between the control experiences dimension and the control environment, control mechanisms, and control outcomes dimensions. Beginning with the motivation and satisfaction sub-dimension, past research has found a connection between the IS control mechanisms that managers implement and subsequent impacts on employee well-being. In situations where employees see an IS activity or tool to slow or obstruct their actions, they may experience diminished motivation or seek control workarounds to re-establish their autonomy, which undermines the effectiveness of the control and the resulting outcomes (Orlikowski, 1991). However, the research also suggests that some IS control environment and control mechanism characteristics can encourage intrinsic and extrinsic motivations that influence an individual's participation in an IS initiative and cultivate feelings of satisfaction, which can work to reinforce the related controls in organizational processes and drive improved outcomes (Roberts et al., 2006; Santana & Robey, 1995; Sia & Neo, 1997). One method of cultivating this motivation is by convincing employees that they have no option but to adhere to IS control mechanisms (Boss et al., 2009), which one can establish through control environment elements, such as in the process and structure sub-dimensions. Research has noted similar findings in the psychological structures sub-dimension; namely, that changes in IS processes can result in employee feelings of stress, uncertainty, and oppression (Baronas & Louis, 1988; Olson, 1982; Orlikowski, 1991). The control mechanisms associated with such initiatives may restrict employee creativity, intuition, and learning, which can, in turn, negatively impact outcomes (Fitzgerald, 1996). Finally, research suggests that the

socialization sub-dimension encourages employees to internalize the organization's assumptions and beliefs as a means to influence shared norms through using particular vocabulary, images, and relations to understand the norms of behavior (Orlikowski, 1991). Past studies have established links between control mechanisms and the structural, cognitive, and relational dimensions of social capital. In particular, effective clan control requires building social capital (e.g., relationship building activities) and reinforcing a team's shared beliefs and values to influence the team's communication quality, trust, and expectations (Chua et al., 2012; Kohli & Kettinger, 2004; Stewart & Gosain, 2006).

3.4.2 What We Don't Yet Know From the IS Control Literature: Control Experiences and Control Environment/Mechanisms/Outcomes

Research examining the links between the control experiences dimension and the control environment, control mechanisms, and control outcomes dimensions has confirmed that employees can experience both positive and negative consequences from IS controls. However, since most IS control research is oriented from the position of the controller, few studies have examined controls that can develop employee feelings of comfort, contentment, equality, or power. Additional studies that further clarify the lower level characteristics of control mechanisms that contribute to motivating and satisfying employees and those that have the opposite effect would be highly useful for managers wishing to establish IS processes that recognize the importance of worker well-being. In addition to the employee-focused benefits, it is unclear how improved employee motivation and satisfaction contributes to subsequent control outcome improvements, such as IS process innovation, quality, or speed.

Much of the research in the socialization sub-dimension focuses on interactions between members of systems-development projects, but it is unclear if we can apply the findings to other IS processes. With organizations increasingly adopting highly interdisciplinary processes such as enterprise architecture, which facilitates the development of organization-wide plans for information, processes, and technology, future research could investigate how controls relate to socialization between organizational stakeholders that may share conflicting views on organizational objectives, politics, and priorities.

In summary, we identified four groups of relationships amongst the five control dimensions in our analysis. While considering the links between the constructs, we also examined the role of theory in framing these relationships, which we discuss in Section 3.5.

3.5 The Use of Theory in IS Control Research

Based on our analysis and drawing on control research outside of IS, we recognize three theories as being broadly applicable to control issues: agency theory, organizational control theory, and labor process theory. Although these theories are the most prevalent theoretical foundations used in the control literature, we recognize that other theoretical paradigms exist and could supplement the approaches discussed below. We characterize each theory by a distinct focus, underlying assumptions, focal actors, and outcomes of interest. Table 3 compares these characteristics. Based on our analysis, we found that researchers have most commonly applied agency theory when studying relationships between the control environment and control mechanisms dimensions and between control mechanisms and control outcomes dimensions. In comparison, researchers have often drawn on organizational control theory when studying relationships with the control execution dimension. Finally, researchers have most frequently applied labor process theory when examining relationships with the control experiences dimension.

Agency theory, which researchers commonly view as contributing many of the principles adopted in control research (Tiwana & Keil, 2009), deals with the relationship between one party (the principal) who delegates work to another party (the agent). Agency seeks to resolve two problems: 1) principals' and agents' divergent interests and 2) the difficulty in verifying what the agent is actually doing (Eisenhardt, 1989). The principal is intent on ensuring that the agent behaves in a way consistent with organizational goals based on the assumption that agents are unreliable and likely to shirk responsibility (Eisenhardt, 1989). Agency theory assumes an implicit contract between principals and agents (Jensen & Meckling, 1976) to influence agent behavior in a manner that is consistent with the principal's objectives (Eisenhardt, 1989; Jenson & Meckling, 1976; Sharma, 1997). Because of the variability in organizational environments, the nature of the controls put into place is subject to the particular context that the principal faces in terms of the task characteristics the agent needs to conduct, the extent that the principal can observe the agent's activities, and the information available to the principal on the agent's activities. Depending on these and other factors, the terms of the implicit contract depend on the particular situation facing the principal and agent (Eisenhardt, 1985, 1989). One application of the theory, termed positivist agency

theory, focuses on situations where principals and agents have conflicting goals and examines the control mechanisms used to restrict the divergence of interests between the two parties (Eisenhardt, 1989). Whereas this view of the theory typically considers an owner-manager relationship, a second application called principal-agent research takes a broader view of agency, including doctor-patient, employer-employee, and principal-professional relationships (Harris & Raviv, 1978; Kohli & Kettinger, 2004; Sharma, 1997). This perspective on agency theory seeks to identify the optimal principal-agent contract while considering varying levels of outcome uncertainty, risk acceptance, and information (Eisenhardt, 1989). From an IS control perspective, agency theory helps to frame the relationships between managers and employees participating in IS processes by providing a lens for understanding their distinct interests (e.g., the timeliness of a systems-development project versus the quality of the resulting system) and the techniques used to design the resulting controls (e.g., a systems development methodology to guide developer activities).

Table 3. Theoretical Paradigm Comparison

Paradigm characteristic	Agency theory	Organizational control theory	Labor process theory
Core focus	Using control mechanisms to restrict the divergence of interests between principals and agents.	How managers use the operational information at their disposal and make decisions that affect the organization.	Examines structures and processes to advocate on behalf of employees who are viewed as being taken advantage of.
Underlying assumptions	Principals and agents have divergent interests; verifying agent activities is difficult for the principal; agents will shirk responsibility if not controlled.	A manager's ability to access and act on information related to organizational activities enables them to achieve objectives and goals.	Capitalistic society imposes inequalities on employees, such as workforce deskilling, knowledge restriction, and an unfair balance of power.
Focal actor(s)	Principals (e.g., owner, managers) and agents (e.g., managers, employees).	Managers.	Employees.
Outcomes of interest	Achieving principal goals and objectives.	Achieving organizational goals and objectives.	Worker well-being.

A second theory used to evaluate control phenomena considers managers as the nerve center of the organization in that their jobs require them to effectively collect, store, and disseminate information relating to day-to-day business activities. Taking an information processing theory approach, Macintosh (1994) argues that a manager's ability to access and act on information related to organizational activities enables the organization to achieve its objectives and goals. IS research that examines the control execution dimension most commonly applies this theoretical approach by focusing on the stream of information that can drive dynamic decision making in organizations. By evaluating changes to the control environment and control outcomes, managers can more effectively evolve their control mechanisms. In addition to considering the mechanisms used to regulate the behavior of employees, this perspective also considers how managers use the operational information at their disposal and make decisions that affect the organization. This approach is consistent with Eisenhardt's (1985, 1989) view of organizational control theory. Here, research sees activities such as performance evaluation, monitoring and rewarding, and the measurement of behaviors and outcomes to be critical to enable managers to facilitate oversight of organizational activities. Where managers identify issues, they take remedial actions to achieve a resolution. In an IS control context, organizational control theory provides a lens to reveal the dynamism and evolution taking place in IS processes by considering how managers obtain, evaluate, and respond to information to make control adjustments (e.g., a systems-development project falling behind schedule is required to report more frequently on its status to management).

A third theory used in the IS control literature is labor process theory, which seeks to free workers from inequalities existing in capitalistic society by considering issues of power, politics, social relationships, and individual identity (Delbridge, 2010; Doolin & Lowe, 2002; Macintosh, 1994). This approach advocates on behalf of employees who experience acts of workforce deskilling, restricted knowledge, and an unfair balance of power. We see elements of the labor process view primarily in IS studies considering the links between the control experiences dimension and the control mechanisms. One can frame this relationship in the context of control mechanisms that constrain the creativity and learning of staff (Fitzgerald, 1996) or more implicitly in the concept of empowerment through self-control and clan-control mechanisms (Kohli &

Kettinger, 2004). The labor process paradigm builds on the broader tenets of critical social theory (Delbridge, 2010) and brings a distinct perspective to control research by "ferreting out abusive control, challenging the supremacy of controlling forces, and devising radical alternatives" (Jermier, 1998, p. 235). A core component of critical theory is to study the structures of domination and processes that lead to the need to emancipate individuals (Brooke, 2002). The theory advocates for staff to enable their intrinsic right to emancipation from political and labor constraints via conditions such as self-determination, self-reflection, social justice, and due process (Hirschheim & Klein, 1994; Mumford, 1983). Past research applies this paradigm in IS processes such as systems development, where one can assess the emancipatory potential of a development approach based on the extent of user participation, improvement in quality of life, job satisfaction, and the effective use of people and technology (Hirschheim & Klein, 1994). Where organizations do not respect such considerations, social critical theory suggests that controlees will experience unfair and unjust social and emotional circumstances. In contrast to the other two paradigms that focus primarily on company owners and managers, the labor process perspective focuses exclusively on the well-being of the employees who are the subject of others' oppressive actions.

Although agency, organizational and labor process theory were the dominant approaches that the papers in this review adopted, we recognize that other studies of control outside of IS have adopted alternative approaches and that theories used elsewhere in IS research could provide valuable insights into IS control issues. Such alternative approaches might include applications of theory X and Y (McGregor, 1960; Ouchi, 1982), evolutionary theory (Lycett & Paul, 1999), deterrence theory (D'Arcy, Hovav, & Galletta, 2009), and work systems theory (Alter, 1999).

Each of agency, organizational, and labor process theory considers how and why organizations use controls and what impacts they can have. However, the core focus and underlying assumptions of each theory vary in relation to how and why organizations employ control. Whereas agency theory considers the divergent interests between principals and agents as the motivation to employ controls, organizational control theory is increasingly concerned with the challenges of managerial decision making. Agency theory's view of powerful managers guiding subordinates to comply with directives differs from organizational control theory's suggestion that controls can provide managers with the ability to access and act on operational information that one can use to respond to changing situations and guide employee behavior. In contrast to these views from the owner and manager perspective, labor process theory considers the power dynamic from the employee's standpoint. By examining the structures that controls establish in organizations, this perspective assesses the extent to which the control impacts individuals. Consistent with past commentators such as Eisenhardt (1985) and Macintosh (1994), we argue that control-related research can benefit from considering and comparing multiple theoretical lenses. We develop this opportunity and others stemming from our analysis in Section 4.

4 Discussion

In Section 3, we outline five dimensions and 18 underlying sub-dimensions that emerge from the IS control literature and that we examine in the context of four distinct relationships between the control dimensions: 1) control environment and control mechanisms, 2) control mechanisms and control outcomes, 3) control execution and control environment/mechanisms/outcomes, and 4) control experiences and control environment/mechanisms/outcomes. Individually, each set of relationships highlights important and useful insights between the dimensions and establishes a distinct approach that aids in clarifying the current state of research in the field. This exercise allows one to analyze and describe the IS control literature and answer "what is", which corresponds to Gregor's (2006) type I (analysis) theory. This analysis allows one to identify gaps in the literature, which can motivate future research. We discuss these gaps below, propose an approach to enhance the breadth of IS control research, and advocate for an increasingly holistic research approach that considers the inter-relationships between IS control dimensions. In doing so, we move the theory contribution towards Gregor's (2006) type III (prediction) theory category by outlining testable propositions that seek to predict control relationships in emerging IS processes.

4.1 Future Research Direction #1: Expanding the Breadth of IS Control Research

Two key observations emerge from the results we outline in Section 3. First, past IS control research has focused overwhelmingly on three IS processes: managing systems development, managing outsourcing, and managing information security. As we note above, we view the term "process" in line with the COBIT framework as a collection of organizational practices that takes inputs and produces outputs in the form of

IS products and services (ISACA, 2012). Taken together, such processes comprise the end-to-end responsibilities of an IT department that range from planning processes such as "managing human resources" and "managing strategy" to implementation processes such as "managing projects" and "managing changes" and to support processes such as "managing operations" and "managing problems" (refer to Appendix E for a complete list of the COBIT-defined IS processes). Each of these 37 COBIT processes includes extensive guidelines and best practices on controls that range from formal policies and managerial oversight to staff consultation and periodic performance evaluation. In this context, IS processes are distinct from business processes such as "manage payroll" in that they are the IT department's rather than a business department's responsibility.

