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Strategic Sensemaking and Software Asset Management: Linkages Between Interpretation and Organizational Action

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STRATEGIC SENSEMAKING AND SOFTWARE ASSET MANAGEMENT: LINKAGES BETWEEN INTERPRETATION AND ORGANIZATIONAL ACTION

A Dissertation

by

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ABSTRACT

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Software is a critical information technology (IT) asset as it plays a key role in the creation of organizational value and it ranks as the first or second most important IT budget disbursement. Organizations are expected to govern software to ensure its efficient use while protecting the copyright of software developers.

Software asset management (SAM) focuses on the good governance and effective lifecycle management of software. SAM impacts the flexibility to support business strategies with software, and protects organizations against liability and security risks associated with software use. Since the 1990s, practitioners and scholars posit that SAM is a strategic issue that should be attended by top management. However, reports indicate that widespread SAM adoption is at early stages and a review of the literature reveals limited research on SAM. Studying SAM is relevant to practice and theory because it could explain the processes behind its adoption in organizations. Two different SAM actions are identified: Proactive and Reactive SAM. This study investigates the role of top managers and important antecedents of SAM actions.

This investigation draws from strategic sensemaking to explain how top management team's (TMT) interpretation of IS strategic issues (i.e., software asset issues) as an opportunity influences proactive SAM. It also draws from institutional theory as explanation of reactive SAM actions. Survey responses from 187 chief information officers were collected.

The study used a scenario to elicit a strategic issue tested in three stages. In the first stage, scholars and practitioners validated the scenario and survey items. In the second, a pilot was conducted to validate the survey instrument and research model. In the third, a full-scale data collection and test of the research model was completed. Findings from this study indicate that TMT interpretation of SAM as an IS strategic issue influences the adoption of Proactive SAM. Also, coercive force has a direct influence on reactive SAM.

This study contributes to the IS literature by developing an instrument to measure reactive and proactive SAM, identifying factors that influence TMT's interpretation, and subsequent SAM action. For practice, the study corroborates the need to involve TMT in the SAM decision making processes because TMT interpretation is positively associated with the willingness to implement Proactive SAM.

DEDICATION

I dedicate the completion of this dissertation to my wife and children. Without their support, cooperation, understanding, and encouragement, it would not have been possible to achieve this challenge. Thank you for your unconditional love and support.

I would also like to dedicate this dissertation to my parents. Their example and teachings always encouraged and challenged me to dream big and work hard towards achieving a chosen path. Gracias mamá y papá.

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CHAPTER I

INTRODUCTION

This chapter presents the background and importance of studying software asset management (SAM). Subsequently, it introduces institutional theory and strategic sensemaking theory, which are used to explain differences in SAM adoption. The chapter also discusses the research questions and research contributions. Finally, the structure of the dissertation is described.

1.1 Background and Importance of Software Asset Management

There is a rising interest in SAM because organizations invest large amounts of resources in software assets. Many studies show the significance of SAM for organizations. For instance, in 2012, out of $540 billion of capital investment that American organizations spent, 52 percent was allocated to IT (Laudon and Laudon 2014). Software assets rank as the first or second most important item in most organizations' ITs budget (Accenture 2014). In 2015, globally, organizations spent $579 billion and $361 billion on software assets and hardware assets, respectively (Forrester 2015). Given the magnitude of investment on software assets, industry experts and scholars recommend that organizations should manage software as a strategic asset (cf. Barber et al. 2016; Ben-Menachem 2008; Ben-Menachem and Gavious 2007; Dutta 2007; Washburn and Langer 2013).

There are strong indications that SAM is needed to achieve more efficient software investments, reduce the costs of operating software, and protect organizations against unexpected expenses on software licensing audits. For instance, in 2015, American organizations wasted an average of $247 per user on unutilized software which translated into an aggregated spending of $28 billion (1E 2016; Dignan 2016). According to the General Accounting Office (GAO), the federal government can save millions of dollars from the estimated $2 to $4 billion spent on unused software by improving the management of software licenses (Flexera 2014; GAO 2015; Miller 2015). Organizations that lack a rigorous SAM program are likely to be unprepared to face software licensing audits. Industry reports revealed that 55 percent of the surveyed organizations had audit discrepancies resulting in payments of at least $100,000; whereas 21 percent of the responding organizations reported audit discrepancies leading to payments of more than $1,000,000 (IDC and Flexera 2014). Licensing infringement uncovered by software audits could result in fines to software users of up to $150,000 per misused software license and retribution payments to affected software developers (Holsing and Yen 1999; Koen and Im 1997). Therefore, SAM can serve as a control mechanism to protect an organization from fines and wastes during the lifecycle of software assets.

Further, organizations have recognized the need to manage Information Technology (IT) as strategic assets through effective IT governance to set IS strategy, deliver value, and manage risk so that IT supports current and future business operations (ITGI 2003; Weill and Ross 2004; Wilkin and Chenhall 2010). IT resource management, a core area of IT governance, is concerned with the management of IT assets (ITGI 2003; Wilkin and Chenhall 2010). IT assets include software, computers and network equipment, IT facilities, data, processes and policies, documentation, contracts, and IT human resources (cf. ITGI 2003; Rudd 2009; Wilkin and

Chenhall 2010). Literature concerned with the governance of software assets underscores the importance of SAM for achieving a more efficient software capital investment (e.g., ISO/IEC, 2012; Rudd, 2009).

Institutions that create normative references, such as ISO/IEC and ITIL/Axelos, have developed standards for best SAM governance practices (ISO/IEC, 2012; Rudd, 2009). The rationale behind these standards is to protect organizations from risks inherent in the use of software and to promote their efficient use by practicing SAM (ISO/IEC, 2012; Rudd, 2009). A list of the potential benefits that organizations could reap from SAM according to both ISO/IEC and ITIL/Axelos includes[1]:

1. Improved cost control of software purchases and reduction in maintenance and support costs [a,b]
2. Competitive advantage as the organizations can take better decisions on software needs because of reliable data [a,b]
3. Better risk management by mitigating the interruption of IT services due to legal, regulatory, and financial exposure [a,b]
4. Protection from damaged reputation [b]
5. Protection against security breaches [b]
6. Improved infrastructure planning that may lead to reduced cost of hardware [b]

Thus, organizations with SAM programs can accomplish two major goals: (1) mitigate interruption or reduced quality of IT services by avoiding software piracy and license misuse (cf. Barber, Hubbard, Marquis, & White, 2016; Bequai, 1998; D. Glass, Price, & Wilson, 1998;

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[1] ISO/IEC 19770-1 [a], ITIL V3 Software Asset Management [b]

Holsing & Yen, 1999; ISO/IEC, 2012; Rudd, 2009), and (2) achieve efficient use of software as an organizational asset by enhancing flexibility in deployment and improving cost visibility which often leads to savings of up to 25 percent of software budget (cf. Barber et al., 2016; Ben-Menachem, 2008; Forrester, 2015; ISO/IEC, 2012; Rudd, 2009).

The preceding discussion emphasized the significant organizational expenditures on software and the benefits of conducting SAM. It follows that understanding the reasons and processes leading to SAM implementation is important and of practical relevance, as software is a strategic organizational asset (cf. Ben-Menachem, 2008; Dutta, 2007; Laudon & Laudon, 2016; Murray & Murray, 1996; Rudd, 2009; Strong & Volkoff, 2010; Swartz & Vysniauskas, 2013; Waltermire, Cheikes, Feldman, & Witte, 2015).

However, despite many benefits of SAM; such as potential efficiency gains in the use of software assets (e.g., Bott, 2000; Dery, 2008; Holsing & Yen, 1999; Jakubicka, 2010; Sharifi, Ayat, Ibrahim, & Sahibuddin, 2009; Swartz & Vysniauskas, 2013), potential savings on software expenses, or improved readiness to face software license audits and avoiding true-up payments (IDC & Flexera, 2014; Overby, 2012; Pender, 2010; Slive & Bernhardt, 1998), the review of the literature indicated scant research on SAM.

This dissertation seeks to address this gap in SAM research by studying the underlying organizational processes leading to differences in SAM adoption. The study investigates SAM in a theory based contextualization (Hong, Chan, Thong, Chasalow, & Dhillon, 2014) with specific factors relevant to the study of SAM in organizations.

In my investigation, it is posited that organizations are open systems that are subject to the influences of the environment (Daft, 2007; Daft & Weick, 1984; W. R. Scott & Davis, 2007). Environmental forces such as institutional pressures (DiMaggio & Powell, 1991) and organizational contextual factors influencing TMT's[2] interpretation of strategic issues (Daft & Weick, 1984; Dutton & Jackson, 1987; Thomas, Clark, & Gioia, 1993) are proposed to affect the implementation of reactive and proactive SAM. For this study, *Reactive SAM* is the ad-hoc inventory tracking and counting actions that organizations take as a response to demonstrate compliance with software vendors' copyright supported by software licenses or contracts (cf. Kardaras, 2012; Plastow, 2006; S. Robinson, 2012). *Proactive SAM* is the voluntary actions that organizations take to plan and execute the lifecycle management system of software as a key strategic asset that generates or supports organizational value (cf. Kardaras, 2012; Plastow, 2006; S. Robinson, 2012).

1.2 Institutional Theory and SAM

The institutional theory asserts that an organization espouses actions that other organizations from its field (i.e., industry sector) have adopted to gain legitimacy and adapt to the environment (DiMaggio & Powell, 1983; DiMaggio & Powell, 1991; W. R. Scott, 1995). The legitimacy achieved through the adoption of generally accepted practices is evaluated by critical stakeholders as an indication of organizational rationality, and that improves the organization's chances to secure important resources necessary to increase its likelihood of survival (DiMaggio & Powell, 1983; DiMaggio & Powell, 1991; W. R. Scott, 1995). Further, as organizations replicate the adoption of generally accepted practices, they institutionalize such measures. Consequently, the adoption of generally accepted practices drives organizations from

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[2] The top management team (TMT) is the group of the highest-level executives with a responsibility to interpret information and make decisions about the formulation, articulation, and execution of strategy and tactics implemented by an organization (Finkelstein, Hambrick, & Cannella, 2009; Klenke, 2003; Raes, Glunk, Heijltjes, & Roe, 2007).

a common sector or organizational field to become similar (isomorphic) (DiMaggio & Powell, 1983).

DiMaggio and Powell (1983) proposed three types of institutional forces, namely, mimetic, normative, and coercive. Mimetic force drives organizations to imitate actions taken by successful competitors operating in the same organizational field (i.e., industry sector). Normative force results from the homogenization of conditions and methods across professional networks of organizations from the same sector. Coercive force comes from the power-dependence on other organizations, such as the government and suppliers that mandate actions.

The literature on institutional theory posits that to understand the active institutional forces, a clear understanding of the context of the organizational field is required (DiMaggio & Powell, 1983; Greenwood, Oliver, Sahlin-Andersson, & Suddaby, 2008). It is in the organizational field where uniform rules, requirements, and societal expectations, to which organizations must conform, are shaped (W. R. Scott, 1991). The focus on defining the institutional context to identify the uniform institutional force(s) exerted on organizations parallels Hong et al. (2014) approach to theory contextualization. Hong et al. (2014) recommend using established theories by incorporating contextual factors as antecedents of dependent variables (contextualization of level 2a). A review of institutional theory articles from six premier management journals found that 77 percent of studies that employ institutional theory used only one institutional force, and of those studies, 20 percent used coercive force as the sole institutional pressure (Mizruchi & Fein, 1999).

The need of SAM has been heavily influenced by the emergence of software development as a valuable activity which is supported by copyright legislation. In the early days of IT, software was an integral part of computing devices, and there was no need to track compliance with software licenses (Ceruzzi, 2003; Madison, 2003). However, in the early 1970s, the practice of bundling hardware and software was eliminated given the potential monopolistic issues of such practice (Madison, 2003). Thus, software starts to be looked at as a valuable IT component, and this is confirmed when legislation that grants intellectual property rights to software developers was passed during the second half of the 1970s (Madison, 2003). The importance of organizational compliance with software licenses and contracts supporting software developers' copyright is tied to the emergence of software as a valuable intellectual asset (Ceruzzi, 2003).

Early SAM literature highlights its important role to protect organizations from liability risk associated with the infringement or lack of compliance with software licenses or contracts (cf. Athey & Plotnicki, 1994; R. S. Glass & Wood, 1996; T. Hoffman, 1993; Radding, 1994). Often, SAM has been viewed as an activity that focuses on ad hoc counting of software licenses with actual organizational use (Reactive SAM). It is argued that a counting and matching focus is a reaction towards the software developers' copyright as established by American legislation. This widely held conception of SAM (Reactive SAM) signals critical stakeholders (i.e., developers and the law) that organizations protect and comply with software developers' intellectual property rights.

According to institutional theory, compliance is not viewed by the organization as being integrated into the processes that seek organizational efficiency but as a demonstration of ceremonial adherence with agreed societal expectations necessary to achieve legitimacy with institutional stakeholders holding importance resources (i.e., software vendors, government) (DiMaggio & Powell, 1983). This conception is consistent with organizations' traditional view that the law sets the minimum societal expectation that should be met by its actors (Gunningham, Kagan, & Thornton, 2004; Hawkins & Hutter, 1993; Kreuter, 2013). However, achieving the minimum expectation through a reactive perspective of SAM does not promote the execution of actions that seek to plan and manage the efficient lifecycle of software, as in Proactive SAM.

As this investigation collects data from multiple industry sectors, and in agreement with institutional theory suggestion of identifying the uniform forces affecting the studied institutional sector (DiMaggio & Powell, 1983), it was found through the review of SAM, that coercive force has been the driving pressure creating the institutionalized belief that organizations must protect software developers' intellectual property rights. Consequently, in the institutional context of this study, only coercive force will be studied.

The role of coercive force explains why organizations react to environmental stimuli, that is copyright law and software licenses, which set a minimum expectation of SAM actions that organizations will execute. In this dissertation, it is posited that coercive force has a direct influence on the implementation of reactive SAM. Reactive SAM focuses on inventory counting and tracking of software licenses to meet the minimum expectation set by copyright law and software licenses (cf. D. Glass et al., 1998; Holsing & Yen, 1999). Figure 1.1 shows the influence of coercive force on reactive SAM.

Figure 1.1 Coercive Force Influence on Reactive SAM

1.3 Strategic Sensemaking and SAM

The IS literature points out that top managers play an important role in supporting the adoption of technology or programs that facilitate the assimilation or use of IT in organizations (e.g., Liang, Saraf, Hu, & Xue, 2007; Orlikowski, 1993; Straub & Welke, 1998).

Top managers are part of the top management team (TMT) which is the organization's highest-level executives who make information on SAM and categorize it as a strategic issue. This categorization leads to organizational choices on software assets. Scholars propose that managerial choices involve the analysis of the organization's task environment interpreted by rationally bounded managers (cf. Cyert & March, 1963; Hambrick & Mason, 1984; March & Simon, 1958; Markóczy, 1997; Simon, 1947; J. D. Thompson, 1967). Organizational actions reflect TMT's interpretation of strategic issues (Hambrick & Mason, 1984). Further, even if diverse TMTs are exposed to similar stimuli, organizational actions can differ because contextual factors in the task environment and information provided by organizational structures are interpreted differently (Daft, 2007; Daft & Weick, 1984; Hall, 1984; Thomas & McDaniel, 1990).

The strategic sensemaking[3] theory sees organizations as interpretation systems of information that scan the environment for information on strategic issues (Daft & Weick, 1984; Dutton & Jackson, 1987; Milliken, 1990; Thomas et al., 1993; Thomas & McDaniel, 1990). Information is facilitated in the scanning stage by organizational factors such as the information processing structure (IPS) (Kuvaas, 2002; Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas, McDaniel, & Anderson, 1991) and the strategic orientation of the organization (cf. Plambeck & Weber, 2010; Thomas et al., 1993; Thomas & McDaniel, 1990). When facing an IS strategic issue the information processing structure allows the CIO and TMT (CIO-TMT IPS) members to exchange information that will be used to analyze the IS strategic issue. Also, the IS

[3] Sensemaking theory has a cognitive stream that focuses on strategic issues and a social stream. This dissertation uses the cognitive stream. Details are provided in the literature review.

strategic orientation of the organization provides TMT a direction about how the organization should position their use of IT to support business objectives.

Information available to TMT is interpreted and assigned meaning leading to resultant organizational actions (Daft & Weick, 1984; Dutton & Jackson, 1987; Sharma, 2000; Thomas et al., 1993; Thomas & McDaniel, 1990). In the case of opportunity[4] interpretation, organizations will conduct an open search for alternatives and adopt proactive actions (Daft & Weick, 1984; Dutton & Jackson, 1987; Sharma, 2000; Thomas et al., 1993).

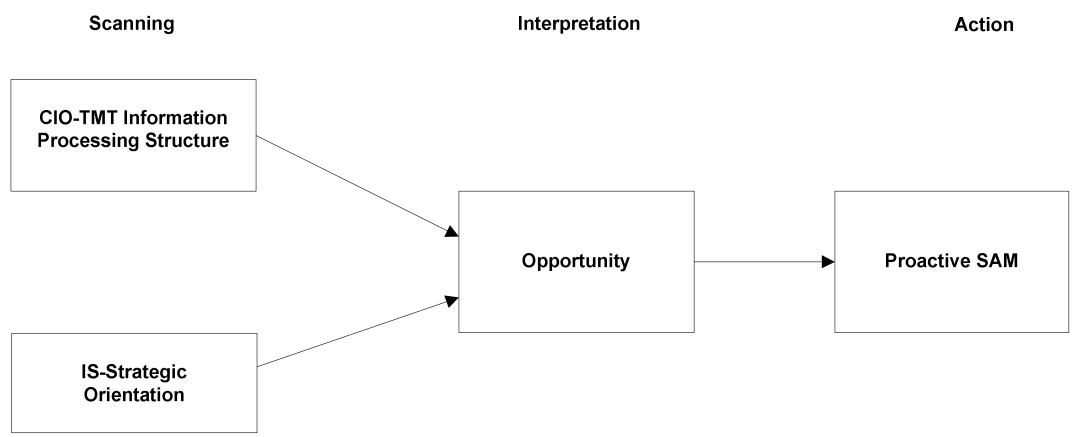

Figure 1.2 Strategic Sensemaking of SAM

It is proposed that when scanning of the environment leads to TMT identification of strategic opportunities in managing software, more alternatives will be considered (cf. Dutton, 1993; Jackson & Dutton, 1988; Nutt, 1984; Sharma, 2000; Sharma & Vredenburg, 1998). When more alternatives are considered, organizations are likely to implement proactive SAM actions (cf. Sharma, 2000; Sharma & Vredenburg, 1998), which are voluntary processes that facilitate the effective planning and efficient management of software through its lifecycle. Figure 1.2 illustrates the proposed organizational factors leading to the strategic sensemaking of SAM.

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[4] In strategic sensemaking theory strategic issues are categorized by managers in a continuum from opportunity to threat (Dutton & Jackson, 1987; Thomas et al., 1993).

1.4 Research Questions

The goal of this dissertation is to expand the understanding of how organizations adopt SAM. This dissertation seeks to fulfill this objective by answering the following research questions:

1. Do TMTs differ in the way they interpret SAM issues?
2. Do CIO-TMT information processing structure and IS strategic orientation explain differences in TMT interpretation of SAM issues?
3. Does the interpretation of SAM issues influence the type of SAM implementation?
4. Does coercive force influence the implementation of reactive SAM?

To answer the research questions, this dissertation:

1. Develops a model that combines different organizational factors influencing the interpretation of SAM issues and subsequent organizational actions based on sensemaking theory
2. Postulates a theoretical explanation to understand the implementation of reactive and proactive SAM actions
3. Develops an instrument to measure reactive and proactive SAM
4. Collects field survey data using a case scenario to test the proposed model empirically

1.5 Research Contributions

This dissertation seeks to expand the understanding of how TMT's interpretation of an IS strategic issue influences the implementation of proactive and reactive SAM actions. The findings of this dissertation will be of interest to researchers, IT practitioners, industry, and trade groups concerned with SAM, software licensing, software piracy, and IT asset management.

It also adds to the IS and SAM literature by exploring the influence of important factors, such as the CIO-TMT information processing structure, and strategic factors such as the IS Strategic Orientation, on TMT interpretation and implementation of SAM actions. It further contributes to theory by explaining why organizations differ in their level of SAM implementation. Additionally, this dissertation extends the literature on strategic sensemaking, as it empirically tests the sensemaking theory within the context of IS strategic issues. Thus, it accounts for the role of CIO who as the holder of specialized IT knowledge enriches the information received by TMT's information processing structure when interpreting IS strategic issues.

For the industry and IS practitioners, the expanded understanding of the factors that lead to managing software as an IS strategic asset can help organizations conceive actions that capture opportunities based on the effective implementation of comprehensive SAM actions. Finally, watchdog organizations could adjust or validate what they do in their awareness campaigns on software copyright based on the findings of this investigation.

1.6 Structure of the Dissertation Proposal

The dissertation is divided into six chapters. In chapter I, the dissertation describes the background and importance of SAM, theories used, research questions, and contribution. Chapter II reviews the related literature on software asset management, sensemaking theory, and institutional theory. Chapter III describes the conceptual model and a set of testable hypotheses that build on the strategic sensemaking theory and institutional theory. Chapter IV presents the research methodology of the empirical study conducted, operationalizes the constructs, and details the different stages used for data collection. Chapter V describes the data analysis and Chapter VI covers the discussion and conclusions.

CHAPTER II

LITERATURE REVIEW

This chapter reviews the literature related to the theoretical model developed for this dissertation, which is presented in Chapter III. Two theoretical perspectives are followed to study the adoption of SAM by organizations. Institutional theory is used, given the influence of coercive force on the adoption of reactive SAM or in other words compliance with copyright laws and software licenses. In addition, strategic sensemaking theory is used to explain TMT's interpretation of the organizational environment that leads to the adoption of proactive SAM, which takes the organization beyond the minimum expectation set by copyright law. These two theories propose that environmental determinism and strategic choice influence organizational decisions and actions.

The review of SAM literature is presented first, followed by the review of IT governance, institutional theory, and the influence of coercive force on reactive SAM. Finally, a review of sensemaking theory and the role of TMT's interpretation in the implementation of SAM actions is presented.

2.1 Software Asset Management

This section reviews the literature on software asset management. SAM is a strategic imperative for organizations, and it should be a concern of top management (Barber et al., 2016; Ben-Menachem, 2008; Forrester, 2015) for several reasons. First, the IT governance literature stresses that SAM is important because software supports, enhances and complements business strategies and organizations should have a strategic focus to ensure that software management is aligned with the achievement of organizational objectives (Trites, 2004; Wilkin & Chenhall, 2010). Second, software assets draw a top percentage of the IT budget and managing software as a strategic asset is important given the large amount of resources that they require (Accenture, 2014; Barber et al., 2016; Forrester, 2015). Third, SAM has been recognized as a practice that can reduce waste on unused software and protect organizations against software liability risk. This is especially important because American organizations are under pressure to reduce the operating costs of IT (Kappelman, McLean, Johnson, & Gerhart, 2014; Luftman & Derksen, 2012), yet two studies show that they wasted up to $28 billion on unused software in 2015 (1E 2016; Dignan 2016), and often need to face software licensing audits resulting in unplanned payments (IDC & Flexera, 2014).

2.1.1 Software Asset Management Literature

Different authors and organizations studying the subject have defined software asset management differently. Most definitions (see Table 2.1) stress the importance of processes (e.g., Holsing & Yen, 1999; Rudd, 2009) needed to manage, control and protect (e.g., ISO/IEC, 2012; Microsoft, n.d.; Powell, 2011; Rudd, 2009) software assets throughout the lifecycle (e.g. BSA, 2014; Microsoft, n.d.; Wurster, Adams, Barber, & Marquis, 2016) of software use in an organization. The protection and control of software assets, which includes information about software assets as well, (ISO/IEC, 2012) is driven by the expectation that organizations should comply with copyright legislation and software licenses granting organizations the right to use software (A. Fisher, 2013; Kardaras, 2012; PwC, 2012).

Additionally, the definitions shown in Table 2.1 specify that SAM allows organizations to accomplish efficiencies in their use of software which leads to cost savings (KPMG, 2013; Microsoft, n.d.; Rudd, 2009). Overall, organizations that adopt a comprehensive SAM program will benefit through improved ability to manage risks, control costs, and obtain a competitive advantage to manage software assets (ISO/IEC, 2012; Rudd, 2009).