Of the 65 papers in our review, 57 addressed issues in one of these three traditional processes (see Figure B2 in Appendix B). Although the management of systems development, outsourcing, and information security are undoubtedly important processes that struggle with control issues, a variety of research suggests that IS departments are responsible for overseeing the operation of many additional processes that also have control-related problems (Bradley, Pratt, Byrd, Outlay, & Wynn, 2012; Chen, Chiang, & Storey, 2012; Yang & Tate, 2012). Many of these IS processes, which we refer to as "emerging", are fundamentally different from traditional IS processes (see Table 4). Such emerging IS processes include APO03 (manage enterprise architecture), APO04 (manage innovation), DSS02 (manage service requests and incidents), and DSS04 (manage continuity). Although we suggest that the identified characteristics are key in differentiating traditional from emerging IS processes, we do not intend the list to be exhaustive; that is, other distinguishing factors may exist.

Table 4. Traditional and Emerging IS Process Comparison

Key characteristics	Traditional IS processes (systems development, outsourcing and security)	Emerging IS processes (e.g., enterprise architecture, innovation, incidents, continuity)
Internal and external IS process motivation	Cost reduction, standardization, risk reduction	Adding value by taking advantage of computer processing power and data assets
Pace of change	Relatively slowly changing	Rapidly evolving
IT-business integration	Limited to moderate integration	Significant integration
Degree of organizational pervasiveness	Strongly institutionalized	Novel, with an uncertain future direction

Where managers and researchers seek to draw on IS control insights from the current academic literature to apply towards these emerging IS processes, it is unclear if the IS control findings associated with the three traditional IS processes should hold or if each IS process contains distinct control relationships that require further examination. Research focusing on organizational control, which primarily examines large firms and mature processes, has made similar observations (Cardinal, Sitkin, & Long, 2010). For example, could a practitioner responsible for managing an emerging IS process draw on the relationships established between the control environment and control mechanisms as they apply to the systems-development process? Without empirical evidence that the control relationships highlighted above apply across a wider range of IS processes, the field is left to generalize and speculate, which leaves organizations at risk of repeating the same failures that have challenged systems development, outsourcing, and security for years. For these emerging IS processes, a gap exists between what IS control research has done and the extent to which we can apply what we know towards these new contexts.

We suggest that applying the insights from past IS control research to the unique challenges of emergent processes represents an opportunity to predict and proactively address the issues before they become widespread. By highlighting a selection of the elements that make emerging IS processes unique (Table 4), we seek to draw attention to the broad research directions and the specific outcomes that one can draw past research on traditional IS processes.

One solution to address this gap in the literature is straightforward: simply conduct more research on emerging IS processes using the approach employed for traditional IS processes. For example, one important emerging IS process is managing enterprise architecture, which refers to planning, design, and integrating business, information, and technology infrastructure to better achieve enterprise and IT

strategies (ISACA, 2012; Ross, Weill, & Robertson, 2006). Although it is only a representative example of the many emerging IS processes and technologies in organizations, enterprise architecture is rising in importance in a wide range of today's organizations alongside increasing evidence that companies struggle to design and oversee the related IS controls (Cram, Brohman, & Gallupe, 2015a; Lam, 2004). The enterprise architecture process typically establishes a baseline and target architecture that aims to create consistency across information, data, technology, and business processes in an organization (ISACA, 2012). Controls in the enterprise architecture process can include the use of architecture standards, strategic vision documents, implementation plans, and stakeholder forums.

Examining controls related to enterprise architecture highlights a unique viewpoint relative to controls in the three traditional IS processes (Table 4). Past research has suggested that a primary motivation for the enterprise architecture process is to develop a long-term architecture vision for an organization to more effectively and innovatively use the systems that are being implemented across an organization (control outcomes) (Tamm, Seddon, Shanks, & Reynolds, 2011). The enterprise architecture process (control execution) has experienced rapid change because organizations struggle to iteratively define controls that staff will accept (control experiences) (Lucke, Krell, & Lechner, 2010). Moreover, IT and business characteristics (control environment) are increasingly driving the creation enterprise architecture controls. However, past research suggests that many organizations are unclear about the future role of the enterprise architecture process (Armour, Kaisler, & Liu, 1999).

Based on these observations and building on the control dimension relationships examined in past research, future research questions could ask how defining a long-term enterprise architecture vision aids organizations in achieving increased innovation (control mechanisms-control outcomes) or how enterprise architecture managers decide on controls while considering the competing interests of IT and business stakeholders (control environment-control mechanisms). Each of these research questions builds on a unique element of the emerging IS process and follows the blueprint of past control research by considering a relationship between a pair of control dimensions.

Although we believe that such research on emerging IS processes that draws on the template established from past IS control studies is valuable and necessary, simultaneously considering the second gap that we note in in Section 4.2 may allow for a more finely tuned and comprehensive future research direction. We discuss this gap using an extended model that builds on the preliminary research questions noted above.

4.2 Future Research Direction #2: Enhancing the Integration of IS Control Research

The second gap identified in our analysis is that few examples of research exist that simultaneously consider more than two of the four identified control dimension relationships. Of the 65 papers in our review, only six addressed either three or four of the relationships that we note in Section 3 (also see Appendix D). Though we recognize the valuable contribution of studies that focus on one or two of the identified control dimension relationships, the close inter-relationships among the five control dimensions led us to consider if a more holistic, integrated view of IS control research could generate a unique and valuable contribution. We reason that such an approach could achieve two principal aims. First, by simultaneously considering a wider range of control dimension relationships, one has an increased potential to understand their interdependencies. That is, although each set of control dimension relationships is valuable on its own, it also plays an important role in influencing the other dimensions. By not considering all the elements as one integrated phenomenon, we argue that the field may be missing important insights. Secondly, an integrated perspective may provide a richer basis for applying past findings on IS control towards the emerging IS processes outlined in the gap above because interactions between the control dimensions may emerge that differ from past findings.

Rather than considering the model of information systems control (Figure 1) as a mapping of the four independent views that past research has adopted, we propose viewing the model as representing the interdependencies between the core concepts at play in IS control; that is, future examinations of IS control should endeavor to include as many dimensions in the model as possible to obtain a complete view of the phenomenon. In proposing this integrated perspective, we argue that both practitioners and researchers can gain an increasingly holistic view of IS control that can contribute to uncovering new insights through simultaneously examining the inter-relationships among the IS control dimensions. Although we recognize that it may be impractical for all future studies to focus on the details of the relationships across all five control dimensions, we suggest that, by better understanding the links between dimensions, IS control researchers can more effectively plan the scope of future studies to cultivate a greater depth of results without significantly deviating in approach. For example, whereas a

past study may have examined the link between the control environment and control mechanisms, a future study adopting our suggestion could consider the same relationship but also concurrently examine the consequences of the changes in control mechanisms on control outcomes and control execution.

Drawing on our proposal for an integrated model of IS control, we demonstrate the benefits of approaching future control research that concurrently considers a range of control dimension relationships by outlining a series of associated propositions. These elements have been intentionally positioned at a general level to remain applicable to a range of processes and IS control challenges. However, in an effort to also address the first research gap described in the preceding section (i.e., further development of control research in emerging IS processes), we provide a more in-depth, "proof-of-concept" example based on the managing enterprise architecture process discussed above. Even in this limited examination, the results highlight unique control opportunities and risks for those responsible for managing emerging IS processes and highlight new directions for future IS control research that can extend the field's current knowledge.

As we note in Section 3, the IS control literature has employed a range of different theories. This literature has commonly (though not exclusively) varied on the lines of the studied control dimension relationships. Our proposal to simultaneously consider the relationships among the control dimensions has the potential to result in ontological and epistemological challenges in cases where one sees the underlying theories to have key assumptions or outcomes of interest that are irreconcilable. Cairney (2013) suggests that three approaches to combining multiple theories exist: synthesis, in which one creates a new theory based on the insights of other theories; complementary, in which one simultaneously considers different theories to identify new insights and explanations; and contradictory, in which one chooses a single existing theory after comparing the insights from multiple theories. Our proposed model adopts a complementary approach by advocating one to simultaneously consider the unique theoretical perspectives underlying the four sets of control dimension relationships. The complementary approach maintains a separation between the theoretical lenses, which can lead to improved accuracy of the resulting explanations since each one has its own individual limitations (Langley, 1999). For example, a researcher who traditionally employed an agency theory approach to studying the relationship between the control environment, control mechanisms, and control outcomes could simultaneously consider how labor process theory may be able to shed new light on the three dimensions by also examining the control experiences dimension. Because the achievement of employee well-being (i.e., labor process theory) may be at odds with owner objectives such as profitability (i.e., agency theory), our proposed model does not argue that a single, optimal scenario exists to reconcile these different views but suggests that one can consider both theoretical viewpoints.

The propositions listed in Table 5 build on the unique aspects of emerging IS processes (see Table 4) and are a first step in applying the integrated model to a context outside of the traditional boundary of systems development, outsourcing, and security while also advocating for a more holistic, integrative view of the relationships among the control dimensions.

Table 5. Proposition and Example Application Summary

Proposition	Future research direction for a sample emerging IS process: enterprise architecture
P1: As information systems increasingly take advantage of new technologies and a growing quantity of data (control environment→control mechanisms), employees will respond positively to the associated IS control adjustments (control execution→ control mechanisms) where they perceive social interactions, creativity, and learning to be enhanced (control mechanisms→control experiences).	Do employees perceive enhanced creativity and improved learning to result from value-seeking EA control adjustments such as establishing a long-term architecture vision and providing EA guidance on projects?
P2: The organizational uncertainty associated with rapidly changing information systems will necessitate ongoing adjustments to IS controls (control execution→control mechanisms) and an increasing reliance on formal, standardized controls (control environment→-control mechanisms), which will contribute to decreased employee well-being (control mechanisms→control experiences).	Does rapid change in EA processes contribute to an increasing use of reference architecture documents and a corresponding decline in employee satisfaction?
P3: As organizations increasingly integrate information systems processes with business processes, employees will respond positively (control environment→control experiences) to the corresponding control changes (control execution→ control mechanisms) where they perceive that such changes reduce inter-departmental politics, bureaucracy, and task uncertainty and objectives are transparent, trustworthy, and socially/environmentally mindful (control mechanisms→control outcomes).	Does the increasing integration of EA processes with business processes correspond with the development of an integrated architecture repository that drives re-use efficiencies and enhanced employee perceptions of diminished departmental politics and bureaucracy?
P4: Emergent information systems will face continued challenges related to the selection of an IS control portfolio (control environment→control mechanisms→ control outcomes) and extensive trial-and-error control experimentation (control mechanisms→ control outcomes→control execution) but will also offer a unique opportunity for employees to influence the nature of IS control characteristics to aid their well-being (control mechanisms→control experiences).	Do organizations that struggle to select and refine an EA implementation strategy receive increased employee contributions in shaping appropriate IS controls that consequently enhance their overall well-being?

4.3 Processing Power and Data Assets

The first characteristic that differentiates emerging IS processes is the motivation to add organizational value by taking advantage of computer processing power and data assets. Whereas a fundamental driver behind traditional IS processes is to realize cost and risk reductions (Bahli & Rivard, 2003; Carmel & Agarwal, 2002; Hirschheim & Lacity, 2000; Lacity & Willcocks, 1998), somewhat different objectives characterize emerging IS processes. Although cost and risk management concerns remain relevant, motivations have more fully extended into creating value through leveraging advances in computer processing power and data assets. By engaging in emerging IS processes, such as managing enterprise architecture, organizations have the potential to realize other objectives, including enhanced employee/customer relationships, strategic agility, improved computing performance, and better decision making (Bradley, Pratt, Byrd, & Simmons, 2011; Tamm et al., 2011). Therefore, emerging processes increasingly focus on pushing the boundaries of what technology can deliver, which provides opportunities for advantages over competitors. This concept differs from the current approach (related to traditional processes) to reduce risks through standardization and by allowing employees to focus on other, more value-added activities (Baskerville & Siponen, 2002; Davern & Kauffman, 2000; Iivari & Huisman, 2007).