Table 2.1
Software Asset Management Definitions (SAM)

Author	Definition
International Association of Information Technology Asset Managers (IAITAM) (as cited in The ITAM Review, 2015, p. 2)	'The practice of integrating people, processes, and technology to allow software licenses and usage to be systematically tracked, evaluated and managed. The goal of Software Asset Management is to reduce IT expenditures, human resource overhead, and compliance risks that are inherent in owning and managing software assets'
KPMG (2013, p. 2)	"is a business practice designed to help effectively manage information technology (IT) costs, limit risks related to the ownership and use of software, and increase IT and end-user efficiencies."
(ISO/IEC, 2012, p. 6)	"is the effective management, control and protection of software assets within an organization, and the effective management, control and protection of information about related assets which are needed in order to manage software assets."
Powell (2011, p. 3)	"is a set of processes that enables organisations to gain control of their software estate from both a license compliance and financial perspective."
ITIL/Axelos (Rudd, 2009, p. 4)	'is all of the infrastructure and processes necessary for the effective management, control, and protection of the software assets within an organisation throughout all stages of their lifecycle'
Microsoft (2016, p. 2)	"is a vital set of continuous business processes that provide a system for the effective management and protection of software assets within your organization throughout all stages of their life cycle. SAM brings together people, processes, and technology to control and optimize the use of software in your organization."
Holsing and Yen (1999, p. 16)	"Software (asset) management is the process of managing organizational software assets...The major goal is to ensure software license compliance through employee education and established purchasing procedures while minimizing software expenses."
BSA (2014, p. 3)	"practices of managing the lifecycle of software assets within an organization. It is a set of managed processes and functional capabilities throughout the five stages of the lifecycle (planning, requisition, deployment, maintenance, and retirement)"
Wurster et al. (2016, p. 14)	"is a framework and set of processes that strategically track and manage the financial, physical, licensing and contractual aspects during the life cycle of software assets"

Managing risks allows organizations to control the use of software as specified by licensing terms and avoid security issues (ISO/IEC, 2012; PwC, 2012; Rudd, 2009). A SAM system verifies that the organization's software use is entitled by documented software licenses (Rudd, 2009). SAM systems protect the organization from failing external software audits that in-turn could have significant negative financial effects on the organization's cash flow or on the management and operations personnel who would have to allocate time to additional unexpected workload (CDW, 2013, 2014; Wallace, Johnson, Mathe, & Paul, 2011). Moreover, SAM prevents service interruptions due to inadequate information about software inventory or shadow IT[5] bypassing IT controls, which could lead to unsupported software that can also compromise the security of the IT infrastructure (Forrester, 2015; PwC, 2012).

SAM also contributes to important cost savings and efficiency in executing the IT budget (ISO/IEC, 2012; PwC, 2012; Rudd, 2009). Organizations that practice SAM saved up to 30% on their IT budgets during the first year of SAM implementation, and up to 10% in subsequent years (Powell, 2011). Usually, improvements come from better negotiation or renegotiated purchasing terms and conditions, better infrastructure planning, better identification of user needs, tighter controls to avoid overdeployment of software, and centralization of SAM management (CDW, 2013; KPMG, 2013; Rudd, 2009). An industry publication explains how the availability of detailed information about software utilization, including daily software usage by person, allowed the University of Michigan to renegotiate with software vendors for better terms and conditions on software licensing, leading to savings of $1.2 million (Hildreth, 2006).

Competitive advantage is also an expected outcome of SAM (ISO/IEC, 2012). When organizations adopt a comprehensive SAM system, they are more likely to obtain better and more detailed information about software assets (Forrester, 2015; Rudd, 2009). The improvement of information not only supports transparency of managing IT assets, but also managerial understanding of the organization’s software assets which is the foundation for decisions that optimize the organization’s software use (Forrester, 2015; KPMG, 2013). Further, having useful information on software assets enhances the organization's capacity to rapidly

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[5] Shadow IT in the context of this study is the software used by employees that do not have formal approval of the IT governance organizational structure (Haag, 2015; Silic & Back, 2014).

respond to and align IT deployment with changing business needs (Marston & Vanderbush, 2012; Rudd, 2009).

Building on the previous SAM definitions, this study defines software asset management *as the integration of people, processes, information, and infrastructure required for the lifecycle management, protection, and efficient utilization of software assets by an organization.*

The review of the SAM literature presented in Table 2.2 identified only 15 studies on SAM.

Table 2.2
Related SAM Literature

Author	Methodology	Description
Albert, dos Santos, and Werner (2013)	Design Science	Research article proposing a SAM governance methodology for software ecosystems based on ISO/IEC 19770 and the Brecho-EcoSys framework. The authors argue that cost control and optimized use software investments can be achieved.
Bean (2013)	Empirical /Qualitative	Case study that investigates the application of SAM to avoid software piracy and meet the Korean regulations on software copyright.
Swartz and Vysniauskas (2013)	Empirical /Qualitative	Case study seeking to identify challenges of SAM at Volvo IT in the context of mainframes. The study used ISO/IEC 19770-1 as the theoretical framework. The absence of software inventory information, redundant software, and lack of role clarity are some of the issues. On the other hand, efficiencies and cost reduction were identified as potential benefits for implementing SAM programs.
McCarthy and Herger (2011)	Empirical / Qualitative	Case study reporting on IBM internal actions associated with software asset management in a setting with 500,000 users connecting to 20,000 servers across 170 countries. ITIL® V3 was followed. The study suggests establishing visibility of software asset lifecycle because software has become the most important IT asset.
Jakubicka (2010)	Analysis	Analysis paper that investigates legislation, management, and financial aspects of SAM which seeks to create a methodology for managing software within the university environment.
Sharifi et al. (2009)	Design Science	Proposes a method to update information on software assets that could be used for configuration management needs of an organization's IT service management function.
Ben-Menachem (2008)	Literature Review	Review the literature on computer science, general management, IS, project management, and software engineering to investigate what previous scholarly work says about managing software systems as business assets. The author concludes there is a lack of discussion in managing software as a business asset.
Dutta (2007)	Analysis	Study that argues for managing software as a core organizational asset playing a key role in the creation of organizational value.
Ben-Menachem and Marliss (2005)	Design Science	Proposes a method to control software by importance and exception and manage IT items as assets recorded in inventory.
Ben-Menachem and Marliss (2004)	Analysis	Proposes the need to create and maintain a software inventory as a first step to treating software as a corporate asset.

Table 2.2
Related SAM Literature

Author	Methodology	Description
Klint and Verhoef (2002)	Analysis	Proposes the use of principles of knowledge management to enable the creation, consolidation, conservation and continuous actualization of tacit and explicit knowledge about software assets.
Bott (2000)	Analysis	Analysis of software as an asset from an accounting and valuing perspective.
Holsing and Yen (1999)	Analysis	Analysis paper discussing ethical, legal, technical, managerial, and economic aspects of software licensing and, software piracy and how the implementation of SAM can promote the legal and cost-effective use of software in organizations.
Bequai (1998)	Analysis	Analysis paper discussing licenses, licensing requirements, type of licensing violators, and the role of management in establishing SAM actions to contain the threat of software piracy.
D. Glass et al. (1998)	Design Science	Proposition of a methodology to implement software asset management in the context of a University.

Most studies emphasized the need for governing and addressing SAM (e.g., Albert et al., 2013; Ben-Menachem & Marliss, 2004, 2005; Dutta, 2007; Holsing & Yen, 1999; Jakubicka, 2010; McCarthy & Herger, 2011; Swartz & Vysniauskas, 2013), and using reliable information (e.g. Klint & Verhoef, 2002; Sharifi et al., 2009) that would allow organizations to establish dependable inventory and compliance procedures to avoid piracy risks and manage copyright requirements (e.g. Bean, 2013; Bequai, 1998; R. S. Glass & Wood, 1996; Holsing & Yen, 1999; Swartz & Vysniauskas, 2013). Additionally, the studies emphasized the importance of being efficient in the use of software as an important organizational asset (Albert et al., 2013; Dutta, 2007; Holsing & Yen, 1999; Swartz & Vysniauskas, 2013).

Albeit SAM studies suggest the importance of management and processes or the governance of software assets, no study has addressed the underlying causes of adopting reactive and proactive SAM in organizations. This dissertation seeks to examine the underlying processes leading to the adoption of reactive and proactive SAM in organizations. Studying this gap is important because of the significant disbursements that software assets require, calls for top management to get involved in defining a SAM strategy, and the essential function that software assets play in supporting the generation of organizational value (Barber et al., 2016; Ben-

Menachem & Gavious, 2007; Ben-Menachem & Marliss, 2005; Forrester, 2015; Wurster et al., 2016).

2.1.2 Software Licensing

The literature highlights that one important aspect of SAM is the effective management of software licenses by software users (cf. ISO/IEC, 2012; Kardaras, 2012; S. Robinson, 2012; Rudd, 2009). In the US, the intellectual property rights of software developers are supported through legislation such as the Title 17 of the United States Code, the Software Copy Protection Act of 1992, or the Digital Millennium Copyright Act of 1998. Traditionally, software developers have relied on software licenses to specify rights and obligations to software consumers (Alspaugh, Scacchi, & Asuncion, 2010). As consumers and organizations continue growing their dependence on software, managing software licenses has become an important expectation of organizations that use software (Alawneh & Abbadi, 2008; Barber et al., 2016; GAO, 2014).

Software licenses represent a governance mechanism that defines the conditions under which a vendor (licensors, developers) grants a consumer (licensee) the rights to use copyrighted software without concern for legal or contractual punishment and in accordance with the vendor’s licensing agreement (cf. Ferrante, 2006; Madison, 2003). Software licenses have three broad categories, namely closed source license (proprietary), open source license, and digital millennium copyright Act (DMCA) licensing (Madison, 2003).

Closed source licensing uses copyright legislation to protect the source code of programs (Classen, 1996; Madison, 2003). Under closed source licensing, the developer remains the owner of each copy of the software and defines specific rights and conditions of software use. Some of the specific rights and restrictions include conditions under which transfer to third parties can take place, geographical location for software operation, and acceptable installation settings (i.e., client-server, cloud, local) (Classen, 1996, 2013). Open source advocates maintain that software should be shared and modified by anyone because it contributes to the greater good of society (McGowan, Stephens, & Gruber, 2007). DMCA is a form of software licensing that grants legal protection to developers who embed digital rights management technology (DRM) into their software to prevent unauthorized use (Burk & Cohen, 2001; Madison, 2003).

A common theme of the different software licenses is reliance on intellectual property legislation to protect the degree of openness or restriction to modify source code, use the executable, and transfer software usage rights (Fitzgerald, 2006; Madison, 2003). Regardless of the licensing model, organizations that use software are expected to manage and respect the intellectual property rights of software developers (e.g. Classen, 2013; Gangadharan, D'Andrea, De Paoli, & Weiss, 2012).

The related literature included in Table 2.3 emphasizes academic and practitioner articles that investigate or analyze the topic of software copyright compliance in organizations. It also suggests that the management of copyrights is a complex issue for organizations and that as hardware and software evolve, so does the complexity of software licensing increase. These articles also suggest that organizations should take a proactive stance to develop software management mechanisms, as it is an important asset exposing organizations to financial and legal risks. The literature on software licensing also points out that by developing programs to understand and manage the rights and obligations granted by developers, organizations will reduce their exposure to and will be more efficient in the negotiation and selection of the best licenses, and will show good faith in case a dispute with software developers arises.

Table 2.3
Related Software License and Licensing Literature

Author	Description
Silberman (2014)	Promoted the importance of developing a policy for the use of open source software (OSS) for organizations to take advantage of OSS platform while addressing licensing and liability risks.
Schmidt (2014)	Analyzed growing of software licensing issues. It also suggested that licensing compliance issues will not disappear with the cloud.
Bumby (2013)	Advocated for the implementation of software asset management processes to prepare for licensing audits and avoid unbudgeted payments of software costs or fines.
Burton (2013)	Analyzed the effect of virtualization and cloud computing on the increased complexity of software licensing.
Tsotsorin (2013)	Analyzed the risks of using open source software and suggested either (1) rewriting, contributing, or limiting its use to internal use or (2) purchasing a commercial license as a remedy for compliance with OSS licensing provisions.
Classen and Fogarty (2012)	Analyzed the complexities that cloud licensing represents for licensors, cloud providers, and end users. For end users, the analysis emphasized the need to seek a flexible license that allows taking complete advantage of software's functionality and user's needs.
Gangadharan et al. (2012)	Analyzed the challenges to comply with the obligations defined by free and open source licenses. The paper prescribed a compliance framework for a free and open source license to avoid losses, negative reputation, and the high cost of legal litigation.
Classen and Fogarty (2011)	Analyzes and emphasizes the importance that licensing clauses restricting geographical locations to use software are analyzed by organizations to avoid audits, fees, fines, and penalties. The analysis also advocates for the implementation of software asset management programs to demonstrate good faith to licensors in the event of a software audit.
Machal-Fulks and Barnett (2011)	Analyzed the different types of software licenses from the traditional (e.g., client, server, per installation) to new licensing models (e.g., single seat, thin clients, cloud). The article argued that organizations must take a proactive stance to negotiate the right licensing scheme and avoid software audits by paying attention to potential licensing issues.
Gull (2011)	Explained how organizations that use software can take advantage of discount options on services, which influence the financial lifecycle of software and thus should be considered by decision-makers.
Alspaugh et al. (2010)	Investigated potential licensing conflicts in software that have proprietary and open source licensed components and provide guidance for what organizations can do to manage heterogeneous licensing scenarios.
Alawneh and Abbadi (2008)	Analyzed how organizations that use software can apply a license management methodology that uses dynamic domains so that the number of licenses negotiated with the vendor is not exceeded.
Ferrante (2006)	Analyzed the growing complexity of software licensing models as hardware and software evolve. It also argued for the existence of a standard licensing framework to reduce the complexity of software licensing managed by users and developers

2.1.3 Software Piracy in Organizations

Avoiding software piracy is one of the objectives of software asset management (cf. Bequai, 1998; Canavan, 2012; D. Glass et al., 1998; Holsing & Yen, 1999; Rudd, 2009). Software piracy is the violation of the copyright holder's intellectual property rights affected by the illegal or unauthorized exploitation of software (c.f. Chavarria, Andoh-Baidoo, Midha, &

Hughes, 2016; Moores & Dhillon, 2000). Software piracy is covered by American legislation such as the Title 17 of the United States Code that recompenses and stimulates innovation; the software copy protection act of 1992 which categorizes software piracy as a felony (Gopal & Gupta, 2010); and the digital millennium Act of 1998 which allows developers to place copy protection measures on digital products to prevent unauthorized copies (Liu, Cheng, Tang, & Eryarsoy, 2011).

Software piracy can be classified as softlifting, commercial piracy, and corporate software piracy (B. K. Mishra, Raghu, & Prasad, 2005). *Softlifting* denotes piracy committed by individuals; *commercial* piracy refers to the duplication, distribution, and trade of unlicensed software; and *corporate software piracy* alludes to copyright infringement in an organization that obtains unlicensed software for its use or the use of its employees (B. K. Mishra et al., 2005).

Further, the literature review sought to identify studies of software piracy in organizations. The review yielded 12 studies on software piracy with organizations as end-users (see Table 2.4). Early work concluded that software piracy was taking place in organizations that use software because of a lack of consensus about who should define and enforce organizational policies on software use (Athey, 1989). Later studies on corporate software piracy investigated the ways in which the lack of organizational policies influence employee attitudes towards carrying out software piracy in the workplace (e.g., Athey, 1989; Cronan, Foltz, & Jones, 2006; Im & Koen, 1990; Im & Van Epps, 1992; R. K. Robinson & Reithel, 1994). Some of these investigations concluded that policies alone are not enough and that punishment, enforcement, education, code of ethics, and top management commitment are necessary to control software piracy in organization (e.g. Akman & Mishra, 2009; Bequai, 1998; Cronan et al., 2006; Holsing & Yen, 1999; Im & Koen, 1990).

Table 2.4

Software Piracy Studies with the Organization as User of Software

Author(s)	Summary
Athey (1989)	Empirical and exploratory study on how organizations enforce policies to control software piracy. Responses from 100 organizations were collected. The study found that clarity on who should define policies for software use in organizations relates to avoidance of software piracy.
Im and Koen (1990)	Analysis paper discussed software piracy at universities from a legal perspective. The paper prescribed the need for IT policies that formally specify the stakeholders, the organization's values, and education to develop awareness of accepted behavior.
Im and Van Epps (1992)	Survey study used faculty, staff, and students as respondents to analyze piracy at 241 schools in the US and the degree of unauthorized software copying at universities. The study found that software piracy takes place in university regardless of the size of the institution. It is also suggested that policy alone will not control piracy and that there is a need for penalties to deter piracy.
R. K. Robinson and Reithel (1994)	An empirical study using respondents who work as personnel directors at public and private universities from 73 different institutions. The study investigated the enforcement of software policies aimed at controlling software piracy and found a need to proactively enforce and communicate software policies, if organizations intend to control software piracy. Additionally, the study suggested assessing employees' software needs to eliminate a motivation carry out software piracy at universities.
Athey and Plotnicki (1994)	Analysis paper discussed software piracy at corporations and its implications for employers who commit software piracy at organizations. The study suggested that software audits and punishment should be used to control software piracy at organizations.
Bequai (1998)	Analysis paper discussed software piracy at organizations and the complexities associated with the issue due to the ubiquitousness of personal computers and the complexity of licensing. This article prescribed the establishment of compliance programs (policies, code of ethics, education, audits) at organizations.
Holsing and Yen (1999)	Analysis paper discussed software piracy at organizations and the need to establish a software asset management program to addresses ethical, legal, technical, managerial, and economic aspects of software piracy to facilitate its avoidance.
B. K. Mishra et al. (2005)	This paper investigated the interaction between consumer organizations that may consider software piracy and antipiracy watchdogs seeking to detect it. Suggestions on the benefits of stricter penalties to deter piracy are presented. Additionally, the authors indicated that higher auditing costs and poor control in consumer organizations affect software developers.
Cronan et al. (2006)	The study measured computer crime in the form of software piracy at universities. A sample of 519 responses was collected. The study found that students perform software piracy at universities and that university policies are not having a deterring effect. The study suggested that universities need to communicate their software piracy policies and penalties proactively to mitigate software piracy.
A. Mishra, Akman, and Yazici (2007)	The study addresses software piracy at Turkish government, private, and academic organizations. The study collected survey data in 162 organizations and found that industry sector influences the attitude towards software piracy.
Akman and Mishra (2009)	This study investigated the differences between government and private sector employees in ethical attitudes towards software piracy. Surveys from 162 Turkish organizations were completed for this study. In the study, 23 percent of the respondents indicated that software piracy takes place in their organizations. Additionally, the study found that the existence of a general code of ethics does not reduce piracy but that specific training on expected computer conduct reduces software piracy.
L.-B. Oh and Teo (2010)	This study investigated employee's intention to whistle blow on software piracy at organizations. The study found that legal protection and a bad relationship with the organization moderate employee intention to whistle blow.

From the summary presented in Table 2.4, it is evident that although the discourse on policies, education, and enforcement for acceptable use of software is prevalent, no study has attempted to investigate the underlying processes that take place when management decides to adopt a SAM program to prevent corporate software piracy.

2.1.4 Software Asset Management Frameworks

Different software asset management models or frameworks have been proposed. From the scholarly literature, Bequai (1998), D. Glass et al. (1998), and Holsing and Yen (1999) indicated that SAM's focal interest is the avoidance of software piracy in organizations and call for a three-pronged approach centering on software end user training processes, administration processes, and software audit processes as the basis for the implementation of robust SAM in organizations. Bequai (1998) advocated for organizations to establish software license compliance programs to avoid software piracy risk. Bequai (1998) also called for managers to define the implementation of software policy, software code of ethics, employee education, procedures for acquiring and inventorying software, periodic audits, a license repository, and procedures requiring employee compliance.

Similarly, Holsing and Yen (1999) pointed out that organizations need to develop SAM to avoid risks associated with software piracy and added that good SAM allows organizations to be more efficient in the use of software as a critical organizational asset. Further, Holsing and Yen (1999) recommended implementing SAM by developing policies and code of ethics, defining acquisition and registration procedures, establishing education programs, conducting periodic audits, and performing an annual review of SAM processes.

Among the three scholarly SAM models, Bequai (1998) and D. Glass et al.'s (1998) model sought to prevent corporate software piracy. However, Holsing and Yen's model (1999) recommends SAM not only for preventing corporate software piracy but also for seeking control, protection, and efficiency in managing software as an important organizational asset.

Likewise, normative organizations such as ISO/IEC and ITIL/Axelos have proposed SAM frameworks as the set of best practices for organizations to adopt. ISO/IEC is a partnership between the International Standards Office (ISO) and the International Electrotechnical Commission (IEC). Both organizations are headquartered in Geneva, Switzerland and have members from different countries that participate in committees that define and maintain international standards for Information Technology (IT). For ISO/IEC 19970 family of SAM standards, the WG21 subgroup oversees the edition and maintenance of the standards. WG21 also receives feedback from national bodies which vote to approve changes to ISO/IEC 19770 (Bicket, 2010).

ISO/IEC has released standards parts 1, 2, 3, and 5 of the 19770 standards. ISO/IEC 19770-1 promotes processes and tiered assessment conformance of organizations that use software. ISO/IEC 19770-2 defines software identification tag standards that can be added by developers. ISO/IEC 19770-3 specifies a software entitlement scheme for developers to encapsulate software entitlements, limitations and usage rights. ISO 19770-5 is a glossary of SAM definitions.

ISO/IEC 19770-1 proposes SAM processes to manage the lifecycle of organizational software (Canavan, 2012; Powell, 2011). It also suggests that SAM empowers organizations to make informed decisions about IS strategy and operations, and provides a reference against which to measure organizational performance on governing software assets (Canavan, 2012).

ISO/IEC 19770-1 has 27 key activities that define the processes required for effective SAM (Canavan, 2012). These processes are grouped in a hierarchy that consolidates 27 processes into six groups of processes and three main categories, namely organizational management processes for SAM, core SAM processes, and primary process interfaces for SAM (Canavan, 2012; Powell, 2011). *Organizational management processes for SAM* focus on governance, roles and responsibilities, policies and procedures, planning, implementation, monitoring, and continuous improvement (ISO/IEC, 2012). *Core SAM processes* define outcomes for software asset identification, software asset inventory management, software asset control, software asset record verifications, software licensing compliance, software asset security compliance, contract management, financial management, and service level

Table 2.5
ISO19770-1:2012 Process Structure

Three Main Categories	Group Processes	Processes
Organizational Management Processes for SAM	Control Environment	Corporate Governance Roles and responsibilities Policies, processes, procedures Competence
	Planning and Implementation	Planning for SAM Implementation of SAM Monitoring and Review Continual improvement
Core SAM Processes	Inventory Processes	Software Asset Identification Software asset inventory management Software asset control
	Verification and Compliance	Software asset records verification Software licensing compliance Software asset security compliance Conformance verification
	Operations Management	Relationship and contract management Financial management Service level management Security management for SAM
Lifecycle process Interfaces for SAM	Life Cycle Process interfaces for SAM	Change Management Acquisition Process Software development Software release management Software deployment Incident Management Problem Management Retirement

management (ISO/IEC, 2012). Finally, *primary processes interfaces* focus on the lifecycle processes interfaces for SAM, including change management, acquisition, development, release management, incident management, problem management, and retirement process (ISO/IEC, 2012). Table 2.5 shows the process structure defined by ISO 19770:2012 and the specific names of each of the 27 SAM processes. Additionally, Table A.1, in the Appendix, elaborates on the descriptions of these processes.

ITIL® V3 Guide to software asset management is another standard that practitioners follow to manage software assets. ITIL is a collection of best practices that focus on IT service management (AXELOS, 2011). The cabinet office of the United Kingdom (UK) government created, maintained, and owned ITIL best practices, although AXELOS, a joint venture between the UK cabinet office and Capita plc, has been in charge of ITIL best practices since 2013 (AXELOS, 2011, n.d.).

ITIL emphasizes the importance of infrastructure and processes in the management, control, and protection of software assets for which the organization is accountable (Rudd, 2009). ITIL classifies its SAM processes into five different groups (overall management processes, core asset management processes, logistics processes, verification and compliance, and relational processes).

Overall management processes include management responsibility, risk assessment, policies and procedures, competency awareness and training, performance metrics and continuous improvement, service continuity and availability management. These elements of overall management seek to provide the management foundation to support the implementation of other SAM processes.

Core asset management processes aim to find and retain life cycle information on software assets as well as to manage hardware assets associated with software. Processes under the core asset management include asset identification, asset control, status accounting, database management, and financial management.

Logistics processes seek to control all activities that influence software over its lifecycle, including requirement definition, design, evaluation, procurement, build, deployment, operation, optimization, and retirement.

Verification and compliance processes check for deviations from SAM policies, processes, procedures, and license usage rights. The analysis of the verification and compliance process reveals corrective actions seeking to avoid future deviations. Actions such as verification and audit, licensing compliance, and security compliance are some of the outcomes of the verification and compliance processes.

Relationship management processes target the management of the relationships with internal (i.e., internal business managers, software users) or external entities (i.e., developers, resellers, outsourcers) regarding the conditions of software. Contract management, supplier management, internal relationship management, and outsourcing management are relationship management processes.

Both ISO/IEC 19770-1 and ITIL® V3 guidelines to SAM focus on the management of software assets, and rather than competing; they complement each other. ISO/IEC standard specifies processes to be accomplished by SAM whereas ITIL proposes how SAM processes should be accomplished (Rudd, 2009).

Table 2.6 summarizes the main factors suggested by different SAM frameworks. The comparison allows mapping ISO/IEC, ITIL, and Holsing and Yen's SAM frameworks to assess similarities and differences. Among the three frameworks, ISO 19770-1:2012 is the most comprehensive. ISO19770-1 categorizes SAM processes into six major groups that highlight managerial (control environment, planning, and implementation), inventory and compliance, and operations and lifecycle processes of SAM. ISO 19770-1 is selected for this study as the reference for three reasons. First, it is comprehensive, and it focuses on people, processes, and technologies to carry out SAM effectively (ISO/IEC, 2012; Powell, 2011). Second, it has been developed and validated through a collaborative effort among multiple national technical bodies, members of ISO and IEC (ISO/IEC, 2012). Third, among the three reviewed frameworks, ISO 19770 is the one most recently revised and holds an active joint committee currently working on the continuous improvement of this international standard (ISO, 2017).

The comparison in Table 2.6 revealed that all SAM frameworks suggest that organizations that use software should go beyond traditional software inventory counting and compliance and implement a set of comprehensive SAM actions to manage software as a valuable organizational asset.

Table 2.6
Mapping of SAM Frameworks

			ISO 19770-2	ITIL	Holsing and Yen (1999)
#	Type of Process	#	Process	Process	Activity
1	Control Environment	1	Corporate governance	Overall management responsibility, risk assessment	------------------------------
		2	Roles and responsibilities	------------------------------	Define SAM supervising role
		3	Policies, processes, procedures	Policies and procedures	Policy and code of ethics
		4	Competence	Competence, awareness, and training	Employee education Program
2	Planning and Implementation	5	Planning for SAM	------------------------------	------------------------------
		6	Implementation of SAM	------------------------------	------------------------------
		7	Monitoring and review	Performance metrics, optimization	------------------------------
		8	Continual improvement	Continuous improvement	Annual Review
3	Inventory Processes	9	Software asset identification	Asset identification	------------------------------
		10	Software asset inventory management	Continuity management, SAM database management	Software inventory
		11	Software asset controls	Asset control	------------------------------
4	Verification and Compliance	12	Software asset records verification	------------------------------	------------------------------
		13	Software licensing compliance	Licensing compliance	------------------------------
		14	Software asset security compliance	Security compliance	------------------------------
		15	Conformance verification	Verification and audit, other compliance	Software audits
5	Operations Management and Interfaces	16	Relationship and contract management	Contract, supplier management, internal business relationship management, outsourcing management	------------------------------
		17	Financial management	Financial management	Budgeting
		18	Service level management	------------------------------	------------------------------
		19	Security management for SAM	------------------------------	------------------------------
6	Life Cycle Process interfaces	20	Change management	------------------------------	Application and version control
		21	Acquisition process	Requirements definitions, evaluation, procurement	Acquisition procedures
		22	Software development	design, build	------------------------------

Table 2.6
Mapping of SAM Frameworks

	ISO 19770-2	ITIL	Holsing and Yen (1999)
23	Software release management		-------------------------------
24	Software deployment	Deployment	-------------------------------
25	Incident management	Operation	-------------------------------
26	Problem management	-------------------------------	-------------------------------
27	Retirement	Retirement	-------------------------------

Further, these frameworks recommend what a SAM program should have but do not reveal how a SAM program can be assessed. The next section reviews maturity models used to assess the implementation of SAM in organizations.

2.1.5 Maturity Models and Reactive and Proactive SAM

Maturity models are used to assess progress in the implementation of processes regarding a given framework and to identify processes that need to be improved (Mistrík, Grundy, Van der Hoek, & Whitehead, 2010).

At least seven different maturity models can be used to assess the implementation of SAM (cf. P. Adams, 2003; ISO/IEC, 2012). The models include ISO/IEC 15504/33000, Cobit®, BPMM maturity model, Microsoft / KPMG SAM optimization model (KPMG, 2008b), IAITAM 360 assessment model, the association of SAM assessment and certification model (SAMAC), and the process maturity model for IT Asset Management proposed by Gartner (P. Adams, 2003). Additionally, ISO 19770-1:2012 proposes a tiered model that organizations can follow to adopt ISO SAM framework in cumulative stages (ISO/IEC, 2012). The tiered model has been added to the list of maturity models because ISO tiers allow assessing the incremental adoption of SAM processes.

Table 2.7 presents a summary of each of these maturity models. Some maturity models have up to six different assessment levels (ISO 15504, Cobit, SAMAC), others have five (BPMM, IAITAM, Gartner,), and two models have four levels (KPMG/Microsoft, ISO 19770-

1:2012). Further, the scope for applying these maturity models is not necessarily restricted to SAM. For instance, ISO 15504/33000, BPMM, Cobit, ITAITAM 360, and Gartner's model are assessment methods that can be applied to IT process maturity in general. In contrast, SAMAC, KPMG/Microsoft, and ISO-19770-1:2012 tiers are developed specifically to assess SAM.

Table 2.7
Summary of Maturity Assessment Models

ISO/IEC 15504 /33000	0-Incomplete Process	1-Performed Process	2-Managed Process	3-Established Process	4-Predictable Process	5-Optimizing Process
	No processes implemented, or processes do not achieve objectives Little or no evidence of process execution	Processes achieve intended purpose	Processes are monitored, planned, and adjusted in managed fashion Process outcomes are defined, controlled, and maintained	Managed processes are capable and established using defined procedures	Established processes are operated within defined boundaries	Predictable processes are subject to continuous improvement which seeks to meet current and future business goals
CobiT® 4.1	0-Non-Existent	1-Initial/Ad hoc	2-Repeatable	3-Defined Process	4-Managed & Measurable	5-Optimized
	Lack of processes Issue is not recognized as needed	Issue is acknowledged No standard processes Issue is dealt on an ad hoc and disorganized basis	Processes are repeatable but rely on individuals rather than a system No formal means of communicating processes	Basic and standardized procedures are documented Procedures awareness and training is formalized Management requires procedures to be followed but lack reliable means of monitoring	Process and procedures are monitored and measured by management which takes actions on deviations Continuous improvement of processes Some automation and tools are used for monitoring processes and procedures	Continuous improvement drives process meeting best industry practices IT supports business strategy and execution facilitating agile organizational responses
BPMM maturity model	1-Initial	2-Managed	3-Standardized	4-Predictable	5-Innovating	
	No specific objectives Attention and success on issues depend on individuals and not on processes	Objectives are managed within a work unit	Objectives center around the adoption of common organizational processes or infrastructure to create organizational consistency	Organizational processes are managed and exploited to achieve consistent results	Focus on continuous improvement of organizational processes Planned innovation	
Microsoft SAM	Basic	Standardized	Rationalized	Dynamic		
	Little control over what IT assets are being used and where Lacks policies, procedures,	SAM processes exist as well as tool/data repository Information may not be complete and accurate and	Vision, policies, procedures, and tools are used to manage IT S/W asset lifecycle Reliable information used	Near real-time alignment with changing business needs. Business competitive		

	resources, and tools	typically not used for decision-making	to manage the assets to business targets	advantage through SAM		
IAITAM 360	Ad hoc	Repeatable	Alignment	Strategic	Adaptive	
	No processes are defined Minimal internal communication (silos) Compliance risk exists	Processes begin to be defined and used consistently across the organization Low degree of alignment with business needs	Key SAM processes defined and coordinated across the organization Some efficiencies emerge Compliance risk is reduced Communication among different areas matures SAM is beginning to be looked at as a core competency	Interaction between SAM processes and key performance indicators is optimized Different departments coordinate software needs in accordance with SAM Proactive planning and decision Alignment between SAM and business goals Organizational buy-in	Process outcomes are predictable Processes adjusted as necessary SAM is an organizational core competency Compliance risks are eliminated or understood	
SAMAC	0-Non-Existent	1-Initial/Ad hoc	2-Repeatable	3-Defined Process	4-Managed & Measurable	5-Optimized
	No SAM is implemented	Effort led by some managers but no official support from organization	Some organizational actions exist	Policies and procedures are defined	Formal management and monitoring of policies and procedures	SAM is reviewed periodically and as needed
Gartner	1-Chaotic	2-Reactive	3-Proactive	4-Service Oriented	5-Value Creation	
	Immature processes Lack of control of IT assets Lack of planning for IT assets IT asset management is one-time activity	Focus on asset counting Employs physical inventory and some auto-discovery recorded on spreadsheets or in a database Accountability lies with IS organization, but there is ineffective change accounting Hardware and software treated separately, not as single complex asset	IT asset manager with dedicated staff exists Inventory data IT inventory, financial, and contractual data is used in coordination IT inventory data is collected with automated tools IT asset lifecycle is managed from requisition to retirement	Established performance indicators used for measuring value of IT asset management program and for planning Review of service delivery with business units and top management Cost targets are defined and used to manage IT assets Software requisition process is automated IT asset inventory levels are monitored and managed	Repository, discovery, software usage monitoring tools are implemented Total cost of ownership measures are integrated with IT asset measures Contract and licenses compliance is not an issue Systems are managed for optimal use Centralized asset management of all enterprise workplace assets Easy and quick access to knowledge of monetary value of IT assets	
ISO 19770	Tier 1 (Trustworthy data)	Tier 2 (Practical management)	Tier 3 (operational integration)	Tier 4 (Full conformance with ISO/IEC SAM)		

Core SAM records License compliance	Essential control environment in place and license compliance are primary objectives Relationship and contract management as well as financial management for SAM are secondary objectives	Core life cycle processes are in place (acquisition, deployment, retirement) Core operations management processes (SA security compliance, Conformance verification, relationship and contract management, financial management, service level agreement)	SAM is strategic for the organization (implementation of SAM, monitoring and review, and continual improvement) Extended service management lifecycle processes (change management, software development process, software release management, incident management, problem management)

Sources: (P. Adams, 2003; ISO/IEC, 2012; ITGI, 2007; KPMG, 2008b)

Maturity models, despite differences in the number of assessment levels or being specific for SAM or not, have similarities as well. All maturity models have initial levels that portray scenarios depicting organizations without or with minimum processes overseeing SAM (i.e., BPMM, SAMAC), that look at SAM as an ad hoc or reactive activity (i.e., Microsoft, IAITAM, Gartner), with SAM's accountability assigned to the IT department rather than the organization (i.e., Cobit, SAMAC, Gartner), and that focus on asset counting while ignoring alignment with organizational objectives (i.e., Gartner, IAITAM). These initial stages of the maturity level of SAM could be typified as reactive measures, where SAM is completed on an ad hoc basis with a focus mainly on inventory counting and tracking (P. Adams, 2003; KPMG, 2008a).

In contrast, at higher levels of SAM maturity, organizations begin to be consistent in their SAM processes (i.e., Cobit, SAMAC, BPMM). They develop agreement and management support to adopt SAM and define policies and procedures (i.e., Cobit, Microsoft, IAITAM). Automated tools are used to manage the lifecycle of software; and SAM information is used for decision-making considering software as an organizational asset (i.e., Microsoft, Gartner). Thus, organizations with higher SAM maturity levels are proactive in the adoption of voluntary and comprehensive SAM actions, enabling the organization with a better capacity to manage and take advantage of software assets.

Gartner's maturity model, which lists reactive and proactive assessment levels, explicitly acknowledges organizational reactiveness or proactiveness towards SAM (P. Adams, 2003). Moreover, Microsoft infrastructure optimization model (IOM), which is the foundation for Microsoft SAM maturity model, indicates that its SAM assessment model was designed to reflect growth from reactive (basic and standard levels) to proactive practices for managing IT assets at rationalized and dynamic levels (cf. Ellermann, 2013; KPMG, 2008a; Mueller-Eberstein, 2010). Likewise, IS and practitioner literature shows that reactive SAM is concerned with keeping track of inventory and reacting after software acquisition has taken place with ad hoc decisions and with non-centralized software management. Consequently, the efficient use of software cannot be achieved (Dery & Abran, 2004; M. Thompson, 2013).

Similarly, the management and marketing literature suggests that organizations could choose to act from reactive to proactive fashion when they are under strong societal expectations (Sharma, 2000; Sharma & Vredenburg, 1998) or under the pressure to respond to market opportunities (Srinivasan, Lilien, & Rangaswamy, 2002; Srinivasan, Rangaswamy, & Lilien, 2005).

Researchers indicate that organizations select reactive strategies to comply with coercive institutional forces, which focus on compliance with environmental regulations or accepted industry practice (Sharma & Vredenburg, 1998). Further, when organizations take proactive responses, they act on opportunities and follow a posture that is future and action oriented, that emphasizes taking charge of situations (Crant, 2000; Frese & Fay, 2001; Ohly & Fritz, 2010), and that covers a comprehensive set of voluntary actions such as environmental issue analysis, planning, policies, organizational objective setting, follow-up and monitoring (cf. Dillon & Fischer, 1992; Klassen & Whybark, 1999; Sharma, 2000).

Table 2.8
Salient Characteristics of Reactive and Proactive SAM

Reactive SAM	Proactive SAM
• There are no organizational policies, processes, or procedures • Accountability lies with the IT department • Usually, there is no education or awareness program • Software Inventory is ad-hoc and focuses mostly on software count • Reviews of SAM are not organized • Information, if collected, is incomplete and not used for decisions or reviews	• Top management support • Formal organizational policies, procedures, planning and verification processes to manage software as an asset • Roles, accountability, and sanctions defined • Centralization in the acquisition or contracting of software assets • Software is managed as an organizational asset from requirement to acquisition, deployment, redeployment, and disposal • Education programs • Periodic monitoring of adherence to policies and procedures • Periodic reviews identifying SAM continuous improvement

Analysis of the different SAM maturity models, presented in Table 2.8, portrays a reactive to proactive continuum (e.g., Gartner, Microsoft). For instance, the Microsoft SAM maturity model, which is based on the Microsoft's Infrastructure Optimization Model, explicitly suggests that SAM in organizations can go from a reactive state to a proactive state (Microsoft, 2008). Similarly, Gartner's maturity framework indicates that SAM evolves from reactive actions that mainly deal with audit threats to proactive actions that seek coordination and continuous improvement of the different SAM activities (Gartner & Flexera, 2012).

Management and marketing studies also suggest that voluntary actions, in organizations, have a pattern going from reaction to proaction (Sharma, 2000; Srinivasan et al., 2002). Thus, it is proposed that SAM frameworks are divided into reactive and proactive actions. Table 2.8 summarizes the analysis of the review of the SAM literature on the assessment frameworks and the salient characteristics that have been identified for reactive and proactive SAM.

This dissertation defines **reactive SAM** responses as:

organizational actions that focus on meeting software vendors' rights to intellectual property granted by the legislation and demanded by software licenses and contracts through ad hoc software inventory, auditing, and tracking (cf. Kardaras, 2012; Plastow, 2006; S. Robinson, 2012).

On the other hand, **proactive SAM** responses are defined as:

voluntary actions that organizations take to plan and manage the lifecycle of software as a key strategic asset that generates or supports organizational value (cf. Kardaras, 2012; Plastow, 2006; S. Robinson, 2012). These voluntary actions include the implementation of a management system that plans and monitors comprehensive SAM actions that comprise control environment, planning and implementation, operations management, lifecycle processes and that schedules the execution of inventory controls and verification and compliance of software licenses (Canavan, 2012; ISO/IEC, 2012).

2.2 IT Governance

Before elaborating on IT governance, a description of governance in the context of organizations is presented. In general, the concept of governance denotes the different governing processes exerted by governments, markets, networks, or organizations (Bevir, 2013). In management, governance is a term that has been present in the literature since the 1960s (Tallon, Ramirez, & Short, 2013). The term governance is derived from the Greek word "κυβερνάω" which means to steer (Eells, 1960; Tallon et al., 2013). A succinct definition of corporate governance can be stated as the system that organizations use to direct and control the organization (Cadbury, 1992; ISO/IEC, 2008; OECD, 1999; Van Grembergen & De Haes, 2008).

Corporate governance plays a key role in organizations, as it sets the tone and promotes ethical and responsible decision-making in organizations (Bonn & Fisher, 2005). Corporate governance is concerned with the development of mechanisms that allow stakeholders to evaluate, set direction, and monitor the performance of the organization (ISACA, 2012)

To achieve its focal interest, corporate governance develops structures, rules and social practices (Bevir, 2013). Corporate governance establishes laws and regulations, structures and standard operating procedures, and corporate culture that bound an organization and steer the achievement of organizational objectives (Warkentin & Johnston, 2008). During the 2000s, corporate governance became a research topic of interest because of organizational shortcomings to report accurate financial information or to implement policies that could prevent stock market losses (e.g., Enron, Worldcom, the 2008 stock market crash) (Brown & Grant, 2005; Erkens, Hung, & Matos, 2012; Weill & Ross, 2004).

As a sub-discipline of corporate governance, IT governance began to be studied during the 1990s (ITGI, 2003; Van Grembergen, De Haes, & Guldentops, 2004; Webb, Pollard, & Ridley, 2006; Weill & Ross, 2004; Wilkin & Chenhall, 2010). Early work on IT governance had a limited perspective (Wilkin & Chenhall, 2010). Initial IT governance studies investigated the strategic planning of information systems and the alignment or fit between organizational strategy and information systems strategy (e.g., Henderson & Venkatraman, 1993). However, following Sarbanes-Oxley in 2002 and Basel II in 2004, an expanded scope and renewed interest in corporate governance brought IT governance under the spotlight (Tallon et al., 2013) with a broader focus (Wilkin & Chenhall, 2010).

IT governance and corporate governance both attempt to verify that decisions concerning strategy and risk management are properly taken to ensure efficient use of IT assets. However, the traditional areas of concern for corporate and IT governance differ. IT is technically complex, pervasive, subject to rapid change, and requires specialized domain knowledge, which creates a need for concrete structures, processes, and relational mechanisms (Bradley et al., 2012; Jewer & McKay, 2012). IT governance is essential for organizations, as it enables the organizations to accomplish important objectives, such as regulatory and legal compliance, operational excellence, and risk management of IT assets (N. Robinson, 2005).

Different definitions of IT governance have been proposed. Some of these definitions are presented in Table 2.9. These definitions highlight the importance of having authority or rights to govern IT (Sambamurthy & Zmud, 1999; Weill & Ross, 2004; Weill & Vitale, 2002). Additionally, the definitions assert that IT governance is the responsibility of the board of directors and the senior management team (De Haes & Van Grembergen, 2015; Van Grembergen, 2003). The definitions also underscore the significance of providing strategic direction to the Information Technology function to achieve the alignment between IS strategy and business strategy (De Haes & Van Grembergen, 2015; Van Grembergen, 2003; Van

Table 2.9
IT Governance Definitions

Author	IT Governance definitions
Sambamurthy and Zmud (1999, p. 261)	'refers to the patterns of authority for key IT activities in business firms, including IT infrastructure, IT use, and project management'
Weill and Vitale (2002, p. 29)	'describes a firm's overall process for sharing decision rights about IT and monitoring the performance of IT investments'
ITGI (2003, p. 10)	'is the responsibility of the board of directors and executive management. It is an integral part of enterprise governance and consists of the leadership and organizational structures and processes that ensure that the organization's IT sustains and extends the organization's strategy and objectives'
Van Grembergen (2003, p. 1)	'is the organizational capacity exercised by the Board, executive management, and IT management to control the formulation and implementation of IT strategy and in this way ensure the fusion of business and IT."
Peterson (2004, p. 8)	'the distribution of IT decision-making rights and responsibilities among enterprise stakeholders, and the procedures and mechanisms for making and monitoring strategic decisions regarding IT'
Weill and Ross (2004, p. 8)	'Specifying the decision rights and accountability framework to encourage desirable behavior in the use of IT'
ISO/IEC (2008, p. 3)	'the system by which the current and future use of IT is directed and controlled. Corporate governance of IT involves evaluating and directing the use of IT to support the organization and monitoring this use to achieve plans. It includes the strategy and policies for using IT within an organization.'
Van Grembergen and De Haes (2008, p. 3)	'Enterprise governance of IT is an integral part of enterprise governance and addresses the definition and implementation of processes, structures, and relational mechanisms in the organization that enables both business and IT people to execute their responsibilities in support of business/IT alignment and the creation of business value.'
De Haes and Van Grembergen (2015, p. 2)	'Enterprise governance of IT (EGIT) is an integral part of corporate governance, exercised by the Board, overseeing the definition and implementation of processes, structures and relational mechanism in the organisation that enable both business and IT people to execute their responsibilities in support of business/IT alignment and the creation of business value from IT-enabled business investments'

Grembergen & De Haes, 2008). Along these lines, organizations should use structure, processes, and relational mechanisms to establish an IT governance system.

IT governance structures define organizational bodies or mechanisms to enable horizontal connection between business leaders and IT management and facilitate strategic IT decision making (De Haes & Van Grembergen, 2009; Peterson, 2004; Van Grembergen & De Haes, 2008). IT governance processes involve IT management and procedure compliance with the organization's IS strategy and policies to enable integration and coordination of business and IT decisions along with the implementation and monitoring of effective IT solutions (Bowen, Cheung, & Rohde, 2007; Peterson, 2004). IT governance relational mechanisms promote active participation and collaboration of corporate, business, and IT management. It includes cross-functional training or rotation between business and IT personnel, shared managerial learning, education programs, and stakeholder participation (De Haes & Van Grembergen, 2004, 2009, 2015; Peterson, 2004).

This study defines IT governance as the organizational structures, processes, and relational mechanisms used to determine strategies and monitor the coordination and implementation of IT objectives supporting the creation of organizational value (ITGI, 2003; Van Grembergen & De Haes, 2008).

In the IS literature, different frameworks have been developed to support, guide, and suggest best practices for IT Governance in organizations (Ko & Fink, 2010; Wilkin & Chenhall, 2010; Willson & Pollard, 2009). Frameworks, such as the IT Infrastructure Library (ITIL), Control Objectives for Information and Related Technology (CobiT), ISO/IEC 38500 (IT Governance), ISO/IEC 27001, and ISO 19770 are examples of best practice guidelines for IT Governance (Ko & Fink, 2010; Wilkin & Chenhall, 2010). These frameworks underscore the importance of implementing IT governance in organizations to align IS strategy and business strategy, maximize organizational value, ensure responsible use of IT assets, and perform risk management (Wilkin & Chenhall, 2010). Moreover, the IT governance Institute suggests core focus areas, namely (1) IT strategic alignment, (2) value delivery, (3) risk management, (4) resource management, and (5) performance management (ITGI, 2003).

ISACA (Information Systems Audit and Control Association) which is the parent organization for ITGI has published a framework that addresses IT Governance. This framework is known as COBIT (Control Objectives for Information Related Technology). The COBIT framework suggests processes and controls to enact IT governance in organizations (De Haes & Van Grembergen, 2015), and it emphasizes the difference between IT management and IT governance (De Haes & Van Grembergen, 2015). Thus, while senior managers and board of directors are accountable for defining, evaluating, and monitoring the execution of IT governance, the CIO or top IT executive is in charge of managing and implementing the strategies defined by IT governance (De Haes & Van Grembergen, 2015; ISO/IEC, 2008).

Further, TMT is accountable for the formulation of strategies and processes ensuring that the organization efficiently invests in IT assets to support, enhance, or complement the organization's strategic needs (ITGI, 2003; Wilkin & Chenhall, 2010). Effective management of IT assets, such as software assets, enables organizations to deploy integrated and efficient IT infrastructure (N. Robinson, 2005). When IT governance of SAM is exerted, costs and effectiveness of the use of software are under better control (Canavan, 2012; ISO/IEC, 2012; Rudd, 2009).

Using software assets exposes the organization to operational risk, licensing liability risk, or reputational risk (cf. Poba-Nzaou & Raymond, 2011; Raghupathi, 2007; Salmela, 2008;

Straub & Welke, 1998; Wilkin & Chenhall, 2010). Hence, IT governance stipulates that the importance and pervasiveness of IT assets in organizations call for TMT to define strategies that address various risks of using software through processes that could anticipate, prevent, or mitigate such risks (cf. Bradley et al., 2012).