One can consider past research spanning the four sets of control dimension relationships to better understand the role of control in situations where new technologies are developing. Research suggests that characteristics of the control environment (e.g., structure, process) will drive the selection of control

mechanisms that management sees as complementing the structures and processes in place (Kirsch, 1997; McFarlan, 1981; Nidumolu, 1996). For example, where an organization introduces emerging process such as enterprise architecture, it will implement a distinct collection of associated control mechanisms that prescribe a particular approach for reviewing and approving the purchase of hardware and software products. Likewise, new IS process controls are associated with revised control expectations (Gopal & Gosain, 2010; Jiang et al., 2004; Sia & Neo, 1997). For example, when an organization undertakes a new enterprise architecture initiative, it will likely establish new control objectives, including a focus on reducing costs (e.g., reusing applications and infrastructure) and better serving the organization (e.g., providing the most advanced applications and infrastructure). Under these circumstances, agency theory would suggest that managers will carefully construct the new controls to both suit the new process circumstances and limit the divergence of interests between principals and agents (Eisenhardt, 1989). However, because of divergent perspectives on important outcomes of an enterprise architecture initiative (e.g., architects may view long-term consistency and reuse of systems to be key and project managers may prefer to defer costly integration activities to future projects) (Cram et al., 2015a), one may need to carefully consider different levels of controllers and controlees as per Soh, Chua, and Singh (2011).

The control execution dimension introduces the realization that new controls implemented to oversee advancing technologies and processes may not work exactly as planned (Choudhury & Sabherwal, 2003; Kraut & Streeter, 1995; Sia & Neo, 1997). Organizations will need to design methods that carefully evaluate each new control's effectiveness to discern the adjustments required over time. For example, if an organization employs a complex, technology-intensive process such as enterprise architecture, it may need to implement controls related to reporting quality. In the circumstance that the organization produces sub-optimal results, management can re-evaluate the controls to determine what changes to make. Organizational control theory suggests that access to the relevant information drives managers' ability to respond quickly to changing circumstances and make accurate decisions (Macintosh, 1994). To that end, we anticipate that managers of emerging IS processes may increasingly desire the automation of control evaluation points (e.g., quality or speed metrics) to provide real-time, powerful insights into the effectiveness of controls.

Finally, the control experiences dimension suggests that introducing controls associated with new technologies has the potential to enhance how employees interact with one another. Past research has identified the opportunity for organizations to implement controls that can stimulate employees' social interactions, creativity, and learning (Chua et al., 2012; Roberts et al., 2006; Santana & Robey, 1995). For example, in an emerging process such as enterprise architecture, employees from a variety of departments can voice their opinions on the broad design of technology and business processes in an organization. Rather than have decisions that are isolated in a single department or those made without consultation with a range of employees, such processes increasingly give a voice to employees on how the work they do is designed, which increases their well-being (Brooke, 2002). By integrating these theoretical arguments and empirical support, we propose that:

P1: As information systems increasingly take advantage of new technologies and a growing quantity of data (control environment-control mechanisms), employees will respond positively to the associated IS control adjustments (control execution-control mechanisms) where they perceive social interactions, creativity, and learning to be enhanced (control mechanisms-control experiences).

In an enterprise architecture context, this proposition encourages researchers to simultaneously consider the relationships among the control dimensions together in the context of advancing new technologies. For example, future research in the area of enterprise architecture may pose the question: do employees perceive enhanced creativity and improved learning to result from value-seeking EA control adjustments such as establishing a long-term architecture vision and providing EA guidance on projects? Such an investigation considers the relationship between the control environment (i.e., value-oriented demands), control mechanisms (i.e., architecture vision and EA guidance), control execution (e.g., EA control adjustments), and control experiences (i.e., enhanced creativity and learning).

4.4 Rapid Pace of Change

The second characteristic that distinguishes emerging IS processes is the rapid pace of change. Although adjustments do occur in the systems development, outsourcing, and security processes, most companies have established relatively mature processes that avoid a high degree of ongoing change (Carmel & Agarwal, 2002; Iivari & Huisman, 2007; von Solms, 2005). In contrast, emerging processes are still

undergoing a period of rapid evolution and maturation as companies compete to provide different product offerings, create innovative approaches, and adjust strategies to take advantage of new opportunities (Simon, Fischbach, & Schoder, 2013).

One can draw on past research stemming from the relationships among the control dimensions to help explain the role of control in situations of rapid IS process change. Past findings suggest that uncertainty in the control environment will drive managerial implementation of formal controls to limit employee autonomy. Since changing processes make it difficult for principals to tell what agents are doing, organizations will implement controls to structure and monitor employee activities. For example, an organization introducing an enterprise architecture process may rely heavily on formal policies and performance metrics to ensure that cost and quality expectations are met (Ross, 2003; Tamm et al., 2011). Past research supports this view: findings suggest that organizations exhibit an increased reliance on formal controls because they work best when task uncertainty is high (Harris et al., 2009; Rustagi et al., 2008).

Supplementing this viewpoint with links to the control execution dimension, we expect that with rapid process change will come the necessity for managers to swiftly evaluate the effectiveness of controls and make timely adjustments when they are not working appropriately. A manager's ability to access and act on information related to organizational activities enables the organization to achieve objectives and goals (Macintosh, 1994). Past studies suggest that, as changes occur to processes, the controls will change as well (Kirsch, 2004; Sia & Neo, 1997). In the context of an emerging process such as enterprise architecture, these arguments suggest that managers should remain diligent in not only monitoring changing process components but also in overseeing the performance of the underlying controls. As a result, the necessary control adjustments may be much more frequent than in traditional processes, which evolve more slowly. This relationship may require managers to devise a more sophisticated and granular reporting system to stay informed of ongoing issues and remedies. In the enterprise architecture process, this activity might include frequent monitoring of project compliance to architecture standards and an extensive approval process for any initiatives that do not comply with the documented strategy.

When one adds insights from the control experiences dimension, we posit that the bias towards adding formal controls to account for uncertainty and rapid change will negatively impact employee well-being. Although past research argues that formal controls such as managerial oversight, documented policies and procedures, and quantified performance output has the potential to positively impact employee well-being (particularly when balanced alongside informal controls) (Santana & Robey, 1995; Weibel, 2010), other studies examining formal control portfolios highlight formal controls' links to employee feelings of stress, uncertainty, and oppression and to the restriction of employee creativity and learning (Baronas & Louis, 1988; Fitzgerald, 1996; Olson, 1982; Orlikowski, 1991). In the context of an emerging process such as enterprise architecture, formal controls may specify precisely what applications and platforms are allowable adoptions in an organization. Where employees have a limited ability to contribute to the discussion on what is allowable, even when a reasonable alternative exists, employees may see such control as repressing their choices. Integrating these theoretical arguments and empirical support, we propose that:

> **P2:** The organizational uncertainty associated with rapidly changing information systems will necessitate ongoing adjustments to IS controls (control execution-control mechanisms) and an increasing reliance on formal, standardized controls (control environment-control mechanisms), which will contribute to decreased employee well-being (control mechanisms-control experiences).

In the context of enterprise architecture, this proposition encourages researchers to jointly consider the relationships among the control dimensions in the context of quickly changing processes. For example, future research in the area of enterprise architecture may pose the question: does rapid change in EA processes contribute to an increasing use of reference architecture documents and a corresponding decline in employee satisfaction? In doing so, such research would consider the relationship between the control environment (i.e., rapidly changing processes), control mechanisms (i.e., reference architecture documents), control execution (e.g., changing controls), and control experiences (i.e., diminished employee satisfaction).

4.5 Business Process Integration

The third characteristic of emerging IS processes is their extensive integration with business processes. Although past research on business-IT alignment, governance, and CIO-CEO relationships considers the complementarity of IT and business activities in traditional processes (Chan & Reich, 2007; Tallon,

Kraemer, & Gurbaxani, 2000), the publications we reviewed tended to focus on controls that managers in the IS department facilitated. We recognize that some degree of business interest is typically associated with processes such as systems development (e.g., requirements definition) or information security (e.g., user authorization of business transactions) but note that managers commonly view these processes as being facilitated by the IS department. In contrast, business stakeholders tend to be increasingly engaged in controlling emerging processes that include an embedded technology component. Rather than being perceived as a process operating predominantly in IS, the management of emerging IS processes such as enterprise architecture tends to be more inter-departmental and shared across a variety of stakeholders (Shah & Kourdi, 2007).

One can draw on past research spanning the relationships between the control dimensions to help explain the role of control in situations where IS and business processes are increasingly being integrated. From a control environment perspective, we expect that the adjustments will comprise changes to structural, process, strategic, and cultural characteristics. Such changes will likely drive the selection of particular control mechanisms, perhaps ones that inter-departmental groups rather than individual departments increasingly design and monitor (Duh et al., 2006; Kulp et al., 2006; Stewart & Gosain, 2006). Managers will then associate these control mechanism changes with revisions to the desired control outcomes (e.g., quality and innovation) that result from the change in stakeholders. For example, whereas IS leadership may have exclusively made technical architecture decisions in the past, organizations adopting an enterprise architecture process will increasingly call on business departments to have a voice in determining the technologies in which to invest to better service the needs of the broader organization (Kappelman & Zachman, 2013; Lehong, Dube, & Angelopoulos, 2013). This view is consistent with an agency perspective, which recognizes an expansion of the principals' interests from IT management to also include business management. This change will result in modified objectives and competing ideas of how organizations should implement controls.

When one adds links to the control execution dimension, we anticipate that managers will increasingly need to evaluate and refine the new controls. Because of the increasing integration between business and IS, the managerial monitoring of how well a process and its controls are performing will likely increase in complexity. These activities should focus on the new control environment characteristics and the new control objectives but should also span all relevant business departments. Such complexity will likely require a highly effective communication and reporting system to report process status to all relevant stakeholders. The enterprise architecture research discusses examples of such monitoring activities, including the automation of enterprise architecture documentation (Farwick et al., 2011; Roth, Hauder, Michel, Munch, & Matthes, 2013). As the relationship between these stakeholders evolves, research suggests that managers will also need to respond with ongoing control adjustments (Choudhury & Sabherwal, 2003; Kirsch, 2004).

Finally, findings related to the control experiences dimension add insights by arguing that employees will benefit from controls that contribute to a better work environment and pursue principled objectives. Although past research suggests that staff experiences, fears, and assumptions about traditional IS processes (e.g., systems development) are distinct from business initiatives (Mähring, 2002), findings also suggest that employees will be more likely to accept controls that minimize politics, bureaucracy, and task uncertainty (Bijlsma-Frankema & Costa, 2010; Choudhury & Sabherwal, 2003; Jin & Montague, 2003; Kohli & Kettinger, 2004; Santana & Robey, 1995). Similarly, employees will more positively view controls that they see as trustworthy and socially responsible (Boss et al., 2009; Love, Irani, Standing, & Themistocleous, 2007; Roberts et al., 2006). In contrast, where an organization sees an IS activity or tool to slow or obstruct an employee's actions, those individuals may experience diminished motivation or seek control workarounds to re-establish their autonomy, which undermines the effectiveness of the embedded control mechanisms (Orlikowski, 1991). In the context of an emerging process such as enterprise architecture where employees view the process and its underlying controls as clarifying job responsibilities and decreasing organizational bureaucracy, employees will view the IS process more positively in comparison to an initiative that only aims to reduce company expenditures through a restructuring effort. Attempts to effectively communicate the nature of emerging processes play a role in shaping employee perceptions of control, which recent findings suggest are widely varied (Lehong et al., 2013). By integrating these theoretical arguments and empirical support, we propose that:

P3: As organizations increasingly integrate information systems processes with business processes, employees will respond positively (control environment-control experiences) to the corresponding control changes (control execution-control mechanisms) where they perceive

that such changes reduce inter-departmental politics, bureaucracy, and task uncertainty and objectives are transparent, trustworthy, and socially/environmentally mindful (control mechanisms-control outcomes).

In the context of enterprise architecture, this proposition encourages researchers to simultaneously consider the links between the control dimensions in the context of IS and business process integration. For example, future research in the area of enterprise architecture may pose the question: does the increasing integration of EA processes with business processes correspond with the development of an integrated architecture repository that drives re-use efficiencies and enhanced employee perceptions of diminished departmental politics and bureaucracy? Such a study would consider the relationship between the control environment (i.e., integration of EA and business processes), control mechanisms (i.e., integrated architecture repository), control outcomes (i.e., re-use efficiencies), control execution (e.g., changing controls), and control experiences (i.e., employee perceptions of politics and bureaucracy).

4.6 Organizational Pervasiveness

Finally, the fourth characteristic differentiating traditional from emerging IS processes is the degree of organizational pervasiveness. Whereas traditional IS processes have a strong institutional presence and acceptance by managers, emerging IS processes such as enterprise architecture are increasingly novel and less ingrained in an organization's structure and culture (Boh & Yellin, 2007; Bradley et al., 2011; Tamm et al., 2011). This characteristic considers the extent that managers perceive a process as a fundamental organizational element, agree on its purpose and objectives, and accept its long-term viability.