This study investigates the ways in which TMT interprets SAM issues and the influences of that interpretation on the adoption of SAM in organizations. This dissertation proposes a research model in Chapter III that emphasizes the role of top management in the strategic sensemaking of SAM. The model suggests that structure (CIO-TMT information processing) is necessary to facilitate the processing of environmental information for managers to interpret SAM issues and make decisions leading to SAM adoption. Understanding IT governance and its emphasis on directing, evaluating, and controlling IT support the proposed strategic sensemaking model presented in Chapter III.

2.3 Institutional Theory and SAM

The institutional theory provides a rationale to explain how the environment shapes organizational actions through external institutional forces (Liang et al., 2007). A fundamental concept in institutional theory is isomorphism (J. W. Meyer & Rowan, 1977). Isomorphism emerges when environmental forces influence the adoption of similar structural change among organizations (J. W. Meyer & Rowan, 1977). These structural changes do not necessarily focus on achieving efficiency but on obtaining legitimacy in the quest to secure resources that facilitate the survival of the organization (DiMaggio & Powell, 1983; J. W. Meyer & Rowan, 1977).

Three types of isomorphic forces are coercive, mimetic, and normative (DiMaggio & Powell, 1983). Coercive isomorphism results from the formal and external cultural pressures originating from other organizations or institutions (i.e., government, vendors) on which there is a dependency or from the society in which the organization operates (DiMaggio & Powell, 1983). Normative isomorphism emerges from the professionalization of organizational actors, which requires defining approaches and requirements to perform a job in the quest to establish a common body of knowledge and legitimize the organization (DiMaggio & Powell, 1983). Mimetic isomorphism occurs when organizations react to environmental uncertainty by imitating other organizations to mitigate uncertainty (DiMaggio & Powell, 1983).

In management, institutional theory has been used extensively to explicate organizational actions (e.g., Campbell, 2007; A. J. Hoffman, 1999; Kostova & Roth, 2002; Mizruchi & Fein, 1999). Similarly, in IS domain, scholars have used institutional theory to improve the understanding of the technological changes adopted by organizations (Liang et al., 2007; Orlikowski & Barley, 2001), information security innovations and investments (Cavusoglu, Cavusoglu, Son, & Benbasat, 2015; Hsu, Lee, & Straub, 2012), and researchers concur that its use to investigate IS phenomena is growing (Weerakkody, Dwivedi, & Irani, 2009).

Table 2.10

Studies Using Institutional Theory in The IS Literature

Author(s)	Data Collection	Summary / Finding
Teo, Wei, and Benbasat (2003)	Emp, quantitative, survey (n=222 organizations), CEO, CIO, CFO as respondents	The study investigated the influence of institutional forces on the adoption of financial electronic data interchange (FEDI). The study supports the importance of coercive, mimetic, and normative pressures in the adoption of FEDI.
Liang et al. (2007)	Emp, quantitative, survey (n=77), managers from IT for Finance	This quantitative study investigated the effect of mimetic, coercive, and normative forces and the mediation of top management (upper echelons) on the degree of ERP use in organizations (assimilation). The study lends support to the influence of institutional forces on the assimilation of information systems in organizations.
Soh and Sia (2004)	Emp, case studies from 3 organizations	The study investigated misalignments in ERP structures and organizational structures resulting from institutional structures adopted by software vendors in ERP. The study confirms that ERP users exercise choices and differentiate the structures under the pressures of institutional forces.
Currie and Guah (2007)	Emp, case studies (n=6), interviews (n=120)	This longitudinal case study investigated how institutional influences (regulatory and normative cultural forces) have shaped the assimilation of a national program for Information Technology in the United Kingdom health care system. The study also highlights how institutional forces facilitate convergence within organizations subject to the same institutional forces but at the same time restrain convergence across other organizations in the healthcare sector.
Q. Hu, Hart, and Cooke (2007)	Emp, case study from one multinational organization	This case study investigated coercive, normative, and mimetic processes. The study found that although coercive forces (like Sarbanes-Oxley) are necessary for adoption of information security measures; other institutional forces and top

Table 2.10
Studies Using Institutional Theory in The IS Literature

Author(s)	Data Collection	Summary / Finding
		management intervention are also important for the adoption of information security practices in the organization.
Butler (2011)	Emp, case study, two organizations	This qualitative case study investigated the influence of institutional forces on managerial sensemaking and decision-making in the context of managerial compliance with environmental sustainability. The study found that institutional forces influence decision-making, sense-making, and knowledge sharing in organizations.
Hsu et al. (2012).	Emp, mixed methods, longitudinal (two collection points), survey(n=140), Top IS managers	This quantitative study framed information security management (ISM) as an administrative innovation. The study investigated the pressure of institutional conformity (peers and supervisory authority), suggesting that the economic factors and organizational capability factors moderate the relationship between the adoption of ISM and assimilation of ISM.
Cavusoglu et al. (2015)	Emp, IT senior and middle managers, survey (n=241)	This quantitative study used institutional theory and resource-based view to investigate differences in the adoption of information security controls. The study found that institutional forces and information security assessment have a direct influence on investments that address the control of information security.
EMP: empirical		

Table 2.10 lists eight studies that have used institutional theory in the IS domain. Four studies were positivist empirical studies while the other four were interpretive studies. Some studies found a direct relationship supporting the influence of institutional forces and organizational actions associated with IS phenomena, such as adoption of financial electronic data interchange (Teo et al., 2003), assimilation of ERP systems (Liang et al., 2007), assimilation of health care IT (Currie & Guah, 2007), adoption of security measures (Q. Hu et al., 2007), assimilation and adoption of IS security innovations (Hsu et al., 2012), and investment in IS security control of resources (Cavusoglu et al., 2015). Further, other IS studies using institutional theory have researched the mediating role of managerial cognition or evaluation in the relationship between institutional forces and outcomes (Butler, 2011; Cavusoglu et al., 2015; Q. Hu et al., 2007; Liang et al., 2007).

This dissertation draws on the institutional theory and uses coercive force as a key factor explaining how organizations react to the adoption of SAM actions that seek to comply with software copyright legislation and expectations set by software licensing. Coercive force has been used in previous IS studies and shown to have an influence on organizational actions (e.g., Cavusoglu et al., 2015; Liang et al., 2007).

On the other hand, mimetic and normative forces will be excluded from this study. Mimetic forces refer to the imitation that organizations from similar industries adopt to achieve legitimacy within the industry sector. Likewise, normative forces result from professionalization of key organizational actors and the adoption of generally accepted practices within a professional group.

DiMaggio and Powell (1983) indicate that the institutional environment is going to have specific institutional forces exerting pressure on organizations. In the context of SAM, the review of the literature revealed that the uniform institutional pressure exerting a force on organizations across industry sectors is the coercive force.

The expectation that organizations should protect software developers' copyright is associated with the emergence of software development as a valuable activity. In the late 1960s, IBM unbundled software from the computers they sold because of a legal complaint presented before the department of justice due to what was perceived as an IBM monopolistic practice (Ceruzzi, 2003; Madison, 2003).

The unbundling marks the point from which software development becomes a valuable activity (Ceruzzi, 2003). Next, in 1976, a modification to copyright law granted copyright to software developers (Ceruzzi, 2003; Madison, 2003). It is after this and the revolution of personal computers in the 1980s and 1990s that the expectation that organizations should protect software developers' copyright by complying with software licenses and contracts became established in society. This pressure to protect software developers' intellectual property and software licenses is a common theme in the SAM literature (e.g., Bequai, 1998; CDW, 2014; Classen, 2013; Holsing & Yen, 1999; Koen & Im, 1997; PwC, 2012). Thus, although normative or mimetic forces may have an influence in certain institutional sectors, in this investigation only the coercive force is studied because it is the uniform across all organizational institutional sectors influencing the adoption of SAM actions.

2.4 Sensemaking Theory: Organizations as Interpretation Systems

Extensive research on sensemaking has been conducted across different research areas (Maitlis & Christianson, 2014), such as psychology (Hofmann, Lei, & Grant, 2009), education (Coburn, 2005; C. Hulland & Munby, 1994), intelligent systems (G. Klein, Moon, & Hoffman, 2006a, 2006b), neurocognition (Lebiere et al., 2013; Y. Sun & Wang, 2013), knowledge management (Malhotra, 2001; Shariq, 1998), information systems (Jensen, Kjærgaard, & Svejvig, 2009; Tallon & Kraemer, 2007), and organizational research (Colville, Brown, & Pye, 2012; Gioia & Thomas, 1996; Plambeck & Weber, 2010; Starbuck & Milliken, 1988; Thomas et al., 1993). This dissertation will investigate strategic sensemaking and the linkages between interpretation and action leading to the adoption of SAM. As a result, the review of the sensemaking literature will be limited to organizational research on strategic sensemaking.

2.4.1 Sensemaking in Organizational Research

In a broad sense, sensemaking is a process used by humans to understand issues or events (Maitlis & Christianson, 2014). In organizational research, sensemaking theory[6] has been utilized with different conceptualizations (Maitlis & Christianson, 2014; Sandberg & Tsoukas, 2015). Some scholars study sensemaking through a narrow perspective asserting that individuals and collectives notice, interpret, and draw conclusions about the environment where they operate (e.g., Daft & Weick, 1984; Ginsberg & Venkatraman, 1992, 1995; Miller, 2005; Plambeck &

[6] In their review of the literature Maitlis and Christianson (2014, p. 62) indicated that sensemaking in organizational studies has been referred to as a perspective, theory, lens, or framework.

Weber, 2010; Thomas et al., 1993). Researchers using the narrow perspective (Maitlis, 2005; Maitlis & Christianson, 2014) conduct studies using cognitive frameworks or schemata that are employed to make sense of noticed stimuli (e.g., Chattopadhyay, Glick, & Huber, 2001; Dutton & Jackson, 1987; Starbuck & Milliken, 1988; Thomas et al., 1993; Thomas & McDaniel, 1990).

On the other hand, scholars following the broader perspective draw on Weick (1995, p. 17) who stated that sensemaking should be "understood as a process that is (1) grounded in identity construction, (2) retrospective, (3) enactive of sensible environments, (4) social, (5) ongoing, (6) focused on and by extracted cues, (7) driven by plausibility rather than accuracy." In other words, the broad view characterizes sensemaking as an ongoing social process where actors with preexisting personal and organizational identities, collectively create and negotiate meaning and retrospectively evaluate their previous action to construct their understanding of the world. Also, sensemaking actors enact their environment by emphasizing plausibility rather than accuracy of conclusions because there may be multiple solutions and finding a solution will require continued construction of meaning (e.g., Maitlis, 2005; Maitlis & Christianson, 2014; Miller, 2005; Weick, 1995; Weick, Sutcliffe, & Obstfeld, 2005).

This study will adopt the narrow definition of sensemaking because the organizational sensemaking literature has shown that strategic sensemaking is a concept that has been used to investigate problems where TMT interprets strategic issues to steer organizational actions (e.g., Ginsberg & Venkatraman, 1992; Sharma, 2000; Thomas et al., 1993).

2.4.2 Sensemaking of Strategic Issues

Organizations occupy a critical position in the modern world (Daft, 2007; W. R. Scott & Davis, 2007). However, views of the organization as closed or open systems exist (Daft, 2007; W. R. Scott & Davis, 2007).

The closed systems school of thought views organizations as depending on internal organizational factors which are not subject to environmental influences (Daft, 2007). One closed system perspective depicts organizations as rational systems that represent a collective interest in following and achieving specific goals constrained by highly formalized structures (W. R. Scott & Davis, 2007). Another closed system perspective describes organizations as natural systems with members who are part of a collective, following interests that are not necessarily common but acknowledge the need to have organizations to achieve objectives (W. R. Scott & Davis, 2007).

On the other hand, the open view argues that organizations are social entities organized around people seeking to achieve goals by utilizing structures that facilitate coordination of activities and understanding of issues resulting from links to the external environment (Daft, 2007; W. R. Scott & Davis, 2007).

As open systems, organizations acquire inputs from the environment, process them, and generate outputs (Daft, 2007; Daft & Weick, 1984; Pondy & Mitroff, 1979). In open systems organizations, managers design and adjust organizational and contextual dimensions to facilitate the transformation of inputs to outputs, as organizations seek to achieve value (Daft, 2007). Therefore, the environment is perceived as a source of information or a source of resources (Sutcliffe, 2001).

The resource dependence follows the assumption that the environment is a source of scarce resources (i.e., capital, labor, raw material) and that organizations compete to secure them as they seek to survive (e.g., Aldrich, 1979; Pfeffer & Salancik, 1978). The number and importance of resources and the extent to which these resources are available influence organizational outcomes (Sutcliffe, 2001). Consequently, organizations seek to reduce or mitigate their dependence on other organizations that hold key resources (power) by structuring strategies that seek to reduce their dependence (Aldrich, 1979). Scholars who follow the resource dependence perspective pay limited attention to the processes by which organizations acquire environmental information; instead, they focus on organizational or task environment characteristics (Sutcliffe, 2001). Resource dependence scholars also assume that the environment is objective and concrete and that management should focus on initiating strategic actions that help the organization adapt to environmental constraints (Smircich & Stubbart, 1985; Sutcliffe, 2001).

Although some scholars see organizations as part of an environment of scarce resources, others see the environment as a source of raw information that managers use to influence organizational choices and actions (Daft & Weick, 1984; Dutton & Jackson, 1987; Sutcliffe, 2001; Tushman & Nadler, 1978; Weick, 1979). This view of organizations as information processing systems asserts that information is the most important environmental factor and that its availability directly influences organizational actions (Fairbank, Labianca, Steensma, & Metters, 2006; Galbraith, 1973; Huang, Pan, & Ouyang, 2014; Knight & McDaniel, 1979; Tushman & Nadler, 1978).

To manage information flow, organizations develop information processing structures to reduce managers' perceived uncertainty (Duncan, 1973; Fairbank et al., 2006; Galbraith, 1973; Knight & McDaniel, 1979; Thomas & McDaniel, 1990). This investigation seeks to understand the underlying processes leading to the adoption of SAM using strategic sensemaking theory. A theory that is used to understand the influence of information on processes leading to organizational actions is the strategic sensemaking theory. The strategic sensemaking considers the ways in which managers interpret information and builds on the information processing perspective of the organization.

2.4.3 TMT Strategic Sensemaking

Sensemaking view is aligned with the open view of organizations and maintains that organizations reflect the ongoing process carried out by its members to make sense of equivocal environmental information that influences managerial interpretation leading to the enactment of a workable level of certainty (Weick, 1969, 1995).

In the strategic sensemaking theory, the TMT is the group of the highest-level executives who have a responsibility to interpret information and make strategic decisions that will steer the organization (Finkelstein et al., 2009; Klenke, 2003; Raes et al., 2007).

In the context of this investigation, when analyzing information on IS strategic issues, TMT members interpret information and categorize or label it as an opportunity or threat associated with the use of software by organizations. This position is supported by strategic sensemaking theory (e.g., Daft & Weick, 1984; Dutton & Jackson, 1987; Thomas et al., 1993; Thomas & McDaniel, 1990) and IT governance literature, which suggests that top managers must provide organizational direction to ensure that IT assets support business value while protecting organizations from IT threats (cf. ITGI, 2003; Wilkin & Chenhall, 2010).

The management literature indicates that environmental determinism or strategic choices influencing organizational decisions influence the role of managers (L. J. Bourgeois, III, 1984; Hitt & Tyler, 1991; Jewer & McKay, 2012; Oliver, 1991; Ravichandran & Liu, 2011). Environmental determinism suggests that the environment directly influences organizational structure and actions and that managers do not play a significant role in defining organizational choices (Burns & Stalker, 1961; Hannan & Freeman, 1977; P. R. Lawrence, Lorsch, & Garrison, 1967). In contrast, other scholars contend that there is an interplay between the environment and the cognition of top managers (e.g., March & Simon, 1958; Markóczy, 1997; Simon, 1947) who make strategic choices so that the organization adapts to the environment (e.g., Child, 1972; Silverman, 1970; Weick, 1969).

Because of the difficulty of capturing the effect of top managers' cognitions ("the black box") on managerial choices, some scholars have followed Hambrick and Mason (1984) and Pfeffer and Salancik's (1978) recommendation that managerial cognition can be captured through demographic proxy measures (i.e., age, functional background, tenure and the like) (e.g., Carpenter, Geletkanycz, & Sanders, 2004; B. S. Lawrence, 1997; Markóczy, 1997; Quinn & Spreitzer, 1997). Other scholars uphold that although proxy demographic measures provide important insights into managerial research, they are not substitutes for the direct measure of managerial cognitions (cf. B. S. Lawrence, 1997; Markóczy, 1997).

The strategic sensemaking theory assumes that when studying strategic issues, managerial cognitions can be captured directly from managers' perceptions. Strategic issues are trends, development, and problems perceived by top managers to affect the organizations' performance, goals, or position in the environment (Ansoff, 1980; Dutton, Fahey, & Narayanan, 1983; Egelhoff, 1982). The sensemaking theory sees organizations as systems that interpret environmental information (Daft & Weick, 1984; Dutton & Jackson, 1987; Milliken, 1990; Thomas et al., 1993). Scholars indicate that when sensemaking takes place, three steps are accomplished, scanning or noticing of information by managers, interpreting of information by assigning meaning and acting on it (Daft & Weick, 1984; Dutton & Jackson, 1987; Maitlis & Christianson, 2014; Milliken, 1990; Thomas et al., 1993).

Scanning is the initial process of sensemaking of strategic issues. Organizations are open systems and participate in an environment, which is a source of information available for scanning or searching (cf. Aldrich, 1979, 2008; Aldrich & Herker, 1977; Choo, 2002; Dill, 1962). Further, the organizational environment is complex, changes continuously, and is a major source of uncertainty (Elenkov, 1997; Weick, 1979). Top managers are expected to gather information from an uncertain, ambiguous or equivocal environment (cf. Daft & Weick, 1984; Dutton & Jackson, 1987; Haukedal, 1994). When top managers fail to scan for information about changes, they might not be able to adapt the organization to such environmental changes (Pfeffer & Salancik, 1978).

Scanning of the environment is limited by managers' bounded rationality (March & Simon, 1958), which prevents them from becoming aware of all available information (Mintzberg, 1973). Scanning's purpose is to identify important trends, events, or changes in the organizational environment (i.e., strategic issues) that could affect the organization's performance or position in the environment (Milliken, 1990). Top managers actively select the scanned information to which they either pay attention or which they ignore when reducing uncertainty or equivocality while constructing their understanding of strategic issues (cf. Daft & Weick, 1984; Dutton et al., 1983; Galbraith, 1973; P. R. Lawrence et al., 1967; Sharma, 2000; J. D. Thompson, 1967).

Duncan (1972) asserted that within an organizational context, the environment comprises the pertinent physical and social factors that need to be considered during organizational decision-making. The literature of strategic issue diagnosis indicates that organizational strategy, organizational structure, and information context are antecedents of the strategic issue diagnosis performed by managers in organizations (Daft & Weick, 1984; Kuvaas, 2002; Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas et al., 1991).

Duncan (1973, 1974) theorized and empirically tested, with data from a survey study, an *information processing structure* that is used in organizations to facilitate information flow to decision makers. Duncan's information processing structure consists of five dimensions, namely hierarchy of authority, degree of impersonality, degree of participation in decision-making, degree of specific rules and procedures, and degree of division of labor. Duncan also suggested that non-routine decisions called for the information processing structures to be less rigid or formalized to facilitate the flow of information required for non-routine decision-making (Duncan, 1973, 1974).

Thomas and McDaniel (1990) built on Duncan (1973, 1974) research and defined a more succinct information processing structure using the dimensions of formalization, integration, and participation. Thomas and McDaniel (1990), Thomas et al. (1991) and Thomas et al. (1993) posited that participation in decision-making by TMT members augments the information processing capacity of the organization because it increases the number and variety of information processors among TMT (Thomas et al., 1993; Thomas et al., 1991). Formalization of information processing structure assumes that having a low degree of formalization nurtures the exchange of information among TMT members and expands their information processing capacity, which is beneficial for facing unstructured situations (Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas et al., 1991). Finally, interaction offers the opportunities for decision-makers to exchange ideas in formal and informal settings and as interaction grows, so does the information processing capacity of TMT (Thomas & McDaniel, 1990; Thomas et al., 1991).

Researchers using the sensemaking theory postulate that high levels of participation and interaction and low formalization increase the flow of information elements, which TMT can utilize to construct their interpretation of an environmental situation (Knight & McDaniel, 1979; Thomas & McDaniel, 1990). The increase of information flow also augments TMT's early awareness of environmental changes (e.g., Daft & Weick, 1984; Huber & Daft, 1987; Kuvaas, 2002; Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas et al., 1991).

Empirical studies using the information processing structure have found that higher degree of information processing capacity is positively related to the perception of the strategic issue as positive and controllable (Kuhn & McPartland, 1954; Kuvaas, 2002; Thomas et al., 1993). The rationale is that high degree of information processing capacity can facilitate or obstruct how managers use information to interpret strategic issues (Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas, Shankster, & Mathieu, 1994). Further, scholars have conceptualized the information processing structure as the degree of participation, integration, and formalization[7] provided to TMT members for the analysis of strategic issues (Thomas & McDaniel, 1990; Thomas et al., 1994). Hence, it is posited that managers that are part of organizations with higher information processing capacity are provided with more information that can be used to identify opportunities when analyzing strategic issues (Kuvaas, 2002; Thomas et al., 1993; Thomas & McDaniel, 1990).

Another factor influencing interpretation of TMT is the organization's *strategic orientation* (Dutton & Jackson, 1987; Ginsberg & Venkatraman, 1992; P. R. Lawrence & Dyer, 1983; A. D. Meyer, 1982; Plambeck & Weber, 2010; Thomas et al., 1993; Thomas & McDaniel,

[7] Participation is the degree to which managers participate in the strategic decision making, interaction is the degree to which strategic managers interact in formal or informal settings, formalization is the use of rules, programs, and standard procedures to analyze strategic decision making

1990; Thomas et al., 1991). Strategic orientation represents managers' perception of the positions that the firm should adopt to succeed (Plambeck & Weber, 2010). This perception of the strategic orientation of organizations can be discerned from the patterns appreciable during important decisions about products, services or actions taken about the domain under which organizations choose to operate (Miles & Cameron, 1982; Plambeck & Weber, 2010; Thomas et al., 1991). Hence, an organization's strategic orientation is an important referent providing a scheme or posture of expected actions which influences the way in which TMT uses or selects information to categorize environmental issues (Daft & Weick, 1984; Ginsberg & Venkatraman, 1992; Plambeck & Weber, 2010; Thomas & McDaniel, 1990).

The organization's competitive posture provides a model of actions, ideologies, or paradigms about what the TMT should value (Ginsberg & Venkatraman, 1992). Domain-offensive and domain-defensive strategic orientations (Miles & Cameron, 1982) provide actions, ideologies, or paradigms that are used by TMT to interpret strategic issues (Ginsberg & Venkatraman, 1992; Plambeck & Weber, 2010; Thomas & McDaniel, 1990). Domain-offensive organizations explore and capitalize on information about new opportunities and seek to offer new products and services (cf. Gioia & Thomas, 1996; Miles & Cameron, 1982; Plambeck & Weber, 2010; Thomas et al., 1991). In contrast, domain-defensive organizations are conservative and process information focusing on known capabilities and defending the current product or service offering (cf. Gioia & Thomas, 1996; Miles & Cameron, 1982; Plambeck & Weber, 2010; Thomas et al., 1991). Researchers assert that domain-offensive strategic orientation has a positive relationship with TMT's perception of a strategic issue as an opportunity whereas domain-defensive orientation is posited to be associated with the interpretation of strategic issues as a threat (Thomas & McDaniel, 1990; Thomas et al., 1991).