One can draw on past research spanning the relationships among the control dimensions to help explain the role of control in situations where an emerging IS process has little pervasiveness and institutional foundation. Findings suggest that characteristics of the control environment sub-dimensions, such as task characteristics and role expectations, are a critical driver for which IS control mechanism managers decide to implement (Kirsch, 1997; Nidumolu, 1996; Rustagi et al., 2008). However, where these characteristics are increasingly ambiguous and flexible (due to their being in emerging processes that are new and undergoing an initial period of adjustment), challenges can arise in establishing an appropriate portfolio of controls. In the context of the enterprise architecture process, research suggests that management may be undecided on how rigorously to mandate compliance with architectural guidelines (Boh & Yellin, 2007; Bradley et al., 2012). By remaining flexible and tailoring the process as it matures, an organization introduces challenges with regard to the difficulty of deciding on the most appropriate controls. Similarly, past research has found that controller knowledge and controllee skills can play a role in influencing the selection of IS controls (Kirsch, 1996, 1997, 2004; Kirsch et al., 2002). However, in emerging IS processes, where the employee skill sets may still be developing as a new process matures, confusion may arise in identifying appropriate controls. For example, an organization with a relatively new enterprise architecture process may experience challenges in identifying the most appropriate controls to implement because of the relative inexperience that employees have with the process (Ross, 2003).

Past research on the control execution dimension has found that organizational structures influence control changes over time. As organizations implement new systems and make adjustments to processes, the corresponding IS control modifications contribute to the perception that the organization is meeting its needs (Sia & Neo, 1997; Silva & Hirschheim, 2007). However, in contrast to traditional IS processes that have a history and evolution that one can refer to when evaluating performance and considering control adjustments, the lack of institutionalization of emerging processes suggests the likelihood of an initial trial-and-error approach to managing controls over time. Because evaluations of control effectiveness are based on identifying performance problems and determining controls operating as intended, emerging processes may be more likely to struggle to establish clearly articulated performance guidelines or control-evaluation techniques than may be possible with more pervasive IS processes. Past research suggests that organizations struggle to quantify performance in the enterprise architecture process (Tamm et al., 2011). Therefore, when organizations identify issues, they can find it difficult to establish what went wrong and remedy the issues.

Finally, past research findings related to control experiences suggest that cultural assumptions, values, and norms contribute to establishing IS controls that become deeply embedded in an organization's processes over time (Orlikowski, 1991; Stewart & Gosain, 2006). Although some of these factors may extend from broader organizational culture characteristics, for emerging IS processes without an extensive company history, these assumptions, values, and norms will likely be at least somewhat malleable at the process level. From a control perspective, employees will much more likely have an

opportunity to contribute to the design and implementation of controls in emerging processes than they might have in traditional processes with well-established and institutionalized control portfolios. Over time, controls will become entrenched and difficult to alter (Orlikowski, 1991), but, before this occurs, there exists an inherent degree of flexibility to make adjustments that better suit stakeholders. This situation can translate into a set of controls that can help organizations achieve benefits (e.g., reducing costs) and contribute to improved motivation, socialization, and satisfaction. Past research suggests that enterprise architecture processes provide a range of benefits (including both financial (e.g., increased market value) and organizational (e.g., improved alignment to business strategy) benefits) in addition to employee well-being (e.g., reduced staff turnover, satisfaction) (Lehong et al., 2013). By integrating these theoretical arguments and empirical support, we propose that:

P4: Emergent information systems will face continued challenges related to the selection of an IS control portfolio (control environment-control mechanisms-control outcomes) and extensive trial-and-error control experimentation (control mechanisms-control outcomes-control execution), but will also offer a unique opportunity for employees to influence the nature of IS control characteristics to aid their well-being (control mechanisms-control execution).

In the context of enterprise architecture, this proposition encourages researchers to integrate concepts among the control dimension relationships in the context of emerging IS process institutionalization. For example, future research in the area of enterprise architecture may pose the question: do organizations that struggle to select and refine an EA implementation strategy receive increased employee contributions in shaping appropriate IS controls that consequently enhance their overall well-being? Such an investigation would consider the relationship between the control mechanisms (i.e., EA implementation strategy), control outcomes (i.e., enhanced well-being), control execution (e.g., control refinement), and control experiences (i.e., employee contributions).

4.7 Summary

The four research propositions that we outline above represent a first step in applying the model of information systems control as a theory development mechanism. We identify a sample of the defining characteristics of emerging IS processes and pose a series of broadly focused research directions that we consider in light of past IS control studies. In doing so, we examine how integrating the relationships among the five control dimensions in the model of information systems control can help one make predictions about how IS control constructs in emerging IS processes will operate. By framing the corresponding research propositions in the specific context of the managing enterprise architecture process, we demonstrate a tangible direction to address the two identified gaps in the current IS control literature in one area of study. We see additional opportunities to forge new research directions in areas other than enterprise architecture, such as managing innovation, managing incidents, and managing continuity. This exercise highlights the benefits that the model can provide by broadening the viewpoints on IS control issues, particularly in the context of emerging IS processes that are of growing importance to organizations but have yet to generate a significant IS control research focus.

5 Conclusion

Our results lead to three primary areas for future research in IS control. First, as we note in Sections 3.1, 3.2, 3.3, and 3.4, a variety of opportunities exist for additional inquiry, which range from examining controls that contribute to employee feelings of equality (control environment-control mechanisms) to the relationship between clan control and profitability objectives (control mechanisms-control outcomes). Research in these areas will continue to build on the cumulative tradition of excellent work that researchers have already conducted in the field. The second direction for future research that we highlight applies to the IS processes outside of managing systems development, outsourcing, and information security. Although we continue to see valuable opportunities for study in these processes, emerging IS processes such as managing enterprise architecture represent a significant and untapped collection of organizational challenges that practitioners currently struggle to solve. By applying the knowledge built from research on the traditional IS processes, the emerging processes may be spared some of the control failures that have challenged organizations in recent years. The third opportunity for future research comprises the integrated approach presented in the model of information systems control. By considering the inter-relationships that exist between the control dimensions and approaching IS control as a single phenomenon rather than a series of isolated elements, the depth and power of the field's findings can continue to grow.

In this review, we examine how one can apply existing IS control constructs and relationships to emerging IS processes to guide future research and practice. Drawing on five control dimensions that emerge from the literature, we develop a model that highlights four core relationships that past studies have examined. We classify 65 studies along the lines of these control dimension relationships and highlight what we know about IS control (and what we still have to learn). These insights provide researchers and practitioners with a means to distinguish the growing body of research from the field into manageable areas that share similar theoretical foundations, core constructs, and outcomes of interest. Although this exercise is useful in understanding what the field has done, we were also interested in what the field has yet to do. Based on two key issues (i.e., the predominant focus on three IS processes and the isolated view of control dimension relationships), we consolidate the control dimensions into an integrated model of information systems control. To show how this model can advance the field and contribute to theory development, we highlight the unique elements of emerging IS processes that currently present pressing control concerns to organizations and outline a series of research propositions that make predictions in areas that the literature has yet to investigate. Researchers can use our findings as a template to position the field towards an increasingly integrative approach that considers a range of emerging information systems processes.

Acknowledgments

We thank Yolande Chan, Jane Webster, and Laurie Kirsch for their comments on earlier versions of this work and to the reviewers and Senior Editor for their valuable suggestions and guidance.

References

Abernethy, M. A., & Stoelwinder, J. U. (1995). The role of professional control in the management of complex organizations. *Accounting, Organizations and Society*, *20*(1), 1-17.

Agarwal, R., & Lucas, H. C., Jr. (2005). The information systems identity crisis: Focusing on high-visibility and High-impact research. *MIS Quarterly*, *29*(3), 381-398.

Aksulu, A., & Wade, M. (2010). A comprehensive review and synthesis of open source research. *Journal for the Association for Information Systems*, *11*(11), 576-656.

Alder, P. S., & Borys, B. (1996). Two types of bureaucracy: enabling and coercive. *Administrative Science Quarterly*, *41*(1), 61-89.

Alter, S. (1999). A general, yet useful theory of information systems. *Communications of the Association for Information Systems*, *1*, 1-70.

Armour, F. J., Kaisler, S. H., & Liu, S. Y. (1999). Building an enterprise architecture step by step. *IT Professional*, *7*, 31-39.

Bahli, B., & Rivard, S. (2003). The information technology outsourcing risk: A transaction cost and agency theory-based perspective. *Journal of Information Technology*, *18*(3), 211-221.

Baronas, A.-M. K., & Louis, M. R. (1988). Restoring a sense of control during implementation: How user involvement leads to system acceptance. *MIS Quarterly*, *12*(1), 111-124.

Baskerville, R. L., & Siponen, M. (2002). An information security meta-policy for emergent organizations. *Logistics Information Management*, *15*(5/6), 337-346.

Baskerville, R. L., & Stage, J. (1996). Controlling prototype development through risk analysis. *MIS Quarterly*, *20*(4), 481-504.

Berry, A. J., Coad, A. F., Harris, E. P., Otley, D. T., & Stringer, C. (2009). Emerging themes in management control: A review of recent literature. *The British Accounting Review*, *41*(2-20).

Bijlsma-Frankema, K. M., & Costa, A. C. (2010). Consequences and antecedents of managerial and employee legitimacy interpretations of control: A natural open system approach. In S. B. Sitkin, L. B. Cardinal & K. M. Bijlsma-Frankema (Eds.), *Organizational control*. Cambridge: Cambridge University Press.

Boh, W. F., & Yellin, D. (2007). Using enterprise architecture standards in managing information technology. *Journal of Management Information Systems*, *23*(3), 163-207.

Boss, S. R., Kirsch, L. J., Angermeier, I., Shingler, R. A., & Boss, R. W. (2009). If someone is watching, I'll do what I'm asked: Mandatoriness, control, and information security. *European Journal of Information Systems*, *18*(2), 151-164.

Bradley, R. V., Pratt, R. M. E., Byrd, T. A., Outlay, C. N., & Wynn, D. E., Jr. (2012). Enterprise architecture, IT effectiveness and the mediating role of IT alignment in US hospitals. *Information Systems Journal*, *22*(2), 97-127.

Bradley, R. V., Pratt, R. M. E., Byrd, T. A., & Simmons, L. L. (2011). The role of enterprise architecture in the quest for IT value. *MIS Quarterly Executive*, *10*(2), 73-80.

Brooke, C. (2002). What does it mean to be "critical" in IS research? *Journal of Information Technology*, *17*(2), 49-57.

Bunker, D., Kautz, K., & Anhtuan, A. (2008). An exploration of information systems adoption: tools and skills as cultural artefacts—the case of a management information system. *Journal of Information Technology*, *23*(2), 71-78.

Cairney, P. (2013). Standing on the shoulders of giants: How do we combine the insights of multiple theories in public policy studies? *The Policy Studies Journal*, *41*(1), 1-21.

Cardinal, L. B. (2001). Technological innovation in the pharmaceutical industry: The use of organizational control in managing research and development. *Organization Science*, *12*(1), 19-36.

Cardinal, L. B., Sitkin, S. B., & Long, C. P. (2010). A configurational theory of control. In S. B. Sitkin, L. B. Cardinal, & K. M. Bijlsma-Frankema (Eds.), *Organizational control*. Cambridge: Cambridge University Press.

Carmel, E., & Agarwal, R. (2002). The maturation of offshore sourcing of information technology work. *MIS Quarterly Executive*, *1*(2), 65-77.

Chan, Y. E., & Reich, B. H. (2007). IT alignment: What have we learned? *Journal of Information Technology*, *22*(4), 297-315.

Chen, H., Chiang, R. H. L., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS Quarterly*, *36*(4), 1165-1188.

Choudhury, V., & Sabherwal, R. (2003). Portfolios of control in outsourced software development projects. *Information Systems Research*, *14*(3), 291-314.

Chua, C. E. H., Lim, W.-K., Soh, C., & Sia, S. K. (2012). Enacting clan control in complex IT projects: A social capital perspective. *MIS Quarterly*, *36*(2), 577-600.

Cobb, R. H., & Mills, H. D. (1990). Engineering software under statistical quality control. *IEEE Software*, *7*(6), 44-54.

Cram, W. A., & Brohman, M. K. (2013). Controlling systems development: A new typology for an evolving field. *Information Systems Journal*, *23*(2), 137-154.

Cram, W. A., Brohman, M. K., & Gallupe, R. B. (2015a). Addressing the control challenges of the enterprise architecture process. *Journal of Information Systems*, *29*(2), 161-182.

Cram, W. A., Brohman, M. K., & Gallupe, R. B. (2015b). Hitting a moving target: A process model of information systems control change. *Information Systems Journal*. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/isj.12059/abstract

D'Arcy, J., Hovav, A., & Galletta, D. (2009). User awareness of security countermeasures and its impact on information systems misuse: A deterrence approach. *Information Systems Research*, *20*(1), 79-98.