Table 2.11 presents a summary of the literature on antecedents of strategic issue interpretation. Some studies utilize the information context as an antecedent of interpretation and often the information processing structure is an important antecedent of interpretation (e.g., Thomas & McDaniel, 1990; Thomas et al., 1991). Studies using the information processing

Table 2.11
Literature on Antecedents of Strategic Issue Interpretation

Year	Type	Method	Finding
Plambeck and Weber (2010)	Emp	Survey, n=220 & secondary data. CEOs, OLS	Organizational strategic orientation influences the strategic issue diagnosis among TMT members.
Kuvaas (2002)	Emp	Five case-scenarios (threat, opportunity, external / internal issue), Survey, n=73 TMT, opportunity and threat scenario, OLS	This study found that participation, as a dimension of TMT information processing structure, is positively related to controllability perceptions of the opportunity scenario.
Gioia and Thomas (1996)	Emp	Mix methods, qual – quant. One case study, interviews, content analysis. Survey of TMTs from 372 universities	Empirical study found that information processing structure has a positive relationship with strategic interpretation.
Dutton (1993)	Conc	N/A	Dutton indicated that three salient contextual characteristics influence the interpretation of issues as opportunities, (1) the information processing capacity, (2) the organization's paradigm (i.e., strategy), and (3) the current agenda of the organization (i.e., the number of issues an organization can deal with, how issues fit current agenda's content).
Ginsberg and Venkatraman (1992)	Emp	Mix methods. Qual-Quant. Field interview and survey study.	Strategic orientation of the organization (efficiency orientation) is positively related to issue interpretation (effect significance and valence).
Thomas et al. (1991)	Emp	Survey, n=162 & Archival, hospital CEOs. OLS.	Management team information processing has a positive relationship with positive/negative, gain/loss, and controllable/uncontrollable interpretation. Strategic orientation has a positive relationship with controllable/uncontrollable interpretation. With positive/negative and gain/loss the relationship has the predicted direction, but it is not significant.
Thomas and McDaniel (1990)	Emp	Survey, n=151 &	Strategic orientation is positively related to controllable/uncontrollable interpretation. TMT information processing has a positive relationship with positive/negative, gain/loss, and controllable/uncontrollable interpretation.
Dutton and Jackson (1987)	Conc	N/A	The organization's ideology (i.e., strategy) and structure influence the interpretation of a strategic issue. The meaning attached to different situations will differ among organizations because of differences in structure and ideology.
Daft and Weick (1984)	Conc	N/A	Proposes a conceptual model of organizations as an interpretation system of environmental information and which take organizational action based on the interpretation of information. The source of environmental information can be internal or external to the organization.
Galbraith (1973)	Conc	N/A	Firms need quality information to cope with an uncertain environment.
Duncan (1973)	Conc	N/A	The study suggests the importance of structures to manage and provide information to organizational members so that they can cope with environmental uncertainty when making decisions. Information processing structure is proposed to have a hierarchy of authority, degree of impersonality, degree of participation in decision-making, degree of specific rules and procedures, and degree of division of labor.

Emp: empirical, Conc: conceptual, N/A: does not apply, OLS: ordinary least squares

perspective contend that structures facilitate the collection and identification of information that could help decision-makers reduce environmental uncertainty and build their interpretation of environmental events (e.g., Duncan, 1973; Galbraith, 1973; Knight & McDaniel, 1979; Pfeffer & Salancik, 1978).

As open systems, organizations are subject to the influences of contextual factors from the task environment. The organizational strategic orientation is a factor from the task environment that acts as antecedent to TMT's interpretation of strategic issues because it can act as a perceptual filter that influences the type of information that TMTs pay attention to (e.g., Ginsberg & Venkatraman, 1992; Plambeck & Weber, 2010; Thomas & McDaniel, 1990). In agreement with the literature on strategic sense-making, this dissertation uses the information processing structure of TMT and the strategic orientation as the antecedents of TMT's interpretation of SAM as an IS strategic issue.

Interpretation follows the scanning process, and it requires that top managers cognitively engage with environmental information acquired through scanning and categorize this information to reduce its complexity, equivocality, or uncertainty by fitting information into meaningful categories (Dutton & Jackson, 1987; Sharma, 2000). This interpretation is also known in the literature as strategic issue diagnosis, categorization of strategic issues, or labeling of strategic issues (Dutton et al., 1983; Dutton & Jackson, 1987). The importance of interpretation relies on the assertion that when top managers categorize and assign meaning to information related to strategic issues, the label facilitates the storage of information, supports the communication of ambiguous information, and influences the actions that will be taken by the organization (Dutton & Jackson, 1987).

Dutton and Jackson (1987) brought the concept of cognitive categories into strategic sensemaking by drawing from cognitive psychology and its categorization theory (e.g., Mervis & Rosch, 1981; Rosch, 1975, 1978). Categorization theory explains the cognitive process through which humans generate categorization concepts about natural objects (Rosch, 1975, 1978). Research in social psychology indicates that people assign positive and negative categorizations not only to objects but also to issues and persons (Fazio, Eiser, & Shook, 2004).

Dutton and Jackson (1987) applied the categorization concept to the strategic issue diagnosis and drawing from previous work (Rosch, 1975, 1978) they indicated that top managers categorize or label strategic issues as opportunities or threats. Opportunities are suggested to represent positive situations in which gain is possible and for which there is reasonable control (cf. Dutton & Jackson, 1987; Fredrickson, 1985; Mintzberg, Raisinghani, & Theoret, 1976; Thomas & McDaniel, 1990). In contrast, threats represent a situation with negative connotations over which there is little control and where loss is likely (cf. Dutton & Jackson, 1987; Staw, Sandelands, & Dutton, 1981).

Jackson and Dutton (1988) conducted two studies in this area. In study 1, they investigated issues that managers associated with threat and opportunity. In Study 2, the researchers developed an experimental design to test whether there are differences in the conclusions of managers about strategic issues to which they assigned different characteristics. The researchers asserted that threat and opportunities are different constructs. Threat has negative connotations involving the absence of control and expectation of loss. On the contrary, an opportunity has a positive connotation related to the perception of control and anticipation of gain. The study also concluded that while managers may avoid participating in situations evaluated as a threat, when situations are labeled as an opportunity, they would seek to participate. It was also found that there is a bias for managers to identify strategic issues as threats and that only the presence of strong evidence signaling an opportunity will suppress the threat perception (Jackson & Dutton, 1988).

Table 2.12
Literature on Categories of Strategic Issue Interpretation

Year	Type	Method	Finding
Dutton and Jackson (1987)	Conceptual	N/A	Strategic issues are categorized as threat or opportunity along a continuum of three dimensions that go from positive to negative, gain to loss, controllable to uncontrollable
Dutton and Duncan (1987)	Conceptual	N/A	Strategic issues are categorized as feasible and urgent.
Jackson and Dutton (1988)	Empirical	Two studies. Study 1 n=78, study 2 n= 83	The study found that threats and opportunities are two different constructs. Threats are aversive, and opportunities generate motivation to participate in addressing them. Additionally, the study suggested that managers are biased in identifying threats, as organizations may reward threat avoidance rather than respond to opportunities. Moreover, managers see threats to strategic issues unless there is strong evidence to suggest otherwise.
Thomas and McDaniel (1990)	Empirical		Strategic issues are framed as either a threat or an opportunity. Three set of dimensions are proposed, namely positive-negative, gain-loss, controllable-uncontrollable. The empirical study found that threat and opportunity can be factored in the dimensions of positive-negative gain and controllable-uncontrollable.
Thomas et al. (1993)	Empirical		Based on previous studies (Thomas & McDaniel, 1990), positive-negative and gain-loss are consolidated into positive-gain/negative-gain. Hence, instead of three dimensions to measure opportunity and threat such as in Thomas and McDaniel (1990), now two dimensions are used: positive-gain/negative-gain and controllable/uncontrollable.
Anderson and Nichols (2007)	Empirical	Survey, longitudinal, n=38	This study used the 15 items designed by Thomas et al. (1993) to measure threat and opportunity and found three factors, namely positive gain, controllability, and threat items. The authors suggested that threat and opportunity are different factors.
Julian and Ofori-Dankwa (2008)		Survey, case describing current economic conditions, CEOs, n=280	Based on their review of the literature, they asserted that threat and opportunity are the categorizations most frequently used for strategic issues analysis. The study also explored the validity of threat-opportunity, and feasibility–urgency categorization of strategic issues, and it sought to integrate both approaches to categorize strategic issues. The study found that feasibility-urgency is a better predictor of intentions and actual responses. Additionally, the authors used the expectancy, instrumentality, and valence motivation theory to support their factor analysis of strategic issues categorization items and found three underlying constructs of favorability, urgency, and influence. They asserted that the three-factor model has better predicting performance compared to threat-opportunity factors.

The literature provides different categories for analyzing strategic issues. On the one hand, most studies in this literature review used the threat opportunity framework (cf. Dutton & Jackson, 1987; Ginsberg & Venkatraman, 1992; Kuvaas, 2002; Plambeck & Weber, 2010; Sharma, 2000; Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas et al., 1991; White, Varadarajan, & Dacin, 2003). On the other hand, some studies (cf. Dutton & Duncan, 1987; Ginsberg & Venkatraman, 1992, 1995; Julian & Ofori-Dankwa, 2008) used feasibility and urgency as categorizations to evaluate strategic issues. However, Julian and Ofori-Dankwa (2008) corroborated that threats and opportunities are the most frequently used categories to analyze strategic issues.

Differences in how threat-opportunity is measured have also been noted. For instance, Dutton and Jackson (1987) proposed to measure threat-opportunities along a continuum of three dimensions: from positive to negative, gain to loss, and controllable to uncontrollable. Using these dimensions, opportunity would be located on the positive side of the continuum and threat on the negative side of the continuum. However, Thomas et al. (1993) cited a previous study (Thomas & McDaniel, 1990) and indicated that threat-opportunity continuum has only two dimensions positive-negative gain and controllable-uncontrollable.

This study will use the threat-opportunity category to evaluate the strategic issue of SAM, and it will use Thomas et al.'s positive-negative gain and controllable-uncontrollable constructs.

Action follows the interpretation stage of the sensemaking of strategic issues (Maitlis & Christianson, 2014; Thomas et al., 1993). Effective action as a response to strategic issues rests on the ability to implement strategic choices derived from the interpretation of information concerning strategic issues (Pfeffer & Salancik, 1978). The way in which TMT interprets the environment influences the action that an organization takes to achieve environmental adaptation (Daft & Weick, 1984; Dutton & Jackson, 1987; Milliken, 1990; Thomas et al., 1993).

Early contributors to strategic sensemaking have asserted that systematic ways used to interpret the environment influence strategic positions, structural adaptation, and decision making (Daft & Weick, 1984). These organizational adaptations may range from small to large, and they can trigger changes to procedures, products, or services; revisions of strategy; and redesign of structures (Dutton & Jackson, 1987).

Ginsberg and Venkatraman (1992) empirically tested the influence of opportunity interpretation on the organization's commitment to acquire organizational capabilities and found a positive relationship between the two concepts. Additionally, Ginsberg and Venkatraman (1995) asserted that interpreting an issue as an opportunity or threat influences the response commitment. Likewise, White et al. (2003) found that managers' perception of a strategic situation as controllable is related to an increased perception of opportunity. The increased perception of opportunity leads to a greater magnitude of response (White et al., 2003).

Dutton (1993) posited that strategic issues labeled as opportunities are associated with perceptions of freedom of choice to respond, access to means to address an issue, and perceptions of competence. Moreover, Dutton (1993) purported that issues that are framed as opportunities suppress the effect of threats and highlight the importance of identifying options and mechanisms of change. Further, it is noted that an organization can frame issues as opportunities to mark a transition from the past to the future when establishing a new organizational direction (Dutton, 1993). Managers can also label issues as an opportunity to project positive values and get organizational members involved in the decided course of action (Dutton, 1993).

Thomas et al. (1993) asserted that issues labeled by TMT as positive-gain or as controllable were positively associated with significant changes in product or service offerings. While conducting an empirical test with a sample of organizations from the health care industry, Thomas et al. (1993) found a positive relationship between the opportunity dimension of controllability, which is the perception that an issue is controllable, and product service change (i.e., action).

Sharma (2000) investigated the interpretation of environmental issues as a strategic opportunity. The study hypothesized a positive relationship between TMT's interpretation of opportunity and proactive adoption of environmental actions that go beyond conformance with the law (i.e., institutional pressures). The investigation found empirical support for a positive relationship between the organization's interpretation of issues as an opportunity and proactivity to adopt voluntary measures to protect the environment (Sharma, 2000).

Chattopadhyay et al. (2001) proposed and empirically tested a model drawing on strategic issue diagnosis (Dutton & Jackson, 1987), threat-rigidity (Staw et al., 1981), and prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). Chattopadhyay et al. (2001) argued that control-reducing threats are likely to produce internally focused actions (threat-rigidity) and that likely losses lead to riskier external targeted actions (prospect).

In a conceptual study, George, Chattopadhyay, Sitkin, and Barden (2006) integrated institutional, prospect, and threat-rigidity theories to determine the ways in which the perceptions of threat and opportunities lead to organizational actions. These researchers contended that potential loss of resources leads to non-isomorphic response and that potential loss of control leads to isomorphic response. George et al. (2006) further asserted that the potential gain of resources leads to isomorphic responses whereas the potential gain of control leads to non-isomorphic responses.

Table 2.13
Related Literature on Strategic Issue Interpretation and Outcomes

Year	Type	Method	Finding
Daft and Weick (1984)	Conc	N/A	As decision makers assign meaning and interpret environmental information, they learn and act.
Dutton and Duncan (1987)	Conc	N/A	The interpretation of a strategic issue as feasible or urgent influences the degree of change action from incremental to radical.
Dutton and Jackson (1987)	Conc	N/A	Threat and opportunities are common labels assigned to strategic issues. Opportunities rather than threats elicit greater participation of organizational members.
Ginsberg and Venkatraman (1992)	Emp	Mix methods. Qual-Quant. Field interview and survey study on case scenario with 430 respondents.	This study found that issue interpretation as an opportunity of value to gain a competitive advantage is positively related to managerial commitment to new technological capabilities.
Dutton (1993)	Conc	N/A	Interpretations are the drivers of organizational action. Labeling an issue as an opportunity adds a positive gloss effect that encourages organizational action. Additionally, opportunity infuses an issue with the value of proactivity and focuses on the future, encouraging involvement and organizational change.
Thomas et al. (1993)	Emp	Survey, 156 CEOs, case scenario and archival data from hospitals. OLS	This study found that issue interpretation as an opportunity of controllability is positively related to actions conducive to greater product service change. Moreover, in contrast to the previous suggestions that opportunity/threat has three dimensions (positive/negative, gain/loss, and controllability), the researchers found only two dimensions, positive gain/negative gain, and controllability.
Ginsberg and Venkatraman (1995)	Emp	Mix methods. Qual-Quant. Field interview, survey on case scenario, collects data from 424 organizations.	Interpretation of an issue as manageable is positively related to commitment to technological competence and administrative competence. Interpretation of an issue as understandable is positively related to commitment to technological competence.
Sharma (2000)	Emp	Survey, 99 organizations and archival data	Managerial interpretation of environmental issues as opportunities is positively related to a voluntary environmental strategy that goes beyond the strategy of conforming to the law.

Table 2.13
Related Literature on Strategic Issue Interpretation and Outcomes

Year	Type	Method	Finding
Chattopadhyay et al. (2001)	Emp	Survey, 92 organizations	This study did not find an association between the opportunity of control to enhance or gain and organizational actions. Furthermore, the study found that control reducing threats lead to internally directed actions that are conservative and that likely losses lead to riskier externally directed actions.
White et al. (2003)	Emp	Survey, 757 organizations, case scenario	An empirical study sought to understand how managers respond to market situations. The study found that the more managers evaluate situations as an opportunity, the more they see it as controllable. Additionally, the study found that large perceptions of controllability lead to a larger magnitude of response.
George et al. (2006)	Conc	N/A	A conceptual model integrated institutional, threat rigidity, and prospect theory. The model indicated that organizations would respond with isomorphic responses when facing gain of resources or loss of control. On the contrary, non-isomorphic responses will take place when the organization faces a potential loss of resources or potential gain of control.
Abebe and Alvarado (2015)	Conc	N/A	A conceptual study that proposed that managerial interpretations of opportunity in the form of perceptions of market gain, market opportunity, and market controllability is positively associated with firm growth intention which leads to acquisitions, market development, and growth strategies.

Conc: conceptual, Emp: empirical, N/A: does not apply

Table 2.13 summarizes the previous research linking interpretation with actions. Although scholars differ on the different types of outcomes that result from managerial interpretations, this study follows Sharma (2000) which found that managerial interpretation of an issue as an opportunity leads to the implementation of voluntary actions that proactively act on the strategic issue because of TMT conducting an open search for alternatives.

CHAPTER III

CONCEPTUAL MODEL AND HYPOTHESES

This chapter presents the development of a conceptual model showing the ways in which TMT interprets information on software assets issues and the influence of interpretation on the implementation of SAM. Subsequently, the proposed hypotheses are presented.

3.1 Conceptual Model

This dissertation assumes that organizations are open systems and subject to the influence of sources of information available in the environment (c.f. Aldrich & Herker, 1977; Daft, 2007; Dill, 1962; Duncan, 1973; J. D. Thompson, 1967). It also seeks to understand the ways in which TMT's interpretation of organizational contextual factors, such as strategic orientation, and information processing of software asset issues influence the implementation of SAM actions. A model that draws from strategic sensemaking theory is proposed to understand the links among scanning of information, interpretation, and action on SAM, as an IS strategic issue.

Managers in organizations are continually facing ambiguous data and loosely felt stimuli that they must somehow order and explicate and to which they must assign the meaning before they make the decisions that lead to organizational action (Gottschalk, 2000; Kuvaas, 1998). The strategic sensemaking theory suggests that top managers scan the environment for information on salient issues, interpret the scanned information, and take action, so that organizations achieve environmental adaptation (Daft & Weick, 1984; Dutton & Jackson, 1987; Milliken, 1990; Thomas et al., 1993; Thomas & McDaniel, 1990).

In the sensemaking literature, strategic issues are defined as trends or developments that could affect the position of the organization (Dutton et al., 1983; Egelhoff, 1982). These strategic issues often bring equivocal and uncertain information that managers label as threats or opportunities (Dutton & Jackson, 1987; Jackson & Dutton, 1988). Labeling these strategic issues as threats or opportunities influences the TMT's perceptions and the actions taken by the organization (Daft & Weick, 1984; Dewald & Bowen, 2010; Dutton & Jackson, 1987; Thomas et al., 1993; Thomas & McDaniel, 1990).

In Chapter I, arguments were presented on why software is a strategic IT asset. For instance, it was mentioned that software requires substantial capital investment, is critical to support the organization's mission and that organizations that use software face audit and liability risks. Consequently, scholars and practitioners agree that software asset management is an IS strategic issue requiring the attention of top management (cf. Barber et al., 2016; Bequai, 1998; BSA, 2011, 2014; Deas, Markowitz, & Black, 2014; Forrester, 2015; Holsing & Yen, 1999; ISO/IEC, 2012; KPMG, 2009; PwC, 2012; Rudd, 2009; Wilkin & Chenhall, 2010). Organizations that are agile and flexible when deploying and managing software assets tend to implement robust SAM (Rudd, 2009). Accurate information on software assets supports the organization's strategic use of software to achieve cost efficiencies, improves IS security, adds value to products offered, and seize market opportunities (Dutta, 2007; KPMG, 2009; Rudd, 2009).

A perspective that looks at software as an asset under IT governance holds top managers accountable for interpreting environmental information about IS-strategic issues concerning software assets. TMT is accountable for interpreting IS strategic issues leading to actions concerning SAM. These interpretations influence organizational adaptation so that threats and opportunities are addressed. The way in which TMT interprets SAM issues as an opportunity explains the adoption of SAM actions.

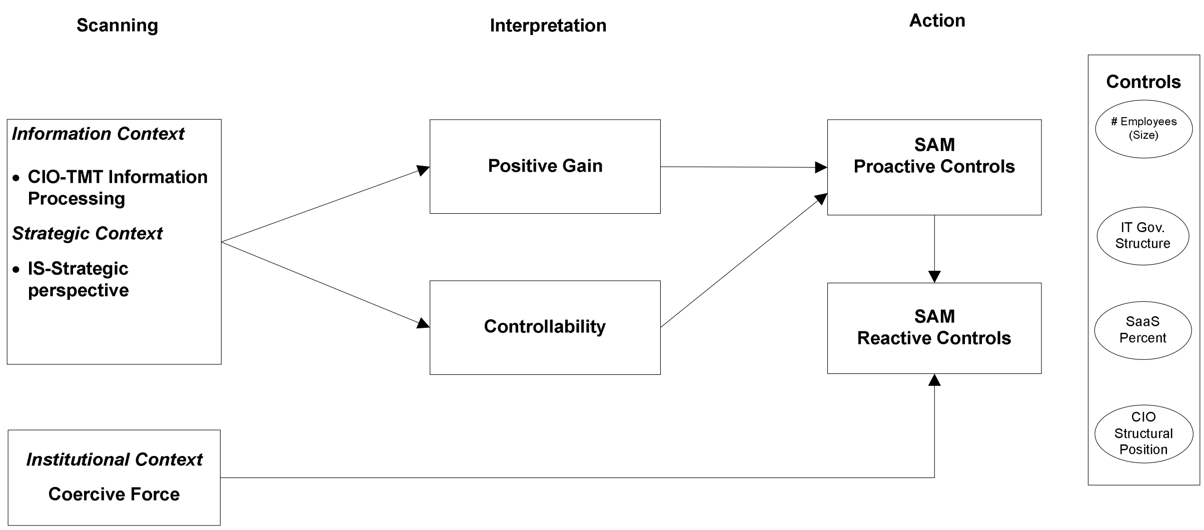

Figure 3.1 Conceptual Model

Figure 3.1 shows the proposed model. The model is developed under the premise that organizations are interpretation systems of information available in the environmental context (Daft & Weick, 1984; Dutton & Jackson, 1987; Thomas & McDaniel, 1990).

Organizations are open systems and subject to influences from their information context (Kuvaas, 2002; Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas et al., 1991). Decision makers need information to cope with environmental uncertainty when making decisions (Duncan, 1973; Galbraith, 1973; Huang et al., 2014). As an organizational contextual factor, the information flows in and around the organization influence managerial interpretation through the amount, filtering, distribution, and type of information made available to decision makers (cf. Duncan, 1973; Galbraith, 1973; Huang et al., 2014; Huber & Daft, 1987; Kuvaas, 2002). TMT's information processing structure is a salient antecedent of interpretation used in the strategic sensemaking literature (Kuvaas, 2002; Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas et al., 1991; Thomas et al., 1994).

Managers have bounded rationality and cannot attend to every information cue available in the environment (March & Simon, 1958). To overcome bounded rationality, organizations develop information processing structures to assist managers in their processing of environmental information. Duncan (1973, 1974) claimed that information processing structures for the non-routine decision making made by top managers (decision unit) could be addressed through information structures that facilitate the exchange of information among decision makers. Thomas and McDaniel (1990) elaborated on Duncan's work and proposed a succinct TMT information processing structure comprised of formalization, interaction, and participation. The information processing structures in organizations have been found to influence the identification of opportunity in strategic issues because they enable the distribution of information that allows the identification of opportunities for gain and controllability (Kuvaas, 2002; Thomas et al., 1993; Thomas & McDaniel, 1990; White et al., 2003).

In the context of IS strategic information issues, such as SAM, this dissertation proposes a modification of the information processing structure used in previous studies (Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas et al., 1991). It is argued that TMT information processing structures dealing with IS strategic issues should have access to specialized knowledge about the information systems (IS) domain. The IS literature offers examples of how the lack of specialized knowledge makes it difficult for top management and IT management to have a shared understanding of the role of IT in organizations (e.g., Armstrong & Sambamurthy, 1999; Chan, 2002; Tan & Gallupe, 2006). Additionally, the IS literature has identified the lack of specialized knowledge as one of the challenges that top managers face when participating in IT strategic thinking (e.g., Chun & Mooney, 2009; Peppard, 2010).

As open systems, organizations have specialized members that cross, span, or interact with the organization's boundaries (Kobrin, 1982). This is necessary because not all members of the organization can or have the knowledge to directly interact with the environment. Consequently, organizational members will have to depend on the perceptions of those specialized members who directly interact with the environment and who acquire domain-specific information (Kobrin, 1982; March & Simon, 1958; J. D. Thompson, 1967). These specialized individuals are said to occupy boundary spanning positions (e.g., Aldrich, 1979; Leifer & Delbecq, 1978; Leifer & Huber, 1977; Tushman & Katz, 1980). Boundary spanners are individuals whose specialization or assignment place them at the organization's boundaries for the purpose of interacting with the environment (J. S. Adams, 1976; Kobrin, 1982; Leifer & Delbecq, 1978). Boundary spanners acquire and process domain specific information, infuse meaning into it, and make it comprehensible to other decision makers (Kobrin, 1982; Miles, 1980).

Thus, in the context of IS strategic issues, the CIO plays a boundary spanning role in the information processing structure of the organization and provides TMT with capabilities to process environmental information about IS strategic issues. Consequently, regarding IS strategic issues, such as SAM, the CIO-TMT information processing structure facilitates the specific information about software assets that TMT needs to make sense and take action. A high degree of information processing capacity will allow decision-makers to identify opportunities associated with IS strategic issues, whereas a small degree of information processing capacity will be associated with the strategic IS issues being perceived as a threat to the organization (Dutton & Jackson, 1987).

The strategic context is also a source of information that managers use to filter scanned environmental information when constructing meaning about strategic issues (Daft & Weick, 1984; Dutton & Jackson, 1987; Ginsberg & Venkatraman, 1992; Plambeck & Weber, 2010; Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas et al., 1991). Miles and Cameron (1982) developed a typology that classifies the organization's strategic orientation as domain-offensive and domain-defensive. The typology has been used to study the influence of strategic orientation on managerial interpretations. Strategic orientation represents the beliefs about the positions that the organization should adopt while acting on environmental developments (Plambeck & Weber, 2010). Products offered or market segments served, and partnerships with other entities reflect the organizational strategy (Miles & Cameron, 1982).

Scholars suggest that strategic orientation influences an organization's culture, structures, and routines, and it is likely to influence the way in which top managers interpret information (e.g., Daft & Weick, 1984; Hambrick, 1981; A. D. Meyer, 1982; Plambeck, 2012; Plambeck & Weber, 2010; Tabak & Barr, 1999; Thomas & McDaniel, 1990). The strategic orientation is likely to help managers filter information about the strategic issue (cf. Hambrick, 1981; A. D. Meyer, 1982; Plambeck, 2012; Plambeck & Weber, 2010; Thomas & McDaniel, 1990). Organizations that are domain-offensive are likely to be associated with opportunities identified by TMT (positive gain and controllability), whereas organizations that are domain-defensive are likely to have a position of defending the current organizational orientation and TMTs are likely to identify threats when interpreting strategic issues (cf. Plambeck, 2012; Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas et al., 1991).

TMT's interpretation of the strategic issue influences the actions of the organization (Daft & Weick, 1984; Dutton & Jackson, 1987). Scholars assert that issues framed as opportunities foster organizational members' willingness to resolve the issue (Ashmos, Duchon, & McDaniel, 1998; Dutton, 1993; White et al., 2003). The perception of opportunity projects a positive gloss over situations, augments the impression of control, and reduces the perception of threat from the evaluated issue (cf. Dutton, 1993; Taylor, 1989; White et al., 2003). Both the positive gloss and the reduced perception of threat suggest a psychological mechanism that enables managers to reduce uncertainty and feel confident and motivated to initiate change and actions as well as to pledge organizational resources, because managers feel that achieving desired results is a concrete possibility (cf. Dutton, 1993; Heath & Tversky, 1991; Krueger & Dickson, 1994; Mullins & Walker Jr, 1996; Taylor, 1989; White et al., 2003).

Building on this logic, when SAM is identified as an opportunity, TMT should be willing to support the implementation of actions that facilitate compliance not only with the intellectual property rights facet of SAM but also with the voluntary implementation of actions that can make an organization achieve the lifecycle management of software assets (Rudd, 2009). Further, empirical research conducted in the domain of marketing and environmental management suggests that in the context of market situation or environmental interpretation, when managers perceive an opportunity, they are more willing to implement responses of large magnitude or support the implementation of actions that go beyond compliance with the law (Sharma, 2000; Sharma & Vredenburg, 1998; White et al., 2003).

Hence, it is conceptualized that voluntary SAM actions reflect proactivity (cf. Sharma, 2000; Sharma & Vredenburg, 1998). It follows that proactive SAM is the extent to which organizations implement voluntary controls that focus on planning and managing the lifecycle of software assets. Managing software with a life cycle focus is an opportunity for an organization to reduce costs of using and maintaining software, to increase agility to respond and deploy software to support the organizations' mission, and to collect information that can be used to reduce or eliminate liability risks due to software audits (ISO/IEC, 2012; Rudd, 2009).

The conceptual model also acknowledges that coercive force generates a reaction to comply with copyright regulations and software licensing agreements (cf. Cavusoglu et al., 2015; DiMaggio & Powell, 1983; DiMaggio & Powell, 1991; W. R. Scott, 1995) because it is not optional to comply with the law. Institutional theory suggests that organizations adopt actions that signal compliance with societal expectations to project legitimacy and facilitate access to resources needed for the viability of the organization (DiMaggio & Powell, 1983). In the context of SAM, showing that the organization counts its software licenses and that it works on reconciling use against entitlement, as authorized by licenses or contracts, signals compliance with copyright expectations. Consequently, this study suggests a direct positive relationship between coercive force and reactive SAM.

The model also proposes a relationship from Proactive SAM to Reactive SAM. Proactive SAM focuses on the planning and control of software assets in order to achieve the lifecycle management of software. Proactive SAM requires a management system supported by top management that defines roles and procedures associated to SAM; looks into the acquisition, deployment and retirement processes of SAM; and ensures information collected by the SAM systems is used to manage the costs of acquiring and using software as well as security issues (ISO/IEC, 2012; Rudd, 2009). Hence, when proactive SAM is performed by organizations, reactive SAM will be instantiated by the planning facets of Proactive SAM.

3.2 Research Model and Hypotheses

This section introduces the research model and hypotheses that will be investigated in this dissertation. Figure 3.2 presents the research model.

Scanning and Interpretation of SAM. In the digital era, it is common for software to be part of products and services offered to customers; and IS strategy plays a fundamental role in supporting and enabling business strategy (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013; Dutta, 2007). Issues affecting the flexibility to rapidly deploy software while pursuing market opportunities can negatively affect the organization's market performance (Bharadwaj et al., 2013). Strategic IS issues about the investment in, deployment, use, and management of IT assets such as software are complex, and ambiguous and should concern the upper echelons of organizations (Barber et al., 2016; Dutta, 2007; IDC & Flexera, 2014; ISO/IEC, 2012; Rudd, 2009).

Regularly, top managers need to make sense of events, trends or emerging situations that potentially affect current and future organizational performance (Anderson & Nichols, 2007; Dutton, Walton, & Abrahamson, 1989; Jackson & Dutton, 1988). Thus, a critical role of top managers is to provide a meaningful interpretation of ambiguous information (Thomas et al., 1993).

Strategic sensemaking requires managerial interpretation of complex, uncertain, and ambiguous information (Daft & Weick, 1984; Dutton & Jackson, 1987; Thomas & McDaniel, 1990). Strategic sensemaking theory has been used to understand how managers exposed to similar environmental stimuli interpret strategic issues (e.g., Anderson & Nichols, 2007; Daft, Sormunen, & Parks, 1988; Gioia & Thomas, 1996; Plambeck & Weber, 2010; Sharma, 2000; Sund, 2013; Thomas et al., 1993; Thomas & McDaniel, 1990). Moreover, managerial interpretations differ because managers are subject to biases and perceptions and to differences in organizational context (cf. Hall, 1984; Thomas & McDaniel, 1990; Thomas et al., 1991; Thomas et al., 1994). These contextual factors and structural differences in organizations (e.g., information processing structure, and strategic orientation) influence how the scanned information is used during TMT interpretation (cf. Kuvaas, 2002; Plambeck & Weber, 2010; Thomas et al., 1993; Thomas & McDaniel, 1990).

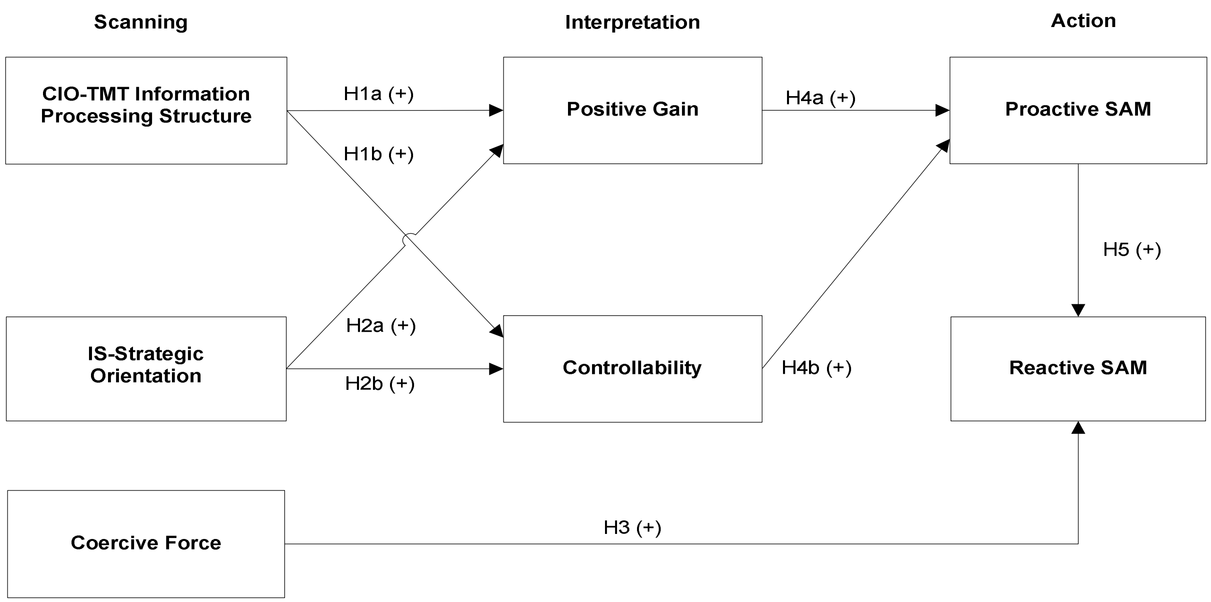

Figure 3.2 Research Model and Hypotheses

When faced with ill-structured situations, people usually try to learn as much as possible before interpreting and making decisions (Skinner, 1995). Managers who use information more extensively have more information available to construct their interpretation (Knight & McDaniel, 1979). This information can provide the knowledge and completeness needed to recognize opportunities (Dutton, 1993; J. D. Thompson, 1967). The information processing perspective supports this view by asserting that top managers who use more information are more likely to perceive an issue more positively and controllable (Thomas et al., 1993; Thomas & McDaniel, 1990). When managers are exposed to ample information about an issue they will be able to cope with ambiguity and reduce uncertainty because psychologically, they perceive issues as controllable, positive, and absent of a threat (cf. Dutton, 1993; McCall & Kaplan, 1985; White et al., 2003).

CIO-TMT Information processing structure. The information processing structure is a mechanism developed by organizations to facilitate exchange and sharing of information among decision makers (Kuvaas, 2002; Thomas & McDaniel, 1990; Thomas et al., 1994). The information processing perspective asserts that some of the most critical activities of decision makers are the acquisition and processing of environmental information (cf. Kuvaas, 1998; Shank, Zeithmlal, Blackburn, & Boyton, 1988; Weick, 1979). Organizational information processing explains organizational behavior by taking into account the information flow that occurs inside and outside of the organization (Knight & McDaniel, 1979).

The information processing structure of TMT has three dimensions: interaction, participation, and degree or formalization for the analysis of information by TMT (Kuvaas, 2002; Thomas & McDaniel, 1990; Thomas et al., 1991; Thomas et al., 1994). High interaction, high participation, and high formalization[8], in the context of IS strategic issues, reflect a high degree of CIO-TMT information processing capacity (cf. Duncan, 1973, 1974; Galbraith, 1973; Thomas & McDaniel, 1990).

TMTs need information to cope with an uncertain environment, and to improve their decision-making processes (Galbraith, 1973; Huang et al., 2014). The information processing

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[8]As conceptualized by (Thomas & McDaniel, 1990) there is an assumption for the information processing structure that low formalization facilitates the analysis of strategic issues (Thomas & McDaniel, 1990). However, in the context of IS strategic issues, it is argued that high formalization is necessary to analyze SAM issues. The argument is supported by findings that when TMTs are heterogonous (i.e., inclusion of CIO with different domain knowledge) there is a need for high formalization in the communication of information among TMT members to facilitate understanding of strategic information (Smith et al., 1994). Also, IT Governance best practices emphasize that TMTs should use formal mechanisms to analyze IS strategic issues (Lawler III & Finegold, 2005; Wilkin & Chenhall, 2010).

structure of organizations augments or constraints the ways in which TMT members search for information and interpret stimuli associated with the strategic issue (Duncan, 1974; Huber, 1991; Thomas & McDaniel, 1990)). Previous studies support this notion, asserting that high TMT information processing capacity promotes or obstructs the use of information when interpreting issues that need to be addressed equivocally (Daft & Lengel, 1986; Duncan, 1973, 1974; Thomas & McDaniel, 1990; Thomas et al., 1994).

High CIO-TMT information processing capacity facilitates extensive use of information (cf. Daft & Lengel, 1986; Galbraith, 1973; Thomas et al., 1993; Thomas & McDaniel, 1990) supporting openness of idea exchange among TMT members (Abebe & Alvarado, 2015). Further, Eisenhardt (1989) indicated that TMTs with high information processing capacity will have more information and processing capabilities to make sense of strategic issues, and will be able to cope with the stress and anxiety that results from ambiguous environmental information. TMTs with high information processing capacity are likely to have more data, more capacity, and expanded field of view to diagnose strategic issues. They will find opportunities in the information provided and believe that positive gains and controllability can be achieved (Daft & Lengel, 1986; Duncan, 1973, 1974; Kuvaas, 2002; Thomas & McDaniel, 1990; Thomas et al., 1991).

However, TMTs with restricted information processing will perceive limited information about an issue. Researchers assert that structures with restricted information processing are not well-prepared to scan for opportunities (L. J. Bourgeois, McAllister, & Mitchell, 1978).

It is argued that SAM is an IS strategic issue. The CIO-TMT information processing structure, allows the CIO to contribute IS domain specific information that can be used by the TMT to interpret IS strategic issues. For this reason, it is expected that high CIO-TMT information processing structure will positively influence the interpretation of SAM strategic issues as positive and controllable (Thomas & McDaniel, 1990; Thomas et al., 1991). Consequently, it is hypothesized that:

H1a: Higher degree of CIO-TMT information processing structure will be positively related to the extent to which TMT will label an IS strategic issue as positive gain.

H1b: Higher degree of CIO-TMT information processing structure will be positively related to the extent to which TMT will label an IS strategic issue as controllable.

Strategic Orientation represents the beliefs about the positions that an organization should adopt while acting on environmental challenges (Plambeck & Weber, 2010). The extent of products and service offering, relations with external entities, type of customer served, and success criteria reflect the organizations' strategy (Miles & Cameron, 1982).

The organization's strategic orientation serves as a filter of ideas and information that TMT members attend to (Plambeck & Weber, 2010; Prahalad & Bettis, 1986). Thus, an organization's strategic orientation is an important referent used by TMTs to filter environmental information (Daft & Weick, 1984; Plambeck & Weber, 2010; Thomas & McDaniel, 1990). It influences an organization's culture, structures, and routines used to interpret information (Daft & Weick, 1984; Hambrick, 1981; A. D. Meyer, 1982; Plambeck & Weber, 2010; Thomas & McDaniel, 1990) and constrains the degree to which managers perceive issues as having similar attributes (i.e., positive cues) (cf. Hambrick, 1981; A. D. Meyer, 1982; Plambeck & Weber, 2010; Thomas & McDaniel, 1990).

Miles and Cameron (1982) indicate that organizations adopt domain-offensive and domain-defensive as strategic orientations. Domain-offensive organizations seek to explore and capitalize on new opportunities whereas domain-defensive organizations have the predisposition to be conservative and exploit known capabilities (cf. Gioia & Thomas, 1996; Miles & Cameron, 1982; Plambeck & Weber, 2010). This perspective is reminiscent of the IS-strategy types proposed by (D. Q. Chen, Mocker, Preston, & Teubner, 2010). These authors suggest that IS-innovators (reminiscent of Domain offensive) focus on leading IS innovation and rapidly responding to opportunities; whereas IS-conservatives (reminiscent of domain defensive) seek for stability and incremental adjustment of existing competencies and only adopt mature and proven technologies (reminiscent of domain defensive) (D. Q. Chen et al., 2010). In this dissertation, IS-domain offensive organizations are those seeking to explore and capitalize on opportunities when using information systems whereas IS-domain defensive organizations are those that seek for stability in exploiting existing capabilities or at the least for incremental adjustments of IS capabilities.

Managers from TMTs in organizations with an IS domain offensive orientation focus on identifying opportunities whereas managers from TMT in organizations that are a domain-defensive focus on identifying threats (Plambeck, 2012; Thomas & McDaniel, 1990). Thus, TMT members from domain-defensive organizations will concentrate on information depicting the issue as negative and threatening for the organization (Plambeck, 2012).

Managers from domain-offensive organizations seek opportunities, collect a richer array of information, are confident in achieving the fit between the environment and the organization, and are likely to have an improved perception of managerial control (Aldrich, 1979; Howell & Sheab, 2001; Thomas et al., 1993). In the context of IS, managers from domain offensive organizations will search, attend to, and process information in areas that could expand the services that the IS organization could offer to support the generation of organizational value (Thomas & McDaniel, 1990; Thomas et al., 1991).

The previous discussion leads to the hypothesis that:

H2a: TMTs in organizations with domain-offensive IS-strategic orientation will be more likely to interpret a strategic issue as positive gain compared to TMTs in organizations with domain-defensive IS strategic orientation.

H2b: TMTs in organizations with domain-offensive IS-strategic orientation will be more likely to interpret a strategic issue as controllable compared to TMTs in organizations with domain-defensive IS strategic orientation.

Coercive force. Institutional theory proposes that coercive force drives organizations to achieve greater legitimacy with their stakeholders, by adopting processes, structures, and strategies used by similar organizations to achieve social legitimization and secure resources that are necessary for the viability of the organization (DiMaggio & Powell, 1983; DiMaggio & Powell, 1991; J. W. Meyer & Rowan, 1977).

Coercive pressure operates on the assumption that organizations are subject to the forces of others upon which they are dependent (DiMaggio & Powell, 1983; Teo et al., 2003). Government regulations and policies exert coercive pressure on organizations (Liang et al., 2007; W. R. Scott, 1995). Through coercive force, stakeholders that control key resources can establish rules or force the compliance with relevant policies or regulations which are deemed to be acceptable organizational practices, within the institutional environment (W. R. Scott, 1995).

The IS domain is subject to regulations prescribing what organizations should do to protect IT assets from misuse (e.g., Gramm-Leach-Bliley Act, Health Insurance Portability, and Accountability Act, the federal information security Act, the Sarbanes-Oxley Act (Cannon, 2011; Cavusoglu et al., 2015). Hence, organizations and CIOs seek to conform to legal or industry standards (Baskerville & Dhillon, 2008). In the context of SAM, copyright legislation and software licenses require organizations to protect software copyright; otherwise, organizations that use software can be subject to civil or criminal penalties, legal fees, lost time due to extended inspections of software assets, and payment for unlicensed software (Flynn, 2009; Holsing & Yen, 1999; Koen & Im, 1997).

Traditionally, organizations that are bounded by legislation to comply with a given precept have regarded the law as a defining referent of legal and social obligation (Gunningham et al., 2004). Socio-legal research asserts that organizations comply with the law for utilitarian reasons because they are motivated to avoid legal penalties or because they perceive the law to be the ultimate definition of society's moral and social duties (Gunningham et al., 2004; Hawkins & Hutter, 1993). In this dissertation, it is assumed that coercive pressure motivates organizations to react and comply with the minimum expectation set by software copyright law.

Organizations frequently approach compliance on a reactive, ad hoc, and case-by-case basis (Dery & Abran, 2004; Gangadharan et al., 2012; Kardaras, 2012). At a minimum, to demonstrate compliance with software copyright, organizations are required to show a match of software used against the entitlement (software licenses) that they have paid for. Usually, to accomplish this minimum requirement with software copyright, organizations perform inventories to account for all software installed and reconcile the count against software licensing entitlements and proofs of purchase to demonstrate adequate SAM (Deloitte, 2012; M. Fisher, 2010; Plastow, 2006; R. J. Scott, n.d). Consequently, it is plausible that the minimum organizational reaction to adherence to copyright laws and software licenses is to adopt reactive SAM that shows suitable management of software copyright. Software inventory, license auditing, and reconciliation against entitlement is the traditional way to match the expectation set by copyright law or software licenses. Thus, it is hypothesized:

H3: Coercive force will positively influence the adoption of reactive SAM.

Interpretation and SAM. Individuals use schema to classify information and reduce environmental complexity by fitting information into meaningful categories (Dutton & Jackson, 1987). TMT's interpretation of strategic issues influences the actions of organizations (Daft & Weick, 1984; Dutton & Jackson, 1987; Ginsberg & Venkatraman, 1992; Thomas et al., 1993). Evaluating a situation as an opportunity has a powerful effect on managers and organizational members, as it can be used by top management to accentuate a point from which the organization will explore and take advantage of a given issue (Dutton, 1993).

Further, appraising an issue as an opportunity takes place when managers see attributes in matters that proclaim opportunities and at the same time rule out or dampen the perception of threat (Jackson & Dutton, 1988). Such perception is important because opportunity frames are psychologically important for decision makers, as they are associated with the belief that strategic issues can be exploited to achieve positive gain and controllability (Dutton, 1993; Jackson & Dutton, 1988; Srinivasan et al., 2005). Managers that are exposed to ample information about strategic issues are subject to threat reduction effects because the available information highlights opportunities or benefits associated with an issue (Dutton, 1993). The threat reduction effect leads managers to have the cognitive flexibility necessary to identify and associate multiple ideas that can be implemented to take advantage of the perceived opportunity (Dutton, 1993; Grawitch, Munz, Elliott, & Mathis, 2003; Isen, 2000; Isen, Johnson, Mertz, & Robinson, 1985; Jackson & Dutton, 1988; Nutt, 1984), and take risks associated with being proactive towards action (Sharma, 2000).

Empirical research in the field of environmental management has found that organizations that frame the requirements of environmental regulations as a beneficial opportunity seek to proactively identify various alternatives to exceed government regulations (e.g., Gunningham et al., 2004; Sharma, 2000). Similarly, accounting scholars have investigated why organizations that proactively adopt accounting practices go beyond legal requirements (Cuijpers & Buijink, 2005). These researchers have found that the expectation to achieve a benefit such as the improvement of better control in the quality of financial reporting motivates organizations to explore a variety of alternatives (Cuijpers & Buijink, 2005). Similarly, in situations of IS strategic issues such as in the context of SAM, when organizations identify an opportunity to improve software management, they enact their environment by adopting proactive SAM in order to take advantage of an identified opportunity (cf. Daft & Weick, 1984; Sharma, 2000; Srinivasan et al., 2002; Srinivasan et al., 2005).

Based on the previous discussion, TMT's categorization of software assets issues as an opportunity leads to TMT's flexibility to discover and associate ideas that can allow the organization to execute proactive actions that could make possible the achievement of benefits associated with opportunities. For this reason, it is hypothesized that:

H4a: TMT's perception of software asset issues as an opportunity for positive gain will be positively associated with the adoption of proactive SAM.

H4b: TMT's perception of software asset issues as an opportunity for controllability will be positively associated with the adoption of proactive SAM.

Organizations with Proactive SAM execute an organizational management system that plans and controls the lifecycle of software assets in order to realize an efficient use of software that supports the achievement of the organization's objectives while protecting the organization against liability or security risks inherent to software use. Hence, in order to plan and control software lifecycle organizations require accurate software inventory information which can be obtained by Proactively scheduling Reactive SAM actions. For this reason, it is hypothesized that:

H5: Higher degree of Proactive SAM adoption will be positively related to the adoption of reactive SAM.

CHAPTER IV

METHODOLOGY

This chapter describes the research method used along with the instrument validation, pilot study, and procedures used to conduct the full data collection to test the research model presented in Chapter III.

4.1 Research Design

IS research can be conducted with different research paradigms (J. Becker & Niehaves, 2007; Mingers, 2001; Orlikowski & Baroudi, 1991; Palvia et al., 2017; Vessey, Ramesh, & Glass, 2002). Scholars indicate that IS research can be classified as positivist, interpretive (W. Chen & Hirschheim, 2004), critical (Chua, 1986; H. K. Klein & Myers, 1999; Orlikowski & Baroudi, 1991) and multimethod (Mingers, 2001; Venkatesh, Brown, & Bala, 2013). Others argue that although the previous methods develop, expand, and verify theoretical knowledge by predicting human or organizational behavior, they are not enough because IS research should also generate IT artifacts that build on the knowledge accumulated with behavioral methods (Hevner, March, Park, & Ram, 2004). Design Science addresses this call for IT artifacts and seeks to create designs that extend human capabilities (Gregor & Hevner, 2013; Hevner et al., 2004).

Positivist research focuses on creating deductive studies that formulate propositions, hypotheses or casual relationships among constructs that can be tested using quantifiable measures obtained out of sample(s) representative of a population (W. Chen & Hirschheim, 2004; H. K. Klein & Myers, 1999; Orlikowski & Baroudi, 1991). Positivists believe there is an observable social reality that is independent of the observer and that it requires quantitative measures for a precise analysis of a cause and effect phenomenon that could result in formalized generalizations rather than a verbal description of the researched object (Friedman & Wyatt, 2006; Hevner & Chatterjee, 2010; Niehaves, 2007; Orlikowski & Baroudi, 1991; Remenyi, 1996).