Daily, C. M., Dalton, D. R., & Cannella, A. A., Jr. (2003). Corporate governance: Decades of dialogue and data. *Academy of Management Review*, *28*(3), 371-382.

Davern, M. J., & Kauffman, R. J. (2000). Discovering potential and realizing value from information technology investments. *Journal of Management Information Systems*, *16*(4), 121-143.

Davis, R. C. (1940). *Industrial organization and management*. New York: Harper.

Davis, R. C. (1951). *The fundamentals of top management*. New York: Harper.

Delbridge, R. (2010). Critical perspectives on organizational control: Reflections and prospects. In S. B. Sitkin, L. B. Cardinal, & K. M. Bijlsma-Frankema (Eds.), *Organizational control*. Cambridge: Cambridge University Press.

Di Tullio, D., & Staples, D. S. (2013). The governance and control of open source software projects. *Journal of Management Information Systems*, *30*(3), 49-80.

Doolin, B., & Lowe, A. (2002). To reveal is to critique: Actor-network theory and critical information systems research. *Journal of Information Technology*, *17*(2), 69-78.

Drury, D. H. (1984). An evaluation of data processing steering committees. *MIS Quarterly*, *8*(4), 257-265.

Duh, R.-R., Chow, C. W., & Chen, H. (2006). Strategy, IT applications for planning and control, and firm performance: The impact of impediments to IT implementation. *Information & Management*, *43*(8), 939-949.

Eisenhardt, K. M. (1985). Control: Organizational and economic approaches. *Management Science*, *31*(2), 134-149.

Eisenhardt, K. M. (1989). Agency theory: An assessment and review. *Academy of Management Review*, *14*(1), 57-74.

Essex, P. A., Magal, S. R., & Masteller, D. E. (1998). Determinants of information center success. *Journal of Management Information Systems*, *15*(2), 95-117.

Farwick, M., Agreiter, B., Breu, R., Ryll, S., Voges, K., & Hanschke, I. (2011). *Automation processes for enterprise architecture management.* Paper presented at the 15th IEEE International Enterprise Distributed Object Computing Conference Workshops.

Ferreira, L. D., & Merchant, K. A. (1992). Field research in management accounting and control: A review and evaluation. *Accounting, Auditing and Accountability*, *5*(4), 3-34.

Fitzgerald, B. (1996). Formalized systems development methodologies: A critical perspective*. Information Systems Journal*, *6*(1), 3-23.

Fitzgerald, B. (2006). The transformation of open source software. *MIS Quarterly*, *30*(3), 587-598.

Flamholtz, E. G., Das, T. K., & Tsui, A. S. (1985). Toward and integrative framework of organizational control. Accounting, *Organizations and Society*, *10*(1), 35-50.

Freidson. (1984). The changing nature of professional control. *Annual Review of Sociology*, *10*, 1-20.

Giglioni, G. B., & Bedeian, A. G. (1974). A conspectus of management control theory: 1900-1972. *Academy of Management Journal*, *17*(2), 292-305.

Gopal, A., & Gosain, S. (2010). The role of organizational controls and boundary spanning in software development outsourcing: Implications for project performance. *Information Systems Research*, *21*(4), 960-982

Gopal, R. D., & Sanders, G. L. (1997). Preventative and deterrent controls for software piracy. *Journal of Management Information Systems*, *13*(4), 29-47.

Gorry, G. A., & Morton, M. S. S. (1971). A framework for management information systems. *Sloan Management Review*, *13*(1), 55-70.

Gray, P. H. (2001). The impact of knowledge repositories on power and control in the workplace. *Information Technology & People*, *14*(4), 368-384.

Gregor, S. (2006). The nature of theory in information systems. *MIS Quarterly*, *30*(3), 611-642.

Gregory, R. W., Beck, R., & Keil, M. (2013). Control balancing in information systems development offshoring projects. *MIS Quarterly*, *37*(4), 1211-1232.

Grundy, E., Collier, P., & Spaul, B. (1994). Auditing personnel: A human resource approach to information systems control. *Managerial Auditing Journal*, *9*(6), 10-16.

Hall, J. A. (1982). Management information systems. *Management Accounting*, *64*(5), 18, 67-68.

Halloran, D., Manchester, S., Moriarty, J., Riley, R., Rohrman, J., & Skramstad, T. (1978). Systems development quality control. *MIS Quarterly*, *2*(4), 1-13.

Halpern, S. A. (1992). Dynamics of professional control: Internal coalitions and crossprofessional boundaries. *American Journal of Sociology*, *97*(4), 994-1021.

Harris, M. L., Collins, R. W., & Hevner, A. R. (2009). Control of flexible software development under uncertainty. *Information Systems Research*, *20*(3), 400-419.

Harris, M., & Raviv, A. (1978). Some results on incentive contracts with application to education and employment health insurance, and law enforcement. *American Economic Review*, *68*(1), 20-30.

Helms, G. L., & Weiss, I. R. (1986). The cost of internally developed applications: Analysis of problems and cost control methods. *Journal of Management Information Systems*, *3*(2), 5-21.

Henderson, J. C., & Lee, S. (1992). Managing I/S design teams: A control theories perspective. *Management Science*, *38*(6), 757-777.

Hirschheim, R., & Klein, H. K. (1994). Realizing emancipatory principles in information systems development: The case for ETHICS. *MIS Quarterly*, *18*(1), 83-109.

Hirschheim, R., & Lacity, M. (2000). The myths and realities of information technology insourcing. *Communications of the ACM*, *43*(2), 99-107.

Iivari, J., & Huisman, M. (2007). The relationship between organizational culture and the deployment of systems development methodologies. *MIS Quarterly*, *31*(1), 35-58.

ISACA. (2012). *COBIT 5.* Rolling Meadows.

Jaworski, B. J. (1988). Toward a theory of marketing control: Environmental context, control types, and consequences. *The Journal of Marketing*, *52*(3), 23-39.

Jensen, M., & Meckling, W. (1976). Theory of the firm: Managerial behavior, agency costs, and ownership structure. *Journal of Financial Economics*, *3*, 305-360.

Jermier, J. M. (1998). Introduction: Critical perspectives on organizational control. *Administrative Science Quarterly*, *43*(2), 235-256.

Jiang, J. J., Klein, G., Hwang, H.-G., Huang, J., & Hung, S.-Y. (2004). An exploration of the relationship between software development process maturity and project performance. *Information & Management*, *41*(3), 279-288.

Jin, K. G., & Montague, R. (2003). Continuous communication control disruptors during systems development. Systematic *Practice and Action Research*, *16*(6), 393-420.

Kappelman, L. A., & Zachman, J. A. (2013). The enterprise and its architecture: Ontology & challenges. *Journal of Computer Information Systems*, *53*(4), 87-95.

Karimi, J., & Konsynski, B. R. (1991). Globalization and information management strategies. *Journal of Management Information Systems*, *7*(4), 7-26.

Kirsch, L. J. (1996). The management of complex tasks in organizations: Controlling the systems development process. *Organization Science*, *7*(1), 1-21.

Kirsch, L. J. (1997). Portfolios of control modes and IS project management. *Information Systems Research*, *8*(3), 215-239.

Kirsch, L. J. (2004). Deploying common systems globally: The dynamics of control. *Information Systems Research*, *15*(4), 374-395.

Kirsch, L. J., Ko, D.-G., & Haney, M. H. (2010). Investigating the antecedents of team-based clan control: Adding social capital as a predictor. *Organization Science*, *21*(2), 469-489.

Kirsch, L. J., Sambamurthy, V., Ko, D.-G., & Purvis, R. L. (2002). Controlling information systems development projects: The view from the client. *Management Science*, *48*(4), 484-498.

Kling, R., & Iacono, S. (1984). The control of information systems developments after implementation. *Communications of the ACM*, *27*(12), 1218-1226.

Kohli, R., & Kettinger, W. J. (2004). Informating the clan: Controlling physicians' costs and outcomes. *MIS Quarterly*, *28*(3), 363-394.

Kraut, R. E., & Streeter, L. A. (1995). Coordination in software development. *Communications of the ACM*, *38*(3), 69-81.

Kulp, S. L., Randall, T., Brandyberry, G., & Potts, K. (2006). Using organizational control mechanisms to enhance procurement efficiency: How GlaxoSmithKline improved the effectiveness of e-procurement. *Interfaces*, *36*(3), 209-219.

Lacity, M. C., & Willcocks, L. P. (1998). An empirical investigation of information technology sourcing practices: Lessons from experiences. *MIS Quarterly*, *22*(3), 363-408.

Lam, W. (2004). Technical risk management on enterprise integration projects. *Communications of the Association for Information Systems*, *13*, 290-315.

Langfield-Smith, K. (1997). Management control systems and strategy: A critical review. *Accounting, Organizations and Society*, *22*(2), 207-232.

Langley, A. (1999). Strategies for theorizing from process data. *Academy of Management Review*, *24*(4), 691-710.

Lee, J.-N., Miranda, S. M., & Kim, Y.-M. (2004). IT outsourcing strategies: Universalistic, contingency, and configurational explanations of success. *Information Systems Research*, *15*(2), 110-131.

Lehong, S. M., Dube, E., & Angelopoulos, G. (2013). An investigation into the perceptions of business stakeholders on the benefits of enterprise architecture: The case of Telkom SA. *South African Journal of Business Management*, *44*(2), 45-56.

Liu, J., Chen, H., Jiang, J. J., & Klein, G. (2010). Task completion competency and project management performance: The influence of control and user contribution. *International Journal of Project Management*, *28*(3), 220-227.

Liu, L., & Yetton, P. (2009). Sponsorship and IT vendor management of projects*. Journal of Information Technology*, *24*(1), 46-54.

Love, P. E. D., Irani, Z., Standing, C., & Themistocleous, M. (2007). Influence of job demands, job control and social support on information systems professionals' psychological well-being. *International Journal of Manpower*, *28*(6), 513-528.

Lucke, C., Krell, S., & Lechner, U. (2010). Critical issues in enterprise architecting—a literature review. In *Proceedings of the Americas Conference on Information Systems*.

Lycett, M., & Paul, R. J. (1999). Information systems development: A perspective on the challenge of evolutionary complexity. *European Journal of Information Systems*, *8*(2), 127-135.

Macintosh, N. B. (1994). *Management accounting and control systems: An organizational and behavioral approach.* New York: Wiley.

Mähring, M. (2002). *IT project governance* (doctoral dissertation). Stockholm School of Economics.

Mao, J.-Y., Lee, J.-N., & Deng, C.-P. (2008). Vendors' perspectives on trust and control in offshore information systems outsourcing. *Information & Management*, 45(7), 482-492.

Maruping, L. M., Venkatesh, V., & Agarwal, R. (2009). A control theory perspective on agile methodology use and changing user requirements. *Information Systems Research*, *20*(3), 377-399.

McFarlan, F. W. (1981). Portfolio approach to information systems. *Harvard Business Review*, *59*(5), 142-150.

McGregor, D. (1960). *The human side of the enterprise*. New York: McGraw-Hill.

Meier, R. F. (1982). Perspectives on the concept of social control. *Annual Review of Sociology*, *8*(1), 35-55.

Morris, S. A., & Marshall, T. E. (2004). Perceived control in information systems. *Journal of Organizational and End User Computing*, *16*(2), 38-56.

Mumford, E. (1983). *Designing human systems for new technology: The ETHICS method*. Manchester: Manchester Business School.

Nidumolu, S. R. (1996). A comparison of the structural contingency and risk-based perspectives on coordination in software-development projects. *Journal of Management Information Systems*, *13*(2), 77-113.

Nidumolu, S. R., & Subramani, M. R. (2003). The matrix of control: Combining process and structure approaches to managing software development. *Journal of Management Information Systems*, 20(3), 159-196.

Olson, M. H. (1982). New information technology and organizational culture. *MIS Quarterly*, *6*(4), 71-92.

Orlikowski, W. J. (1991). Integrated information environment or matrix of control? The contradictory implications of information technology. *Accounting, Management & Information Technology*, *1*(1), 9-42.

Ouchi, W. G. (1978). The transmission of control through organizational hierarchy. *Academy of Management Journal*, *21*(2), 173-192.

Ouchi, W. G. (1979). A conceptual framework for the design of organizational control mechanisms. *Management Science*, *25*(9), 833-848.

Ouchi, W. G. (1982). *Theory Z.* New York: Avon Books.

Pare, G., Trudel, M. C., & Jaana, M. (2012). *Stand-alone literature reviews in information systems research: Development of a taxonomy of review types and assessment of current practices*. Paper presented at the Administrative Sciences Association of Canada Conference, St John's, Newfoundland, Canada.

Phan, D. D., & George, J. F., Vogel, D. R. (1995). Managing software quality in a very large development project. *Information & Management*, *29*(5), 277-283.

Piccoli, G., & Ives, B. (2003). Trust and the unintended effects of behaviour control in virtual teams. *MIS Quarterly*, *27*(3), 365-395.

Pick, J. B. (1991). Staffing, planning, and control of information systems in charitable nonprofit organizations. *Information & Management*, *20*(4), 295-311.

Powell, A., Piccoli, G., & Ives, B. (2004). Virtual teams: A review of current literature and directions for future research. *The DATA BASE for Advances in Information Systems*, *35*(1), 6-36.

Rao, M. T., Brown, C. V., & Perkins, W. C. (2007). Host country resource availability and information system control mechanisms in multinational corporations: An empirical test of resource dependency theory. *Journal of Management Information Systems*, *23*(4), 11-28.

Riehl, J. W. (1982). A management framework for systems users. *Information & Management*, *5*, 323-337.

Rittenberg, L. E., & Purdy, C. R. (1978). The internal auditor's role in MIS developments. *MIS Quarterly*, *2*(4), 47-57.

Roberts, J. A., Hann, I., & Slaughter, S. A. (2006). Understanding the motivations, participation, and performance of open source software developers: A longitudinal study of the Apache projects. *Management Science*, *52*(7), 984-999.

Ross, J. W. (2003). Creating a strategic IT architecture competency: Learning in stages. *MIS Quarterly Executive*, *2*(1), 31-43.

Ross, J. W., Weill, P., & Robertson, D. C. (2006). *Enterprise architecture as strategy*. Boston: Harvard Business School Press.

Roth, S., Hauder, M., Michel, F., Munch, D., & Matthes, F. (2013). Facilitating conflict resolution of models for automated enterprise architecture documentation. In *Proceedings of the Nineteenth Americas Conference on Information Systems.*

Rustagi, S., King, W. R., & Kirsch, L. J. (2008). Predictors of formal control usage in IT outsourcing partnerships. *Information Systems Research*, 19(2), 126-143.

Santana, M., & Robey, D. (1995). Perceptions of control during systems development: Effects on job satisfaction of systems professionals. *Computer Personnel*, *16*(1), 20-34.

Shah, H., & Kourdi, M. E. (2007). Frameworks for enterprise architecture. *IT Professional*, *9*(5), 36-41.

Sharma, A. (1997). Professional as agent: Knowledge asymmetry in agency exchange. *Academy of Management Review*, *22*(3), 758-798.

Sia, S. K., & Neo, B. S. (1997). Reengineering effectiveness and the redesign of organizational control: A case study of the inland revenue authority of Singapore. *Journal of Management Information Systems*, *14*(1), 69-92.

Silva, L., & Hirschheim, R. (2007). Fighting against windmills: Strategic information systems and organizational deep structures. *MIS Quarterly*, *31*(2), 327-354.

Simon, D., Fischbach, K., & Schoder, D. (2013). An exploration of enterprise architecture research. *Communications of the Association for Information Systems*, *32*, 1-72.

Sitkin, S. B., Cardinal, L. B., & Bijlsma-Frankema, K. M. (Eds.). (2010). *Organizational control*. Cambridge: Cambridge University Press.

Soh, C., Chua, C. E. H., & Singh, H. (2011). Managing diverse stakeholders in enterprise systems projects: a control portfolio approach. *Journal of Information Technology*, *26*(1), 16-31.

Spears, J. L., & Barki, H. (2010). User participation in information systems security risk management. *MIS Quarterly*, *34*(3), 503-522.

Stewart, K. J., & Gosain, S. (2006). The impact of ideology on effectiveness in open source software development teams. *MIS Quarterly*, *30*(2), 291-314.

Straub, D. W., & Welke, R. J. (1998). Coping with systems risk: Security planning models for management decision making. *MIS Quarterly*, *22*(4), 441-469.

Tallon, P. P., Kraemer, K. L., & Gurbaxani, V. (2000). Executives' perceptions of the business value of information technology: A process-oriented approach. *Journal of Management Information Systems*, *16*(4), 145-173.

Tamm, T., Seddon, P. B., Shanks, G., & Reynolds, P. (2011). How does enterprise architecture add value to organisations? *Communications of the Association for Information Systems*, *28*, 141-168.

Tannenbaum, A. S. (1962). Control in organizations: Individual adjustment and organizational performance. *Administrative Science Quarterly*, *7*(2), 236-257.

Tannenbaum, A. S. (1968). *Control in organizations*. New York: McGraw-Hill.

Tiwana, A. (2010). Systems development ambidexterity: Explaining the complementary and substitutive roles of formal and informal controls. *Journal of Management Information Systems*, *27*(2), 87-126.

Tiwana, A., & Keil, M. (2009). Control in internal and outsourced software projects. *Journal of Management Information Systems*, *26*(3), 9-44.

Van Maanen, J. (2010). Identity work and control in occupational communities. In S. B. Sitkin, L. B. Cardinal, & K. M. Bijlsma-Frankema (Eds.), *Organizational control*. Cambridge: Cambridge University Press.

von Solms, B. (2005). Information security governance: COBIT or ISO 17799 or both? *Computers & Security*, *24*(2), 99-104.

Wallace, L., Keil, M., & Rai, A. (2004). Understanding software project risk: A cluster analysis. *Information & Management*, *42*(1), 115-125.

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly*, *26*(2), xiii-xxiii.

Weibel, A. (2010). Managerial objectives of formal control: High motivation control mechanisms. In S. B. Sitkin, L. B. Cardinal, & K. M. Bijlsma-Frankema (Eds.), *Organizational control*. Cambridge: Cambridge University Press.

Yang, H., & Tate, M. (2012). A descriptive literature review and classification of cloud computing research. *Communications of the Association for Information Systems*, *31*, 35-60.

Appendix A: Additional Control Terminology

Table A1. Additional Control Terminology

Term	Definition	Reference
Administrative control	Refers to control over group and department-wide initiatives (usually by senior staff).	Davis (1951)
Attempted and realized control	Attempted controls refer to the attempt to influence a controlee with a control mechanism. Realized controls refer to the successful employment of the control mechanism.	Tiwana & Keil (2009)
Coercive control	Attempts to force compliance and effort, particularly in situations where controlees are reluctant and uncooperative. Coercive controls highlight to superiors when the actions of subordinates do not comply with expectations.	Alder & Borys (1996)
Control activities	A control activity may specify that the requirements for a new information system should be validated to achieve quality objectives. A control mechanism specifies the details of how the control activity will be operationalized in practice (e.g., who will do what, when they will do it, what they will do, etc.).	Gorry & Morton (1971), ISACA (2012)
Cultural control	Refers to the values and normative patterns of worker behavior in an entire division or firm.	Jaworski (1988), Ouchi (1979)
Financial control	Refers to control over financial activities such as budgets and financial ratios.	Giglioni & Bedeian (1974)
Individual control	Refers to control over an individual's behavior.	Henderson & Lee (1992)
Intellectual control	Refers to the process of controlling an individual or group by teaching them how to conduct a set of practices or processes.	Cobb & Mills (1990)
Managerial control	Refers to control that managers employ over subordinates' activities.	Giglioni & Bedeian (1974), Henderson & Lee (1992), Santana & Robey (1995)
Operative control	Refers to control over specific projects and processes, usually by mid-level and junior staff.	Davis (1951)
Organizational control	Refers to control as it broadly applies to organizational settings.	Santana & Robey (1995)
Professional control	A form of self-regulated social control pertaining to specialized, autonomous professional workers. Examples include professional associations responsible for discipline and the allocation of privileges.	Abernethy & Stoelwinder (1995), Freidson (1984)
Social control	The extent that groups intentionally influence the behavior of individuals and how individuals intentionally influence the behavior of one another.	Meier (1982)
Team control	Refers to control over group behavior.	Henderson & Lee (1992)

Appendix B: Methodology

To conduct a comprehensive and rigorous literature review on control in an IS context, we followed Webster and Watson's (2002) guidance. Our approach is consistent with a narrative review type as defined by Pare, Trudel, and Jaana's (2012) IS review taxonomy: one that describes research models and frameworks as a means to build new theory, examine important topics, and direct future research. To select materials, we first used a keyword search (using the terms "control" and "information systems control") in databases such as the Web of Science and ABI/Inform to identify journal papers meeting the review scope. After collecting these publications, we conducted a backwards search for works cited in the papers identified in the first step. We also conducted a forward search to identify other sources that cited the identified papers. We set no date restrictions and focused on studies in any peer-reviewed journal that publishes information systems-related papers. We did not exclusively rely on journals specializing in information systems for papers: we also used accounting, general management, and organizational behavior journals as potential sources. We identified 65 papers in 21 journals. Appendix C lists the reviewed papers, their publication outlet, and the primary IS process under examination.

Figure B1 depicts the multi-stage approach (which Aksulu and Wade's (2010) content analysis approach influenced) we used to analyze the literature. We coded the collected publications using an iterative model that employed an inductive approach to identifying the core dimensions and sub-dimensions in the IS control literature. This method corresponds with codes and categories that emerge from the data rather than pre-established theory. We recognize, however, that our preliminary views on IS control were also influenced by themes identified in past research findings on organizational control (Giglioni & Bedeian, 1974; Tannenbaum, 1968) and literature review approaches from other areas of IS (Powell, Piccoli, & Ives, 2004).

We began by incrementally reviewing each of the 65 identified papers and identifying the specific IS control constructs that they investigated. We broadly interpreted these constructs, which included key areas of inquiry, philosophical views on control, and contextual aspects of the IS process being studied. We coded and recorded IS constructs from each paper in a continually updated list, which we periodically reviewed for common characteristics that might suggest a broader IS control theme existing across multiple studies. For example, if two or more papers indicated that IS controls were put in place to reduce IS process costs, we reasoned that a formal category relating to "cost reduction" could be appropriate. We refer to such patterns in this study as control sub-dimensions, and they represent a distinct, specific area of inquiry noted in the literature. As these sub-dimensions began to take shape, we formally defined, refined, and expanded them as we included new IS control papers in the review.

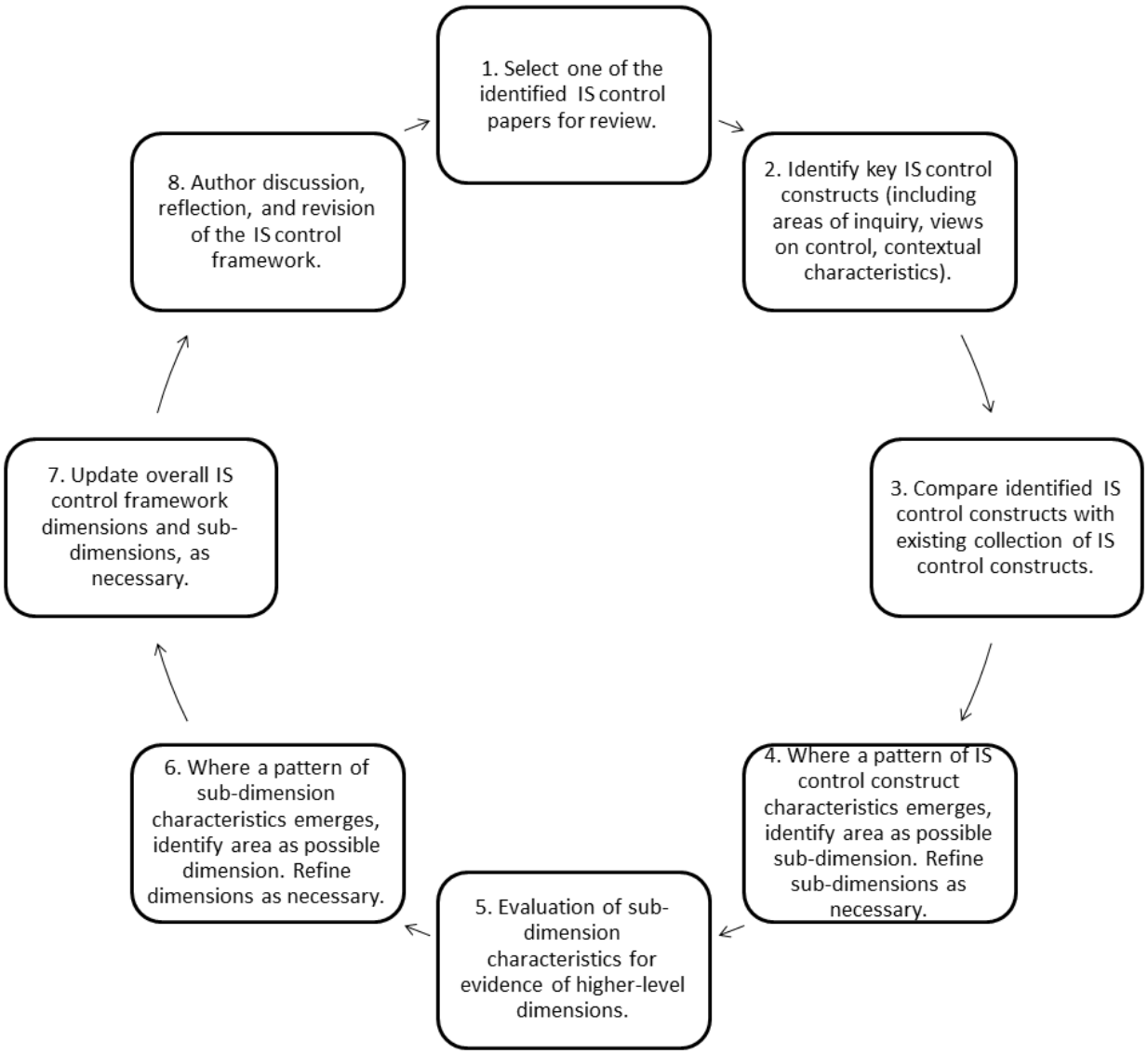

Figure B1. Literature-analysis Approach

Because we also identified common characteristics across the sub-dimensions, we also considered the existence of higher-level dimensions (consisting of multiple sub-dimensions). For example, where we identified one sub-dimension related to "cost reduction" and another sub-dimension related to "quality improvement", we saw a control dimension related to "control objectives" as an appropriate broad category to encompass both sub-dimensions. Each control dimension represents a general topic area in the research that shares a common, high-level subject theme. We updated and revised the control dimension definitions throughout the analysis process.