Interpretive research assumes knowledge is not objective. This means that knowledge is created by people's social constructions such as language, shared meaning, documents, tools, and artifacts (Baroudi & Igbaria, 1995; W. Chen & Hirschheim, 2004; H. K. Klein & Myers, 1999; Orlikowski & Baroudi, 1991). Also, interpretive researchers believe that understanding is built by the meaning that people assign to a studied phenomenon (H. K. Klein & Myers, 1999; Orlikowski & Baroudi, 1991). Further, interpretive research method does not necessarily seek generalizations of findings but rather a deep understanding of the studied object which could be the starting point to inform other studied contexts (Orlikowski & Baroudi, 1991).

Critical research conducts social critique exposing constraining structural conditions upon which the society's status quo is sustained (Orlikowski & Baroudi, 1991). Critical research aims to use reason to reflect critically on the reality of the social world to identify changes necessary to alter the constraining structural conditions that sustain the status quo while enabling opportunities for achieving human potential (Alvesson & Willmott, 1992; H. K. Klein & Myers, 1999; Orlikowski & Baroudi, 1991).

Design science research paradigm seeks the creation and evaluation of sociotechnical artifacts such as methods, models, prototypes that expand human and organizational capabilities through the implementation of information systems (Gregor & Hevner, 2013; Hevner et al., 2004). Design science is complementary to positivist and interpretive research methods that propose theories or interpretation of reality, and it creates artifacts used to solve organizational or individual level issues relying on knowledge accumulated by behavioral research (Hevner et al., 2004).

Previous research studying the influence of TMT strategic sensemaking on organizational actions has utilized positivist research as a suitable methodology to understand the strategic sensemaking processes leading to organizational action (e.g. Ginsberg & Venkatraman, 1992; Thomas et al., 1993; Thomas & McDaniel, 1990; White et al., 2003). These studies using strategic sensemaking usually present a case scenario to elicit a situation that is typical of strategic decision making in order to measure with a survey respondents impressions about the strategic scenario (Thomas & McDaniel, 1990). This method assumes that strategic decision making reflects the organization's patterns of behavior that are developed and practiced by organizations (Fredrickson, 1986). It is also assumed that managers are able to easily identify the organization's strategic patterns and when managers come to a decision, these patterns will be palpable across managerial choices made in situations perceived as strategic for the organization (Fredrickson, 1986; Thomas & McDaniel, 1990). Consequently, this study will present respondents with a strategic scenario contextualized for a SAM situation and will use a cross-sectional survey to collect respondents' impressions of the strategic situation.

4.2 Analytical Method

Studies using positivist paradigm, usually test hypothetic-deductive theory and employ quantitative methods such as surveys with cross-sectional empirical data (W. Chen & Hirschheim, 2004). Quantitative methods traditionally use first generation or second generation statistical tools to analyze empirical data (Lowry & Gaskin, 2014). First generation tools include techniques such as ANOVA, t-tests, factor analysis, linear regression, and multiple regression whereas second generation tools include techniques such as structural equation modeling (SEM) (Dijkstra & Henseler, 2015; Fornell & Larcker, 1987; Lowry & Gaskin, 2014; Urbach & Ahlemann, 2010). The contrasting difference between first generation and second generation techniques is that the latter allows researchers to simultaneously test causal associations among multiple independent and dependent variables while first generation techniques follow a piecemeal fashion (Lowry & Gaskin, 2014; Urbach & Ahlemann, 2010). In this study, SEM will be used to simultaneously test the theorized association between independent and dependent variables.

Structural equation modeling (SEM) is a statistical technique widely used in business, social sciences and information systems research to analyze empirical data (Gefen, Straub, & Rigdon, 2011; Henseler, Hubona, & Ray, 2016; Marcoulides & Saunders, 2006; Ringle, Sarstedt, & Straub, 2012). SEM methods allow researchers to incorporate unobserved variables in order to test relationships among latent constructs of proposed research models (Hair, Hult, Ringle, & Sarstedt, 2013; Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014). SEM tools can be classified in two families: covariance-based SEM (CB-SEM) and variance based SEM (VB-SEM) (Dijkstra & Henseler, 2015).

CB-SEM estimates a model's parameters by dividing indicator's variance into common variance among factors and unique indicator variance (unique and error/systematic) (Hair, Sarstedt, Ringle, & Gudergan, 2017). CB-SEM generates a covariance matrix (common variance) to estimate a model's parameters by following a common factor model methodology (Hair, Sarstedt, et al., 2017; Henseler et al., 2016). The objective of CB-SEM is to compare the theoretical covariance matrix suggested by the proposed model and the covariance matrix that results from the empirical data to determine if the model provides a plausible explanation.

VB-SEM includes several techniques, but PLS-SEM can be considered as the most developed technique within this category (Dijkstra & Henseler, 2015). PLS-SEM does not divide the variance into common and unique variance because rather than accounting for the common variance it accounts for the total variance of the indicators (Chin, 1998; Hair, Sarstedt, et al., 2017; Tenenhaus, Vinzi, Chatelin, & Lauro, 2005). PLS-SEM is designed to do this because its primary objective is to account for the variance of the dependent variable. Consequently, PLS-SEM assumes that for the estimation of model parameters and relationships all variances (common, unique, error) from endogenous and exogenous variables need to be included in the estimation. PLS-SEM creates linear combinations of the observed variables (proxies) and then estimates parameters and relationships (Hair, Sarstedt, et al., 2017; Henseler et al., 2016). Critics of PLS-SEM suggest that although this methodology has good predictive and exploratory abilities, it is not suitable for confirmatory studies (Rönkkö & Evermann, 2013). Scholars contending that PLS-SEM is not suitable to confirm theoretical models argue that PLS-SEM does not provide consistent estimates and lacks fit indices to assess how well the model matches the empirical data (Rönkkö & Evermann, 2013).

However, recent articles have suggested the extensive use of PLS-SEM in leading journals in strategic management (Hair, Sarstedt, Pieper, & Ringle, 2012), marketing (Hair, Sarstedt, Ringle, & Mena, 2012) and IS where a greater proportion of studies have utilized this methodology (J.-M. Becker, Rai, & Rigdon, 2013; Ringle et al., 2012; Urbach & Ahlemann, 2010). Also, new methodological research in the PLS-SEM arena has resulted in the development of a consistent PLS algorithm (PLSc), and fit indices such as the geodesic distance (d_G), the squared Euclidean distance (d_ULS), also known as the unweighted least squares distance, and the standardized root mean square residuals (SRMR) (Dijkstra & Henseler, 2015; Hair, Hult, Ringle, & Sarstedt, 2016).

The SRMR measures "the root mean square discrepancy between the observed correlations and model-implied correlations" (Hair et al., 2016, p. 193). The cutoff value for a PLS model with proper fit has an SRMR value of less than 0.08 (Henseler et al., 2016; L. t. Hu & Bentler, 1999). Further, the geodesic distance (d_G), and the squared Euclidean distance (d_ULS) are two different ways to measure the discrepancy between the sample's empirical correlation matrix and the correlation matrix implied by the model (Dijkstra & Henseler, 2015; Henseler, 2017). Software packages such as SmartPLS version 3 or ADANCO use bootstrapping to calculate the 95%-percentile (HI95) or 99%-percentile (HI99) for the d_G and the d_ULS. When d_G or d_ULS are above the upper limit of the calculated percentile it is unlikely that the proposed model is plausible (Henseler, 2017; Henseler et al., 2016).

4.3 Sample Size for CB-SEM and VB-SEM

The final sample size for this study is 187 valid observations. A priori sample size guidelines for CB-SEM diverge. For instance, some rules of thumb suggest having 200 observations (Boomsma, 1982; Tabachnick & Fidell) or at least 150 observations (Hair, Black, Babin, & Anderson, 2010) for CB-SEM to work . Others indicate the need for a ratio of at least 20 observations per measured indicator (Tanaka, 1987), 10 observations per measured indicator (Barclay, Higgins, & Thompson, 1995; Chin & Newsted, 1999; Nunnally, 1967) or even 5 observations to observed indicator (Bentler & Chou, 1987).

Table 4.1 shows the suggestions of the different rules of thumb with regards to the anticipated final model.

Table 4.1
Estimated Sample Size According to Different Rules of Thumb

Rule of thumb from:	(Barclay et al., 1995; Chin & Newsted, 1999; Nunnally, 1967)	(Tanaka, 1987)	(Bentler & Chou, 1987)
Suggested ratio of observations per measured indicator	20:1	10:1	5:1
Estimated sample size, 37 items*	740	370	185

* 36 measured items associated with 7 different constructs + 1 control variable

Although these rules of thumb provide important guidance, they do not agree in a suggested number of observations. Also, these rules of thumb have been tested with Monte Carlo Analysis using different loadings and effect size, and it has been found that they are not the best way to calculate or corroborate what the sample size for a given SEM model should be (Westland, 2010). This finding seems to support Tanaka (1987) insight that sample size calculation should consider not only the number of indicators but also the number of latent variables and estimated parameters.

Building on previous work, Westland (2010) developed an algorithm that determines CB-SEM sample size in terms of the ratio of the number of indicator variables to latent variables and the lower bound correlation between latent variables that should be detected. The algorithm is available at http://www.danielsoper.com/statcalc/calculator.aspx?id=89 (Soper, 2017; Westland, 2012). Entering a priori information for 37 items, 7 latent variables, 0.2 lower bound correlation, 0.8 power, $\alpha = 0.05$, it was determined that 425 observations are required to test the proposed model with CB-SEM. The number of collected observations is 187. Consequently, there would be issues using CB-SEM because the sample size requirements are not met.

In contrast to CB-SEM, PLS-SEM has been suggested to have robust estimation capabilities because its algorithm is based on ordinary least squares (OLS) and that allows for solution convergence even in cases with small sample sizes and complex path models (Hair et al., 2016; Iacobucci, 2010). There are rules of thumb suggesting that an adequate sample size for

PLS-SEM is equal to 10 times the number of paths going into the construct with most arrows pointing in (Barclay et al., 1995).

However, a better practice is to conduct a power analysis accounting for the data characteristics, expected significance, desired power, and minimum effect anticipated to be found (Chin & Newsted, 1999; Hair et al., 2016; Marcoulides & Chin, 2013; Marcoulides, Chin, & Saunders, 2009). Cohen's (1988, 1992) power tables for OLS can be used to calculate PLS sample size given a desired power and effect sizes. Similarly, power calculation software such as G*Power can be employed to estimate the sample size required for OLS given a priori conditions defining minimum effect size, number of independent variables, power and significance level (Faul, Erdfelder, Buchner, & Lang, 2009). Reactive SAM (RSAM) is the construct that needs to be analyzed because it could have up to 7 predictor arrows pointing in. Thus, assuming a lower bound R^2=0.1, power=0.8, α=0.05 and RSAM having seven predictors it was found that Cohen's tables prescribe a sample size of at least 137 observations. The previous conditions were also parametrized into G*Power software, and the calculation suggested 137 observations as well.

Consequently, after analyzing distributional characteristics of the sample[9], available number of observations, exploratory and confirmatory nature of the study it is concluded that PLS-SEM is the tool that can be used to address this study with 187 valid observations.

4.4 Instrument Development Process

As illustrated in Figure 4.1, the instrument development process follows three broad stages: definition, scale development, and instrument testing. Similar strategies have been employed in previous IS studies (Benbasat, Goldstein, & Mead, 1987; Gerow, Thatcher, &

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[9] In the sample descriptive section, it is indicated that the sample is not normally distributed.

Grover, 2015; Hoehle & Venkatesh, 2015) and explained by MacKenzie, Podsakoff, and Podsakoff (2011).

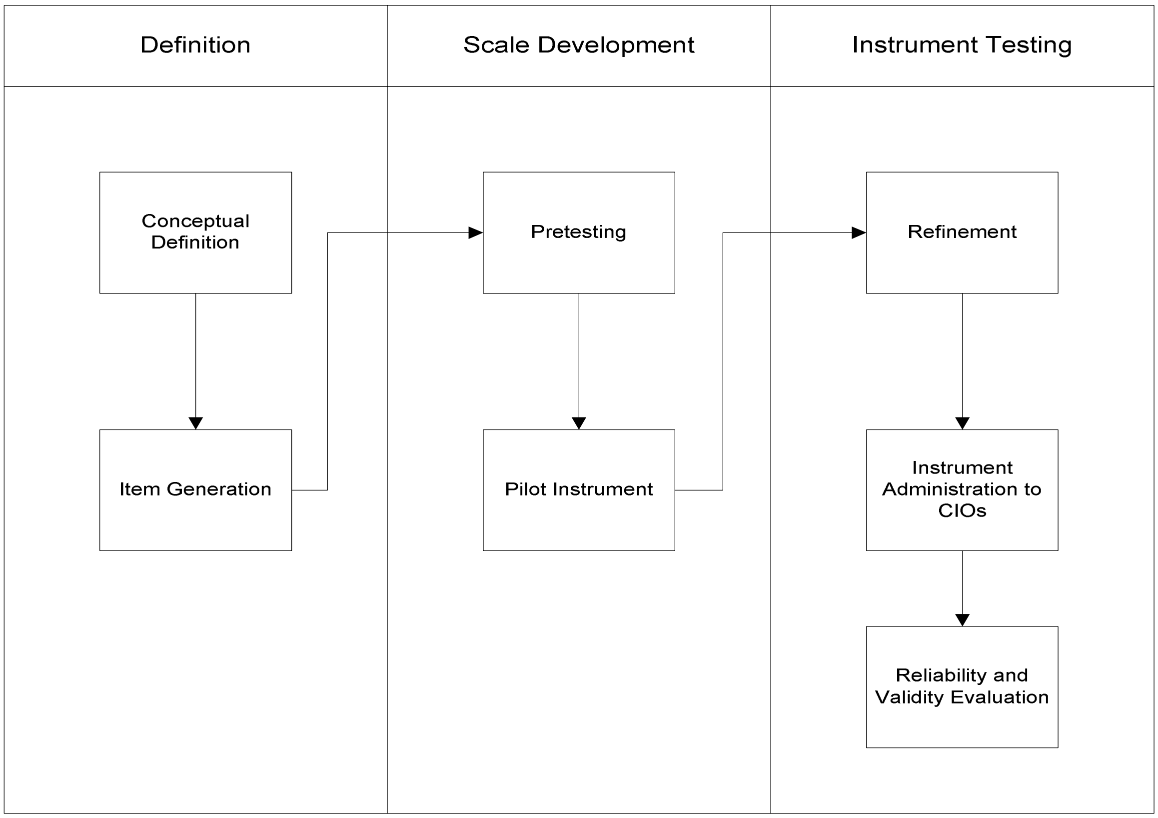

Figure 4.1 Instrument Development Process

The definition stage required the conceptual definition of constructs to be measured and the proposition of instrument items to measure the defined constructs. As presented in chapter 2, a review of the literature framed under the strategic sensemaking theory was conducted. Wherever possible, items for the different constructs were adapted from existing scales (Straub, 1989). If no scales were available, new measures were developed. Table 4.2 presents operational definitions and literature used for the constructs, and information about modified or new measures.

Table 4.2

Constructs and Operational Definitions

Construct	Definition	Adapted from:	Type	Initial Piloted Items	Items after Pilot's CFA	Items tested full survey	Items after CFA	Acronym
Environment								
Coercive	Formal external pressures exerted by intellectual property rights law and software licenses and contracts	(Cavusoglu et al., 2015; DiMaggio & Powell, 1983; Liang et al., 2007)	1st order reflective	4	4	4	4	Inst
Scanning								
CIO-TMT Information Processing Structure (IPS)	Extent to which TMT members have organizational structures that facilitate or impede the use of information specific for the interpretation of IS strategic issues	Adapted for this study. (Duncan, 1973, 1974; Thomas & McDaniel, 1990)	1st order reflective	9	8	9	8	Form, Intr, Part
IS Strategic Orientation	Belief about how IS should position itself and respond to development in its environment	(Miles & Cameron, 1982; Plambeck & Weber, 2010; Thomas & McDaniel, 1990)	1st order reflective	6	4	5	4	Stra
Interpretation								
Positive Gain	Extent to which strategic issues are evaluated as an opportunity for potential gain	(Dutton & Jackson, 1987; Plambeck & Weber, 2010; Thomas et al., 1993)	1st order reflective	10	4	4	4	PoGa
Controllability	Extent to which strategic issues are evaluated as an opportunity for improved controllability	(Dutton & Jackson, 1987; Plambeck & Weber, 2010; Thomas et al., 1993)	1st order reflective	5	4	5	4	Contr
SAM Actions								
Reactive SAM	Extent to which organizations intent to implement basic or ad hoc controls that track software inventory and software usage with licensing entitlement.	Developed for this study and draws from (ISO/IEC, 2012)	1st order reflective	8	4	4	4	RSAM
Proactive SAM	Extent to which organizations implement processes for managing the lifecycle of software assets. Proactive SAM includes organizational management (i.e., planning, policies), operations management (i.e., service level, vendor management, security management), and lifecycle management of software (i.e., acquisition, deployment, incident management, retirement of software)	Developed for this study and draws from (ISO/IEC, 2012)	1st order reflective	20	4	12	8	PSAM
			Total	62	32	43	36	

Although there is no agreement as to whether an exploratory factor analysis is required when CFA is conducted with SEM tools (Gefen & Straub, 2005) exploratory factor analyses were conducted. Tables A.6 and A.7, in the Appendix, presents a principal component analysis of the SAM instrument during the pilot stage and full-scale study, respectively. PCA depicts that SAM has two factors, and like in CFA, SAM has reactive and proactive dimensions.

CIO-TMT information processing structure, IS Strategic Orientation, institutional force (coercive), positive-gain, and controllability are modeled as reflective first order constructs with modified items identified in the review of the literature. Reactive SAM and Proactive SAM are also modeled and tested as first order reflective constructs.

Reactive and Proactive SAM constructs were developed following a literature review and draw on content adapted from ISO 19770-1:2012. Reactive SAM focuses on compliance and has items that refer to inventory processes and verification and compliance (two group processes from the ISO framework). Further, Proactive-SAM focuses on control environment, planning and implementation, operations management, and lifecycle management (three group processes from the ISO framework) and it has items that represent each of the indicated contents.

4.5 Case Scenario

The majority of the studies that have used the strategic sensemaking framework have utilized case-scenarios that are presented to respondents to elicit a strategic situation (e.g. Ginsberg & Venkatraman, 1992; Kuvaas, 2002; Thomas et al., 1993; Thomas & McDaniel, 1990; White et al., 2003). Using a case-scenario is supported by the rationale that strategic analysis is a decision-making activity that reflects organizational patterns of behavior (Fredrickson, 1986; Weick, 1979). These organizational patterns of behavior are the readily available view and perception of executives. Further, the attributes of the organizational decision-making process are consistent across decisions taken by managers in contexts that they perceived as strategic (Fredrickson, 1986). Consequently, the strategic situation presented in a scenario can be used to investigate strategic decision making on strategic issues because it is perceived as strategic and will generate responses consistent with the strategic orientation of the organization (Fredrickson, 1986; Kuvaas, 2002; Thomas et al., 1993; Thomas & McDaniel, 1990).

The case scenario was structured with a balanced strategic situation with 16 information cues that present realistic scenario that CIOs and TMT may face regarding SAM issues (cf. Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas et al., 1991; White et al., 2003). The information cues were developed after reviewing practitioners' and scholars' literature (1E, 2016; Addy, 2007; Barber et al., 2016; Canavan, 2012; CDW, 2013, 2014; Forrester, 2015; Holsing & Yen, 1999; KPMG, 2008b, 2009, 2015; Rudd, 2009). The review of the literature identified situations that CIOs may face when analyzing SAM issues. Each information cue seeks to balance the potential sources of information by having the attributes of being (1) formal/informal, (2) good/bad, (3) and internal/external (see Table A.2). Also, the information cues can only have one attribute from each of the three sets; consequently, eight different types of combinations are possible (e.g., external-formal-good, internal-informal-bad) (Thomas et al., 1993; Thomas & McDaniel, 1990). Each of the eight possible combinations is presented twice in the scenario, resulting in 16 information cues.

Interviews with qualified respondents were conducted to review and verify the validity of the realistic scenario (e.g., CIOs, IT support technicians, IS scholars). Three CIOs, two IT support technicians, and three IS scholars were consulted. The first version of the case scenario was shown to the three IS scholars and two IT support technicians. IT support technicians and CIOs confirmed that the situations appear to be typical of an organizational situation. One of the CIOs suggested adding an initial sentence that could provide context about the SAM situation. Also, IS scholars suggested adjustments to the wording to improve clarity, length, and flow of the information cues.

The original version of the scenario had 426 words. The scenario was modified. An initial statement presents a hypothetical context stating that "After a year of slow growth, the outlook of your organization is positive, and crucial business strategies rely on the execution of IT initiatives. Resources for IT, however, continue to be limited." Also, the scenario wording while maintaining the 16 information cues was written more succinctly. Consequently, the scenario was reduced from 426 words to 344, including the initial statement stating the hypothetical context. The final version of the case-scenario along with the survey questions are available in the Appendix section.

4.6 Instrument Validity and Pretest

The pretesting step is used to validate some or all aspects of the instrument before proceeding into the pilot test (Boudreau, Gefen, & Straub, 2001; Straub, 1989). Pretesting an instrument can use interviews or actual versions of the survey that can be presented to experts for their evaluation (Straub, 1989).

The face validity verification of the survey instrument started with the analysis of items for Reactive and Proactive SAM. The basis of the SAM measures are the six categories of SAM processes described by ISO 19770. These six categories were grouped into Reactive (inventory process and verification and compliance) and Proactive SAM (planning and implementation, control environment, operations management, and lifecycle). The conception of Reactive and Proactive SAM emerged from the analysis of the maturity models, proposed by KPMG, Microsoft and Gartner, that can be used to assess SAM implementation and indications that SAM can be reactive, ad-hoc, and request driven or Proactive with formal management systems focused on planning and implementing a lifecycle management seeking efficiency and optimization of costs on the use of software (e.g., P. Adams, 2003; KPMG, 2008b).

Through a detailed reading of ISO 19770 and similar frameworks such as ITIL SAM and (Holsing & Yen), 8 items were proposed for measuring reactive SAM and 20 items for proactive SAM. These 28 items were reviewed with three CIOs from different industry sectors (Education, Energy, Manufacturing) and three Information Systems PhDs. The revision sought to establish if these items were relevant to the domain of SAM, and to get feedback on the wording of the items.

Subsequently, an item rating activity was conducted with the twenty-eight items to test if the items are evaluated by raters as representative of the domain content of the construct (MacKenzie et al., 2011). An instrument (see Figure 4.2) that showed each of the items and the different SAM processes was presented to two IS PhDs, one management Ph.D., who had experience as IS consultant, and one CIO. Definitions of the SAM processes were provided. Then the respondents independently rated each of the survey items with each of the SAM processes using a score that rates from 1 to 5, with 1 being not at all related to the construct definition and 5 completely related to the provided construct definition. Also, although each statement aims to reflect a SAM process, each SAM process belongs to either Reactive or Proactive SAM category. Thus, items that were rated in a process different to the one originally expected but that matched the expected SAM category were still considered to have the validity to be tested in the pilot instrument.

Three out of four respondents ranked twenty-three items with scores of 5. Two out of four respondents disagreed on the process level of three items but agreed on the main category (Reactive SAM). Two items were classified in two different processes that could be either Reactive or Proactive SAM. These two items were "Top management reviews reports measuring

SAM implementation" (Control Environment / Proactive) and "Generates financial reports about software assets? (i.e., budgeting, financial, taxes, costs)" (Operations Management / Proactive).

After further review and corroboration of the potential reasons for the ambiguity of these items, the wording was modified for the control environment item "Expect top management to review reports measuring SAM implementation progress against plan?" For the operations

Item	Control Environment				Inventory Processes				Verification & Compliance				Planning & Implementation				Operations Management				Lifecycle Processes			
	Rater				Rater				Rater				Rater				Rater				Rater			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1. Executes processes to record all changes impacting software and related assets lifecycle (Lifecycle / Proactive)	4	3	5	1	1	5	1	1	1	3	4	1	1	3	3	1	1	4	3	3	5	5	4	5
2. Top management or equivalent body defines a corporate statement scoping software asset management (Control Environment / Proactive)	5	3	2	5	1	5	2	1	1	3	3	1	1	3	4	1	1	5	5	1	1	3	3	1
3. Regularly verifies compliance with security requirements for software assets (i.e. access controls to master copies, installation/usage rights controls) (Verification & Compliance / Reactive)	3	3	3	3	1	3	3	1	5	5	4	5	1	3	2	1	3	4	3	3	1	1	3	1

Figure 4.2 Item Rating Example
In this example, item 2 has different ratings. Rater 1 and 4 consider it to be a control environment item but raters 2 and 3 consider it to be an operations management item.

management item, after additional review of the literature, it was determined that further testing could be conducted using pilot respondents to establish if the ambiguity with this item would still be an issue with a larger sample of respondents. Consequently, twenty-eight items measuring SAM were used in the pilot test.