As we made additions and refinements to the sub-dimensions and dimensions, we inductively made changes to the study's overall IS control-classification framework. Throughout the process, we reviewed the current version of the framework and reflected on its current state, including additional refinements and possible gaps. This process continued iteratively until we reviewed all identified IS control papers and viewed the classification framework as comprehensively representing the topic areas addressed in the included papers. We identified a total of five IS control dimensions and 18 IS control sub-dimensions. We discuss specific details and definitions of the IS control dimensions and sub-dimensions in Section 3.

Review Scope and Boundaries

We focused specifically on control literature pertaining to IS processes, the unit of analysis in this study. Consistent with COBIT (ISACA, 2012), we considered examples of IS processes to include (but not limited

to) managing the development of information systems, managing information security, and managing IS outsourcing. Such activities can include employees in the IS department (e.g., developers), outside the IS department (e.g., end users, business executives), and from third parties (e.g., technology consultants, outsourcing managers), provided the process that the individual is engaged in is information systems centric. Where a process involved control but was business-focused (e.g., treasury management, marketing strategy, financial reporting), we excluded associated publications are from our study to remain consistent with our objective of better understanding IS control phenomena. Table B1 provides details of areas considered inside and outside our review's scope. Our approach is consistent with Webster and Watson (2002) who advise staying in a single unit of analysis unless one has an underlying justification to expand to a multilevel perspective. Figure B2 notes the primary IS process (based on COBIT 5) for each of the identified IS control papers and the relative number of papers for each process. Refer to Appendix C for a detailed list.

Table B1. IS Control Literature Review Scope

In scope	Outside of scope
Controls operating in an IS process unit of analysis (including but not limited to managing systems development, managing security, managing IT outsourcing)	Controls operating outside of an IS process unit of analysis (e.g., treasury management, marketing strategy, financial reporting)
Control focused on affecting human behavior via managerial techniques	Control focused on low-level technical specifications and settings in an information systems object, such as a software application
Control operating in and between organizations (e.g., security, IS outsourcing)	Control operating outside of organizations (e.g., crowdsourcing, open source, social media)

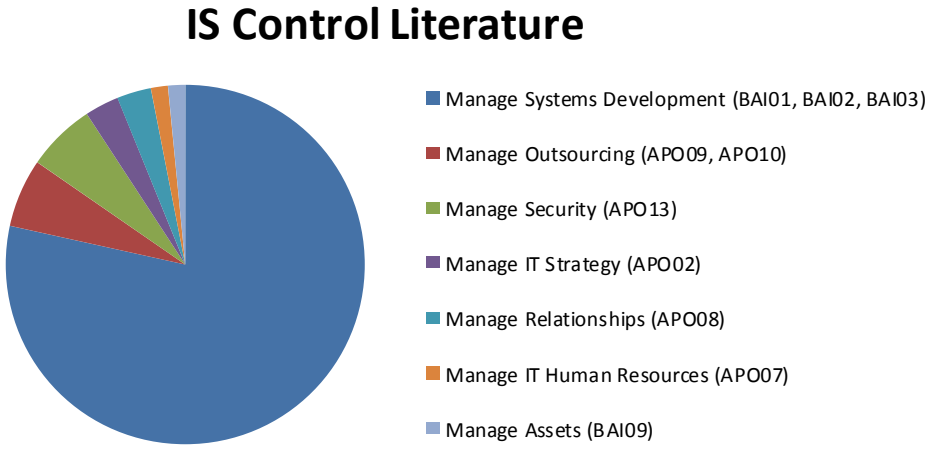

Figure B2. IS Control Papers by COBIT Process

Although some of the IS processes under review occurred at a single organization (e.g., information security), others were spread across two or more organizations (e.g., outsourcing). We did not exclude any IS control publications based on the internal or external nature of the IS control's operation. We did, however, exclude studies taking place outside of a traditional business context (e.g., crowdsourcing, open source, social media) as a result of differences in controlee characteristics (e.g., non-employees, volunteers), controller characteristics (e.g., limitations on power to address non-compliance), and mechanism characteristics (e.g., variability in policy and procedure mandatoriness). Although control remains an important aspect of these activities (Di Tullio & Staples, 2013), we set it outside the scope of this study and advocate that future research address it.

We also considered the nature of the IS controls themselves. Our approach to IS control focused on the managerial techniques used to control human behavior (e.g., monitoring subordinate output or implementing a policy or procedure to guide day-to-day activities) and excluded low-level technical controls embedded in systems (e.g., firewalls or passwords). In keeping with the motivation for our study,

we adopted this approach because of the variability in effectiveness of managerial controls. In contrast, low-level technical controls tend to be more binary and less susceptible to failure. Under this view, IS control focuses on the relationship between the behavior of organizational and inter-organizational actors as they conduct their day-to-day activities and pursue IS objectives (Kirsch, 1997).

Although much of the IS literature indicates that control will result in positive consequences for organizations (Choudhury & Sabherwal, 2003; Kirsch, 2004; Santana & Robey, 1995), some research has also uncovered the negative outcomes that can result from controls (Fitzgerald, 1996; Orlikowski, 1991). We did not exclude any publications based on philosophical judgments on control consequences because we recognize the value of literature and perspectives that advocate views challenging the status quo.

Appendix C: Literature Review Paper Listing

Table C1. Journal Papers Reviewed

Journal	Number of papers
MIS Quarterly	15
Journal of Management Information Systems	10
Information Systems Research	8
Information and Management	7
Information Systems Journal	3
Journal of Information Technology	3
Management Science	3
Organization Science	2
Communications of the ACM	2
Accounting, Management, and Information Technology	1
Computer Personnel	1
European Journal of Information Systems	1
Harvard Business Review	1
Management Accounting	1
Managerial Auditing Journal	1
Interfaces	1
Journal of Organizational and End User Computing	1
Information Technology and People	1
International Journal of Project Management	1
International Journal of Manpower	1
Systematic Practice and Action Research	1

Table C2. IS Control Paper Listing

Paper	Journal	Primary IS process
Baronas & Louis (1988)	*MIS Quarterly*	Systems development
Baskerville & Stage (1996)	*MIS Quarterly*	Systems development
Boss et al. (2009)	*European Journal of IS*	Security
Bunker, Kautz, & Anhtuan (2008)	*Journal of Information Technology*	Systems development
Choudhury & Sabherwal (2003)	*Information Systems Research*	Outsourcing
Chua et al. (2012)	*MIS Quarterly*	Systems development
Cram & Brohman (2013)	*Information Systems Journal*	Systems development
Cram et al. (2015b)	*Information Systems Journal*	Systems development
Drury (1984)	*MIS Quarterly*	*IT strategy
Duh et al. (2006)	*Information and Management*	Systems development
Essex, Magal, & Masteller (1998)	*Journal of MIS*	Systems development
Fitzgerald (1996)	*Information Systems Journal*	Systems development
Fitzgerald (2006)	*MIS Quarterly*	Systems development
Gopal & Gosain (2010)	*Information Systems Research*	Systems development
Gopal & Sanders (1997)	*Journal of MIS*	*Assets
Gray (2001)	*Information Technology and People*	Systems development

Table C2. IS Control Paper Listing

Paper	Journal	Primary IS process
Gregory et al. (2013)	*MIS Quarterly*	Systems development
Grundy, Collier, & Spaul (1994)	*Managerial Auditing Journal*	Security
Hall (1982)	*Management Accounting*	Systems development
Halloran et al. (1978)	*MIS Quarterly*	Systems development
Harris et al. (2009)	*Information Systems Research*	Systems development
Helms & Weiss (1986)	*Journal of MIS*	Systems development
Henderson & Lee (1992)	*Management Science*	Systems development
Jiang et al. (2004)	*Information and Management*	Systems development
Jin & Montague (2003)	*Systematic Practice & Action Research*	Systems development
Karimi & Konsynski (1991)	*Journal of MIS*	*IT strategy
Kirsch (1996)	*Organization Science*	Systems development
Kirsch (1997)	*Information Systems Research*	Systems development
Kirsch (2004)	*Information Systems Research*	Systems development
Kirsch et al. (2002)	*Management Science*	Systems development
Kirsch et al. (2010)	*Organization Science*	Systems development
Kling & Iacono (1984)	*Communications of the ACM*	Systems development
Kohli & Kettinger (2004)	*MIS Quarterly*	Systems development
Kraut & Streeter (1995)	*Communications of the ACM*	Systems development
Kulp et al. (2006)	*Interfaces*	Systems development
Lee, Miranda, & Kim (2004)	*Information Systems Research*	Outsourcing
Liu, Chen, Jiang, & Klein (2010)	*International Journal of Project Management*	Systems development
Liu & Yetton (2009)	*Journal of Information Technology*	Systems development
Love et al. (2007)	*International Journal of Manpower*	*IT human resources
Mao, Lee, & Deng (2008)	*Information and Management*	Outsourcing
Maruping et al. (2009)	*Information Systems Research*	Systems development
McFarlan (1981)	*Harvard Business Review*	Systems development
Morris & Marshall (2004)	*Journal of Organizational and End User Computing*	Systems development
Nidumolu & Subramani (2003)	*Journal of MIS*	Systems development
Nidumolu (1996)	*Journal of MIS*	Systems development
Olson (1982)	*MIS Quarterly*	Systems development
Orlikowski (1991)	*Accounting, Management, and Information Technology*	Systems development
Phan, George, & Vogel (1995)	*Information and Management*	Systems development
Piccoli and Ives (2003)	*MIS Quarterly*	*Relationships
Pick (1991)	*Information and Management*	Systems development
Rao et al. (2007)	*Journal of MIS*	*Relationships
Riehl (1982)	*Information and Management*	Systems development
Rittenberg & Purdy (1978)	*MIS Quarterly*	Systems development
Roberts et al. (2006)	*Management Science*	Systems development
Rustagi et al. (2008)	*Information Systems Research*	Outsourcing
Santana & Robey (1995)	*Computer Personnel*	Systems development

Table C2. IS Control Paper Listing

Paper	Journal	Primary IS process
Sia & Neo (1997)	*Journal of MIS*	Systems development
Silva & Hirschheim (2007)	*MIS Quarterly*	Systems development
Soh, Chua, & Singh (2011)	*Journal of Information Technology*	Systems development
Spears & Barki (2010)	*MIS Quarterly*	Security
Stewart & Gosain (2006)	*MIS Quarterly*	Systems development
Straub & Welke (1998)	*MIS Quarterly*	Security
Tiwana & Keil (2009)	*Journal of MIS*	Systems development
Tiwana (2010)	*Journal of MIS*	Systems development
Wallace, Keil, & Rai (2004)	*Information and Management*	Systems development

Appendix D: Control Dimension Matrices

Table D1. Control Dimension Matrices

Paper	CEn	CM	CO	CEx	SEE
Baronas & Louis (1988)					X
Baskerville and Stage (1996)	x	x			
Boss et al. (2009)		x	x		x
Bunker et al. (2008)	x	x	x		x
Choudhury & Sabherwal (2003)	x	x	x	x	x
Chua et al. (2012)	x	x			x
Cram & Brohman (2013)	x	x	x		
Cram et al. (2015b)	x	x	x	x	x
Drury (1984)		x	x		
Duh et al. (2006)	x				
Essex et al. (1998)		x	x		
Fitzgerald (1996)		x	x		x
Fitzgerald (2006)			x		
Gopal & Gosain (2010)		x	x		
Gopal & Sanders (1997)		x	x		
Gray (2001)		x			x
Gregory et al. (2013)		x		x	
Grundy et al. (1994)		x			
Hall (1982)		x			
Halloran et al. (1978)		x	x		
Harris et al. (2009)	x	x	x		
Helms & Weiss (1986)		x	x		
Henderson & Lee (1992)		x	x		
Jiang et al. (2004)			x		
Jin & Montague (2003)		x	x	x	x
Karimi & Konsynski (1991)	x				
Kirsch (1996)	x	x			
Kirsch (1997)	x	x			
Kirsch (2004)	x	x	x	x	

Table D1. Control Dimension Matrices

Paper	CEn	CM	CO	CEx	SEE
Kirsch et al. (2002)	x	x			
Kirsch et al. (2010)	x	x			
Kling & Iacono (1984)	x	x			
Kohli & Kettinger (2004)	x	x	x		x
Kraut & Streeter (1995)			x		
Kulp (2006)	x	x	x	x	x
Lee et al. (2004)		x	x		
Liu et al. (2010)		x	x		
Liu & Yetton (2009)		x	x		x
Love et al. (2007)					x
Mao et al. (2008)	x	x	x		
Maruping et al. (2009)		x	x	x	
McFarlan (1981)	x	x			
Morris & Marshall (2004)	x	x			x
Nidumolu & Subramani (2003)		x	x		
Nidumolu (1996)	x				
Olson (1982)					x
Orlikowski (1991)	x	x	x	x	x
Phan et al. (1995)	x	x	x		
Piccoli & Ives (2003)					x
Pick (1991)	x	x	x		
Rao et al. (2007)	x	x			
Riehl (1982)	x	x		x	
Rittenberg & Purdy (1978)			x		
Roberts et al. (2006)		x	x		x
Rustagi et al. (2008)	x	x			
Santana & Robey (1995)					x
Sia & Neo (1997)	x	x	x	x	x
Silva & Hirschheim (2007)		x		x	
Soh et al. (2010)	x	x	x	x	
Spears & Barki (2010)			x		

Table D1. Control Dimension Matrices

Paper	CEn	CM	CO	CEx	SEE
Stewart & Gosain (2006)	x	x			x
Straub & Welke (1998)			x		
Tiwana & Keil (2009)	x	x	x	x	
Tiwana (2010)		x	x		
Wallace et al. (2004)	x				

Table D2. Control Environment Dimension Matrix

Citation	Strategy	Structure	Process	Culture	People
Baskerville & Stage (1996)		x	x		x
Bunker, Kautz, & Anhtuan (2008)		x			x
Choudhury & Sabherwal (2003)		x	x		x
Chua, et al. (2012)		x		x	x
Cram & Brohman (2013)		x	x		
Cram, Brohman, & Gallupe (2015b)		x	x		x
Duh et al. (2006)	x				
Harris et al. (2009)	x	x			
Karimi & Konsynski (1991)	x	x			
Kirsch (1996)			x		x
Kirsch (1997)			x		x
Kirsch et al. (2002)			x	x	x
Kirsch (2004)				x	x
Kirsch et al. (2010)					x
Kling & Iacono (1984)		x		x	
Kohli & Kettinger (2004)					x
Kulp et al. (2006)				x	
Mao et al. (2008)			x	x	
McFarlan (1981)		x			
Morris & Marshall (2004)			x		x
Nidumolu (1996)			x		
Orlikowski (1991)	x	x		x	x
Phan & George (1995)					

Table D2. Control Environment Dimension Matrix

Citation	Strategy	Structure	Process	Culture	People
Pick (1991)					x
Rao et al. (2007)	x	x			
Riehl (1982)	x	x			
Rustagi et al. (2008)			x		x
Sia & Neo (1997)			x		
Soh et al. (2011)		x	x		x
Stewart & Gosain (2006)				x	
Tiwana & Keil (2009)		x	x		x
Wallace et al. (2004)		x			

Table D3. Control Mechanisms Dimension Matrix

Citation	Category	Activity
Baskerville & Stage (1996)		x
Boss et al. (2009)		x
Bunker et al. (2008)		x
Choudhury & Sabherwal (2003)	x	
Chua et al. (2012)	x	
Cram & Brohman (2013)	x	
Cram et al. (2015b)		x
Drury (1984)		x
Essex, Magal, & Masteller (1998)	x	
Fitzgerald (1996)		x
Gopal & Gosain (2010)	x	
Gopal & Sanders (1997)	x	
Gray (2001)		x
Gregory et al. (2013)	x	
Grundy et al. (1994)		x
Hall (1982)		x
Halloran et al. (1978)		x
Harris, et al. (2009)	x	x
Helms & Weiss (1986)		x
Henderson & Lee (1992)	x	
Jin & Montague (2003)		x
Kirsch (1996)	x	
Kirsch (1997)	x	x
Kirsch et al. (2002)	x	
Kirsch (2004)		x

Table D3. Control Mechanisms Dimension Matrix

Citation	Category	Activity
Kirsch et al. (2010)	x	
Kling & Iacono (1984)	x	
Kohli & Kettinger (2004)	x	x
Kulp et al. (2006)		x
Lee et al. (2004)		x
Liu et al. (2010)		x
Liu & Yetton (2009)		x
Mao et al. (2008)		x
Maruping et al. (2009)	x	
McFarlan (1981)		x
Morris & Marshall (2004)		x
Nidumolu & Subramani (2003)	x	
Orlikowski (1991)		x
Phan & George (1995)		x
Pick (1991)		x
Rao et al. (2007)	x	x
Riehl (1982)		x
Rustagi et al., 2008)	x	
Sia & Neo (1997)		x
Silva & Hirschheim (2007)		x
Soh et al. (2011)	x	
Stewart & Gosain (2006)	x	x
Tiwana & Keil (2009)	x	
Tiwana (2010)	x	

Table D4. Control Outcome Dimension Matrix

Citation	Quality	Profit & cost	Speed & schedule	Innovation	Compliance	Hybrid
Boss et al. (2009)					x	
Bunker et al. (2008)					x	
Choudhury & Sabherwal (2003)						x
Cram & Brohman (2013)	x	x	x			x
Cram et al. (2015b)						x
Drury (1984)						x
Essex et al. (1998)	x	x				x
Fitzgerald (1996)				x		

Table D4. Control Outcome Dimension Matrix

Citation	Quality	Profit & cost	Speed & schedule	Innovation	Compliance	Hybrid
Fitzgerald (2006)		x				
Gopal & Gosain (2010)	x	x	x			
Gopal & Sanders (1997)		x				
Halloran et al. (1978)	x					
Harris et al. (2009)						x
Helms & Weiss (1986)		x				
Henderson & Lee (1992)	x	x	x			
Jiang et al. (2004)	x	x	x		x	
Jin & Montague (2003)	x		x			
Kirsch (2004)						x
Kohli & Kettinger (2004)	x	x				
Kraut & Streeter (1995)						x
Kulp et al. (2006)		x			x	
Lee et al. (2004)		x		x		x
Liu & Yetton (2009)	x	x	x			
Liu et al. (2010)						x
Mao et al. (2008)		x				
Maruping, et al. (2009)	x					
Nidumolu & Subramani (2003)						x
Orlikowski (1991)	x	x	x	x		
Phan & George (1995)	x					
Pick (1991)	x					
Rittenberg & Purdy (1978)					x	
Roberts et al. (2006)		x				
Sia & Neo (1997)		x	x			

Table D4. Control Outcome Dimension Matrix

Citation	Quality	Profit & cost	Speed & schedule	Innovation	Compliance	Hybrid
Soh et al. (2011)			x			
Spears & Barki (2010)					x	
Straub & Welke (1998)					x	
Tiwana & Keil (2009)	x	x	x			x
Tiwana (2010)						x

Table D5. Control Execution Dimension Matrix

Citation	Control effectiveness	Control evolution
Choudhury & Sabherwal (2003)	x	x
Cram et al. (2015b)	x	x
Gregory et al. (2013)	x	x
Jin & Montague (2003)	x	x
Kirsch (2004)		x
Kohli & Kettinger (2004)		x
Kraut & Streeter (1995)	x	
Kulp et al. (2006)	x	
Maruping et al. (2009)	x	
Orlikowski (1991)		x
Riehl (1982)	x	
Sia & Neo (1997)	x	x
Silva & Hirschheim (2007)		x
Soh et al. (2011)	x	x
Tiwana & Keil (2009)	x	

Table D6. Control Experiences Dimension Matrix

Citation	Motivation and satisfaction	Psychological structures	Socialization
Baronas & Louis (1988)		x	
Boss et al. (2009)	x		
Bunker et al. (2008)		x	x
Choudhury & Sabherwal (2003)			x
Chua et al. (2012)	x		x
Cram et al. (2015b)	x	x	x
Fitzgerald (1996)		x	
Gray (2001)	x		x
Jin & Montague (2003)	x	x	x

Table D6. Control Experiences Dimension Matrix

Citation	Motivation and satisfaction	Psychological structures	Socialization
Kohli & Kettinger (2004)			x
Kulp et al. (2006)	x		
Liu et al. (2010)	x		x
Love et al. (2007)		x	
Morris & Marshall (2004)		x	
Olson (1982)		x	
Orlikowski (1991)	x	x	x
Piccoli & Ives (2003)		x	
Roberts et al. (2006)	x		
Santana & Robey (1995)	x		
Sia & Neo (1997)	x		
Stewart & Gosain (2006)			x

Appendix E: COBIT Processes

Table E1. COBIT Processes (ISACA, 2012)

Reference	IS process name
EDM01	Ensure governance framework setting and maintenance
EDM02	Ensure benefits delivery
EDM03	Ensure risk optimization
EDM04	Ensure resource optimization
EDM05	Ensure stakeholder transparency
APO01	Mange the IT management framework
APO02	Manage strategy
APO03	Manage enterprise architecture
APO04	Manage innovation
APO05	Manage portfolio
APO06	Manage budget and costs
APO07	Manage human resources
APO08	Manage relationships
APO09	Manage service agreements
APO10	Manage suppliers
APO11	Manage quality
APO12	Manage risk
APO13	Manage security
BAI01	Manage programs and projects
BAI02	Manage requirements definition
BAI03	Manage solutions identification and build
BAI04	Manage availability and capacity
BAI05	Manage organizational change environment
BAI06	Manage changes
BAI07	Manage change acceptance and transitioning
BAI08	Manage knowledge
BAI09	Manage assets
BAI10	Manage configuration
DSS01	Manage operations
DSS02	Manage service requests and incidents
DSS03	Manage problems
DSS04	Manage continuity
DSS05	Manage security services
DSS06	Manage business process controls
MEA01	Monitor, evaluate and assess performance and conformance
MEA01	Monitor, evaluate and assess the system of internal control
MEA01	Monitor, evaluate and assess compliance with external requirements

About the Authors

W. Alec Cram is an Assistant Professor of Information and Process Management at Bentley University. He received his PhD from Queen's University. Before returning to school, he worked as an IT Audit Manager at Deloitte. His research focuses on how information systems control initiatives can contribute to improving the performance of organizational processes, such as systems development and information security. His work has been published in outlets including the *Information Systems Journal*, *European Journal of Information Systems*, *Information and Management*, and *Journal of Information Systems*.

M. Kathryn Brohman is Associate Professor & Distinguished Faculty Fellow of Management Information Systems at Queen's University. Kathryn's research explores the impact of digital IT strategy on organizational behavior. Her work has been published in the *Harvard Business Review*, *Decision Sciences*, *Communications of the ACM* and *MISQ Executive* and presented at leading conferences in her field. He entered academia after working with Sun Microsystems and is an expert in complex project implementations, agile development, and digital connectedness.

R. Brent Gallupe is Professor of Management Information Systems, Director and Founder of the Queen's Executive Decision Center, and Associate Dean—Faculty at Smith School of Business, Queen's University, Canada. He also holds an on-going Visiting Professor appointment at the University of Auckland, New Zealand. His current research interests include IS Control Alignment, Collaborative Technologies, and IT-enabled Transparency. He earned an MBA at Schulich Business School, York University, and a PhD in Business Administration at the University of Minnesota. He has held editorial appointments at a number of leading IS journals including MIS Quarterly. His work has been published in such journals as *Management Science*, *MIS Quarterly*, *Information Systems Research*, *Academy of Management Journal*, *Sloan Management Review*, and *Journal of Applied Psychology*.

Copyright © 2016 by the Association for Information Systems. Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and full citation on the first page. Copyright for components of this work owned by others than the Association for Information Systems must be honored. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers, or to redistribute to lists requires prior specific permission and/or fee. Request permission to publish from: AIS Administrative Office, P.O. Box 2712 Atlanta, GA, 30301-2712 Attn: Reprints or via e-mail from publications@aisnet.org.