Items for CIO-TMT IPS, IS Strategic Orientation, coercive force, positive-gain, and controllability were derived from previous items used in the literature and adapted for the context of this study. Three IS PhDs worked on the validation of the adapted items before the pilot data collection and before the final data collection. For instance, item 22 from the pilot study was originally worded during the validity stage as, "Label the situation as a potential gain" and its wording was changed to "Evaluate the situation as a potential gain." Further, items for participation, interaction, and formalization which tap into the information processing structure were modified to match an IS strategic issue. For example, items that measured coercive force were adapted to measure forces resulting from intellectual property rights and software licenses.

Next, the integrated survey including items and case scenario was pretested for an additional round of feedback with two additional CIOs and three IS Ph.D. One important change that resulted from this round came out of the observation given by one IS Ph.D. suggesting to edit the wording of the survey to ensure that respondents were answering on behalf of the organization and not from a personal level. Consequently, in the survey's instructions section, the following comment was added: "*Please answer the questions of the accompanying survey based on what your organization would do (not you personally).*" Also, the same comment caused an adjustment of the coercive force questions to ensure that respondents were answering from the perspective of the organization. For example, the initial stem for the coercive force was "*On issues as the one presented in the scenario…There are regulations that impose severe penalties for noncompliance with government's regulations on intellectual property*." After the pretest feedback, the stem of the coercive force question was changed to "*For each statement, select the answer that represents your organization… My organization is aware of severe penalties for noncompliance with government's regulations on intellectual property rights*."

Finally, during the pretest stage, the two CIOs that participated were asked to read in detail the complete survey and provide feedback about its content. The CIOs confirmed that the case scenario looked realistic, and it was suggested that questions were clear and no additional changes were advised to the proposed survey.

4.7 Pilot Test

The instrument was pilot tested with empirical data to confirm its validity following suggested guidelines (Boudreau et al., 2001; MacKenzie et al., 2011; Straub, 1989). The pilot instrument was administered using Qualtrics survey tool. Qualtrics is used to deploy online surveys and allows to use respondent panels from market research organizations. The target population for this research is CIOs as they are the most qualified respondents regarding IS strategic issues (Bradley et al., 2012; Carter, Grover, & Thatcher, 2011; Preston, Karahanna, & Rowe, 2006). Getting CIOs or any other TMT member to respond to surveys is a very difficult task (Gerow et al., 2015). Consequently, it was deemed that using a market research organization with a panel of CIOs was suitable for this study as previous IS investigations have used a similar approach (e.g., Angst & Agarwal, 2009; Posey, Lowry, Roberts, & Ellis, 2010; H. Sun, 2012). *Research Now* was selected because a previous IS study that collected CIOs' responses used its CIO panel (Gerow et al., 2015). *Research Now* is an established research firm which at the time of providing their service reported to have 2604 CIOs in their research panel spread across the United States.

The study used the CIOs as the key informant (Preston et al., 2006) because previous studies suggest that this class of IS professionals is the highest level IS/IT executive likely to play a fundamental role in IS strategic decisions (cf. Armstrong & Sambamurthy, 1999; Bradley et al., 2012; Grover, Jeong, Kettinger, & Lee, 1993; Preston & Karahanna, 2009).

4.8 Pilot Sample Description

Before performing statistical analysis, the data was reviewed to understand its characteristics. CIOs participating in this pilot were screened by *ResearchNow* by analyzing the reported demographics of their CIO panel to ensure that they were 18 years or older, part of an organization with 50 or more employees, and holders of the CIO or equivalent position in an organization. CIOs that did not match the selected criteria were not considered by ResearchNow as suitable to be invited to complete the survey. Following previous studies that used case scenarios, the survey instrument requested respondents to answer on behalf of the organizations and not from a personal perspective (e.g., Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas et al., 1991).

Data collection started on November 16, 2016, and stopped on November 23, 2016. ResearchNow sent five hundred and thirty-seven randomly generated invites to CIOs from their research panel. Two respondents declined to participate, and two provided incomplete answers, which are not included in the analysis. Fifty-seven complete observations were collected. A response rate of 10.6 percent was achieved. Methodological research investigating response rates indicate that existing guidelines on response rates are contradictory and not necessarily supported by data (Baruch & Holtom, 2008; Cycyota & Harrison, 2006). Also, methodological research on response rate indicates that response rates from top executives are lower than individual level studies at organizations and the reported mean for management studies ranges from 32% to 35% (Baruch & Holtom, 2008; Cycyota & Harrison, 2006). In the IS domain, previous research using the CIO as respondent has achieved response rates from 7 to 20% (Gerow et al., 2015; W. Oh & Pinsonneault, 2007; Preston et al., 2006).

The data describing the sample demographics include respondent's gender, age, tenure, and education level. The survey instrument also included demographic information about the organization such as industry sector, size by number of employees, size by revenue, and organization's home state.

The average age of respondents was 45.22 years with a standard deviation of 8.98. Forty-three respondents were male, 12 females and 2 did not answer the gender question. Respondents' average years at the current organization is 11.68 years with a standard deviation of 6.97. The education level was mostly bachelor and graduate level both accounting for 91.26% of the respondents (see Table 4.3).

Table 4.3
Respondent's Education Level

#	Education Level	Count	%
1	Bachelor	27	47.37%
2	Graduate	25	43.86%
3	Associate	4	7.02%
4	High School	1	1.75%
	Total	57	100%

Respondents were asked to indicate their organization's home state. Answers from organizations located in 21 different states of the US were collected. California is the home state with the most respondents and accounts for 21.5% of completed surveys (see Table 4.4).

Table 4.4
Organizations' Home State

#	State	Count	%
1	California	12	21.05%
2	New York	5	8.77%
3	Massachusetts	4	7.02%
4	Michigan	4	7.02%
5	New Jersey	4	7.02%
6	Florida	3	5.26%
7	Illinois	3	5.26%
8	Pennsylvania	3	5.26%
9	Connecticut	2	3.51%
10	Delaware	2	3.51%
11	Maryland	2	3.51%
12	Minnesota	2	3.51%
13	Ohio	2	3.51%
14	Virginia	2	3.51%
15	Colorado	1	1.75%
16	Hawaii	1	1.75%
17	Idaho	1	1.75%
18	Kentucky	1	1.75%
19	Missouri	1	1.75%
20	South Carolina	1	1.75%
21	Washington	1	1.75%
	Total	57	100%

The survey instrument also included information to measure organizational size by number of employees (see Table 4.5). Organizations with 500 to 1000, 1000 to 2500, and 100 to 500 employees account for 26.32%, 22.81% and 21.05%, respectively (see Table 4.5).

Table 4.5
Organization Size by Number of Employees

#	No. of Employees	Count	%
1	500 to 1000	15	26.32%
2	1000 to 2500	13	22.81%
3	100 to 500	12	21.05%
4	50 to 100	8	14.04%
5	5000 to 10000	4	7.02%
6	10000 or more	4	7.02%
7	2500 to 5000	1	1.75%
	Total	57	100%

Organizations from the manufacturing sector contributed the most responses, with 28.07% (see Table 4.6).

Table 4.6
Industry Sector of Surveyed Organizations

#	Industry Sector	Count	%
1	Manufacturing	16	28.07%
2	Information Technology	8	14.04%
3	Consulting Services	7	12.28%
4	Banking/Finance/Insurance	6	10.53%
5	Retail/Wholesale/Distribution	4	7.02%
6	Education	3	5.26%
7	Healthcare	3	5.26%
8	Government	2	3.51%
9	Bio-Technology, Pharmacology	2	3.51%
10	Other	2	3.51%
11	Food/Beverages/Consumer Packaged Goods	1	1.75%
12	Hospitality	1	1.75%
13	Media/Entertainment/Publishing	1	1.75%
14	Telecommunications	1	1.75%
	Total	57	100%

Descriptive statistics for the items are provided in Table 4.7. Items were scored using a Likert scale (1-7). Standard deviations range from 1.82 (Intr02) to 1.18 (ReAc01). All items are negatively skewed. Values for skewness range from -0.35 (Form03) to -1.55 (Inst01). The negative skewness reveals that all answers are concentrated on the right side of the measurement scale (scores from 4 to 7).

Kurtosis ranges from -0.45 (Intr02) to 3.408 (ReAc02). Twenty of the measured items have kurtosis with absolute value of less than 1; nine have kurtosis absolute values between

Table 4.7

Descriptive Statistics for Pilot

Item	Mean	Std. Deviation	Skewness	Kurtosis
Contr01	4.82	1.50	-0.48	-0.09
Contr02	5.46	1.48	-1.22	1.52
Contr03	5.39	1.62	-1.33	1.56
Form01	5.19	1.32	-0.47	0.35
Form02	5.04	1.44	-0.47	0.03
Form03	5.32	1.26	-0.35	-0.45
Inst01	5.88	1.30	-1.55	3.14
Inst02	5.33	1.29	-1.08	1.61
Inst03	5.33	1.58	-1.27	1.44
Inst04	5.02	1.61	-1.07	0.76
Intr01	5.00	1.45	-0.83	1.07
Intr02	4.75	1.82	-0.70	-0.45
Part01	4.81	1.73	-0.83	0.03
Part02	5.18	1.44	-0.62	-0.30
Part03	5.81	1.42	-1.20	0.80
PoGa03	5.40	1.47	-0.95	0.82
PoGa05	5.33	1.50	-0.73	-0.05
PoGa06	5.11	1.44	-0.79	0.85
PoGa10	4.98	1.63	-0.71	-0.12
PrAc01	4.75	1.56	-0.62	0.24
PrAc02	4.75	1.56	-0.80	0.28
PrAc03	5.00	1.40	-0.61	0.06
PrAc04	5.26	1.46	-1.16	1.38
ReAc01	5.88	1.18	-0.97	0.56
ReAc02	5.70	1.41	-1.49	3.41
ReAc03	5.39	1.49	-1.31	2.11
ReAc04	4.79	1.50	-0.88	0.95
Stra01	5.51	1.32	-1.02	1.50
Stra02	5.35	1.23	-1.01	1.94
Stra03	4.77	1.69	-0.73	-0.10
Stra04	4.79	1.74	-0.87	-0.04

Controllability (Contr), Formalization (Form), Institutional (Inst), Interaction (Intr), Participation (Part), Positive-Gain (PoGa), Proactive(PrAc), Reactive (ReAc), and Strategy (Stra)

1 and 2.108, and only two items have kurtosis with absolute values greater than 3. From the analysis, it is inferred that survey items meet Kline (2005) guidelines of kurtosis values of less than |10| and skewness of less than |3|. Consequently, non-normality is not an issue for applying structural equation modeling Kline (2005).

4.9 Full Data Collection

For the full data collection, one hundred eighty-seven complete observations were collected. Previous power calculations presented in section 4.3 determined that a sample size of at least 137 observations is adequate to analyze the proposed model. Consequently, since the full data collection has 187 complete observations, it can be supported that the number of observations meet and pass the threshold required for a power of at least 80%.

4.9.1 Missing Values

The PLS-SEM analysis is using 36 items and 187 observations meaning that 6732 scores are the maximum that can be collected. Out of the potential 6732 scores, 19 are missing, and they are associated with 15 items.

Missing data could have negative effects such as reducing the sample size or biasing the statistical analysis (Hair et al., 2010; Tabachnick & Fidell, 2001). Methodological research suggests determining the extent and pattern of missing data to decide what action(s) can be taken to address it (Hair et al., 2010; Hair et al., 2016; Tabachnick & Fidell). In the full data set, nineteen observations had one missing value (2.78% / observation). These nineteen missing values were spread across fifteen survey items. Twelve survey items had one missing value (0.23%), two survey items had two missing values (1.07%), and one survey item had three missing values (1.60%). Overall, the percentage of missing values was 0.28 percent (19 missing values out 6732). While analyzing Table A.5, it was noticed that no consistent pattern exists on the missing values. Further, cut-off values that suggest eliminating a given observation indicate that observations with more than 5 percent of missing value should be eliminated and that data sets with more than 15 percent of missing values have significant issues (Hair et al., 2010; Hair et al., 2016; Tabachnick & Fidell). However, as described above, this is not the case for the full data collection. Consequently, scholars that investigate multivariate statistics suggest that mean imputation is an acceptable technique to account for the missing values and that given the small extent of missing value in the analyzed data set it is posited that no significant bias is added to the statistical analysis (Hair et al., 2010; Hair et al., 2016; Tabachnick & Fidell).

4.9.2 Sample Descriptive Statistics

Descriptive statistics, normality tests, and analysis of the sample demographics were conducted. Table 4.8 shows the descriptive statistics. Standard deviation ranges from 0.922 (RSAM01) to 1.625 (Stra01). All items are negatively skewed, and that means that majority of answers were selected from 4 to 7 in the used likert[10] scale measures. The minimum absolute value for skewness value is 0.353 (PSAM07), and the maximum is 1.298 (Inst01). Further, the minimum absolute value for kurtosis is 0.011 (Stra04), and the maximum is 1.789 (Inst01).

Table 4.8
Descriptive Statistics for Full Data Collection

No.	Item	Mean	Standard Deviation	Kurtosis	|Kurtosis|	Skewness	|Skewness|
1	Stra01	5.150	1.625	-0.168	0.168	-0.749	0.749
2	Stra02	5.198	1.406	0.013	0.013	-0.717	0.717
3	Stra04	5.096	1.548	-0.011	**0.011**	-0.790	0.790
4	Stra05	5.246	1.556	0.206	0.206	-0.811	0.811
5	Part01	5.551	1.259	0.952	0.952	-0.902	0.902
6	Part02	5.428	1.197	0.624	0.624	-0.819	0.819
7	Part03	5.519	1.247	0.208	0.208	-0.727	0.727
8	Inter01	5.481	1.238	-0.030	0.030	-0.587	0.587
9	Inter02	5.567	1.174	0.044	0.044	-0.701	0.701
10	Inter03	5.540	1.162	0.969	0.969	-0.871	0.871
11	Form01	5.332	1.274	-0.110	0.110	-0.643	0.643
12	Form03	5.332	1.417	0.205	0.205	-0.751	0.751
13	Inst01	6.011	1.156	1.789	**1.789**	-1.298	**1.298**
14	Inst02	5.840	1.088	1.575	1.575	-1.084	1.084
15	Inst03	5.936	1.107	1.205	1.205	-1.064	1.064
16	Inst04	5.909	1.117	1.274	1.274	-1.071	1.071
17	PoGa01	5.214	1.178	0.173	0.173	-0.542	0.542
18	PoGa02	5.198	1.118	0.246	0.246	-0.560	0.560
19	PoGa03	5.316	1.175	0.167	0.167	-0.476	0.476
20	PoGa04	5.332	1.191	0.032	0.032	-0.436	0.436
21	Contr02	5.326	1.116	-0.087	0.087	-0.510	0.510
22	Contr03	5.455	1.086	-0.235	0.235	-0.476	0.476
23	Contr04	5.513	1.031	0.413	0.413	-0.745	0.745
24	Contr05	5.588	1.078	0.288	0.288	-0.644	0.644
25	RSAM01	5.406	0.922	0.412	0.412	-0.443	0.443
26	RSAM02	5.663	0.991	0.732	0.732	-0.742	0.742
27	RSAM03	5.679	1.031	0.074	0.074	-0.563	0.563
28	RSAM04	5.738	0.998	0.445	0.445	-0.658	0.658
29	PSAM01	5.374	1.174	0.521	0.521	-0.684	0.684
30	PSAM02	5.374	1.156	0.883	0.883	-0.790	0.790
31	PSAM03	5.390	1.120	-0.311	0.311	-0.402	0.402
32	PSAM04	5.497	1.072	-0.356	0.356	-0.440	0.440
33	PSAM05 (CEnv01)	5.465	1.220	-0.293	0.293	-0.613	0.613
34	PSAM07 (P_Imp03)	5.422	1.069	-0.560	0.560	-0.353	**0.353**
35	PSAM08 (LCy07)	5.401	1.047	-0.084	0.084	-0.468	0.468
36	PSAM09 (OMgt01)	5.369	0.958	-0.279	0.279	-0.394	0.394
n=187							

[10] Items were measured with likert scales from 1 to 7

Methodological research suggests that SEM tools are more susceptible to kurtosis as it has a direct influence over variances and covariances (Byrne, 2010). Guidelines to assess non-normality in the data suggest that skewness greater than 2 (West, Finch, & Curran, 1995) or 3 (Kline, 2005) and kurtosis greater than 7 (West et al., 1995) or 10 (Kline, 2005) are evidence of non-normality issues. The calculations of kurtosis shown in Table 4.8 and the summary presented in the previous paragraph suggest that non-normality is not an issue of the full data set.

4.9.3 Sample Demographics

Table 4.9 shows the organizations' home state for the sample. A question from the demographics sections allowed respondents from 37 states to select the organization's home state. Two respondents did not specify the organization's home state. California with 21.39%, New York with 13.90% and Florida with 7.49% are the top 3 home states for organizations which have CIOs completing this survey.

Table 4.9
Organizations' Home State Full Data Collection

#	State	Count	%
1	California	40	21.39%
2	New York	26	13.90%
3	Florida	14	7.49%
4	Texas	8	4.28%
5	New Jersey	7	3.74%
6	Illinois	6	3.21%
7	Massachusetts	6	3.21%
8	Ohio	6	3.21%
9	Pennsylvania	6	3.21%
10	Virginia	6	3.21%
11	Missouri	5	2.67%
12	North Carolina	5	2.67%
13	Washington	5	2.67%
14	Kentucky	4	2.14%
15	Oregon	4	2.14%
16	Colorado	3	1.60%
17	Maryland	3	1.60%
18	Michigan	3	1.60%
19	Nevada	3	1.60%
20	Connecticut	2	1.07%
21	Delaware	2	1.07%

Table 4.9
Organizations' Home State Full Data Collection

#	State	Count	%
22	District of Columbia	2	1.07%
23	Indiana	2	1.07%
24	Minnesota	2	1.07%
25	Tennessee	2	1.07%
26	Wisconsin	2	1.07%
27	Alabama	1	0.53%
28	Arkansas	1	0.53%
29	Georgia	1	0.53%
30	Hawaii	1	0.53%
31	Iowa	1	0.53%
32	Kansas	1	0.53%
33	Mississippi	1	0.53%
34	Nebraska	1	0.53%
35	New Hampshire	1	0.53%
36	South Carolina	1	0.53%
37	Utah	1	0.53%
38	Missing Values	2	1.07%
	Total	187	100.00%

Demographic data to capture the size of the organization in terms of number of employees was collected. Previous work studying TMTs and CIOs within an IS strategic context controlled for variables such as number of employees (size), and industry sector (e.g., Preston & Karahanna, 2009; Preston et al., 2006). Table 4.10 shows that most of the CIOs are part of organizations with 1000 to 2500 employees (22.46%), followed by organizations with 500 to 100 employees and organizations with 10000 employees or more. Further, the combined percent of small organizations, that is organizations with 50 to 100 and 100 to 500 employees, amount 17.64%.

Table 4.10
Organization Size by Number of Employees

Number of Employees	Count	%
50 to 100	3	1.60%
100 to 500	30	16.04%
500 to 1000	38	20.32%
1000 to 2500	42	22.46%
2500 to 5000	13	6.95%
5000 to 10000	24	12.83%
10000 or more	37	19.79%
Total	187	100.00%

Table 4.11
Organizations Industry Sector

#	Industry Sector	Count	%
1	Manufacturing	37	19.79%
2	Information Technology	33	17.65%
3	Banking/Finance/Insurance	22	11.76%
4	Education	15	8.02%
5	Healthcare	14	7.49%
6	Retail / Wholesale / Distribution	12	6.42%
7	Other	11	5.88%
8	Consulting	9	4.81%
9	Government	8	4.28%
10	Food/Beverage/Consumer Packaged Goods	5	2.67%
11	Medical / Bio-Technology / Pharmacology	5	2.67%
12	Hospitality	4	2.14%
13	Non-Profit	4	2.14%
14	Telecommunications	3	1.60%
15	Media / Entertainment / Publishing	2	1.07%
16	Real Estate	1	0.53%
17	Missing Values	2	1.07%
	Total	187	100.00%

Data from 16 industry sectors were collected (Table 4.11). Manufacturing with 19.79%, Information Technology with 17.65% and Banking/Finance/Insurance with 11.76% account for the top three industry sector sources. Two respondents (1.07%) did not declare their industry sector.

As managing software assets should fall under the attention of the organization's IT governance (Rudd, 2009; Wilkin & Chenhall, 2010), questions that captured the perceived IT governance structure was asked. These questions were modeled after the IT governance categories proposed by (Weill & Ross, 2005). Business monarchy is where senior executives make IT governance decisions. In IT Monarchy, an individual or groups of IT executives make IT governance decisions. Federal is the IT governance setting where senior executives and business executives make IT governance decisions. IT duopoly takes place when IT executives and business unit executives make IT governance decisions. In the Feudal setting business unit leaders take IT governance decisions, and in the Anarchy configuration, there is no clear pattern about who makes IT governance decisions.

Table 4.12
IT Governance Setting

IT Governance Type	Count	%
Business Monarchy	84	44.92%
IT Monarchy	43	22.99%
Federal	7	3.74%
IT Duopoly	42	22.46%
Feudal	10	5.35%
Anarchy	1	0.53%
Total	187	100.00%

Table 4.12 shows that Business Monarchy (44.92%), IT Monarchy (22.99%), and IT duopoly (22.46%) account for the majority of the organizational IT Governance configuration in the surveyed organizations (90.37%).

Moreover, there is a growing trend towards consuming software as a service provided (SaaS) by third parties (Goutas, Sutanto, & Aldarbesti, 2015) which require organizations to analyze software assets deployment strategy (Schaffer, 2014). Consequently, a survey question asked CIOs' their perception about the percentage of software used by their organization under SaaS. Table 4.13 shows that the reported average of SaaS is 36.642% with a median of 38% and standard deviation of 22.927.

Table 4.13
Degree of SaaS Adoption

Measure	Mean	Median	Standard Deviation	Skewness	Kurtosis
SaaS Percentage	36.642	38	22.927	0.259	-0.269
n = 187					

Structural power of the CIO has been identified as an important variable to understand their influence in processes associated with IT strategic decisions (Karahanna & Preston, 2013; Preston, Chen, & Leidner, 2008). Thus, information about the structural power was collected using two different questions: one question captured whether a CIO is a formal TMT member (Table 4.14) and the other question tapped into establishing how many reporting levels exist between the CIO and CEO of the organization (Table 4.15) as performed in previous studies (Karahanna & Preston, 2013; Preston et al., 2008).

Table 4.14
CIO's Formal Position Within TMT

CIO Formal Member of TMT?	Count	%
Yes	177	94.65%
No	10	5.35%
Total	187	100.00%

Table 4.15
CIO Report Level

CIO Report Level	Count	%
Direct Report	110	58.82%
One Level	66	35.30%
Two or more Levels	11	5.88%
Total	187	100.00%

Finally, the study also checked to establish if respondents considered that the presented case scenario is considered by them as an IS strategic issue. Respondents were presented with the definition of strategic issues stating that they are "situations that could alter the position of the organization, affect the whole organization, or impact the purposes or goals of the organization." A 7-level Likert scale ranging from 1 (not at all) to 7 (very great extent) was used to assess the perception as to whether the situation presented in the case scenario was strategic for the organizations' IS. One hundred sixty-two respondents answered with values of 5 or more. Table 4.16 presents the details.

Table 4.16
Control About Perception as To Whether Case Scenario Is an IS Strategic Issue
"To what extent would your organization consider the situation described in the scenario to be … Strategic for Organization's Information Systems (IS)?"

Likert Options	Not at all	Very Small Extent	Small Extent	Moderate Extent	Fairly Great Extent	Great Extent	Very Great Extent
Likert Scores	1	2	3	4	5	6	7
Count	1	3	3	18	54	77	31

Descriptive statistics for this question
n=187, mean = 5.55, standard deviation=1.08

CHAPTER V

DATA ANALYSIS

This chapter presents the data analysis and results of the pilot test and full study. It starts with the data analysis of the pilot test. Next, it follows with the analysis of the full study.

5.1 Pilot Data Analysis

The pilot data analysis is an important stage of the instrument development because it is the opportunity to test the research instrument before the project reaches the point where the final survey is administered (Boudreau et al., 2001). Conducting the pilot stage allows researchers to examine the survey properties, check the convergent and discriminant validity (MacKenzie et al., 2011), verify the factorial validity of the model (Gefen & Straub, 2005), and identify improvement to the final instrument.

The pilot study uses SmartPLS 3 to analyze the 57 observations (Ringle, Wende, & Becker, 2015). In chapter IV the data characteristics were tested, and although non-normal, it meets the kurtosis and skewness cut off points that are deemed acceptable to conduct SEM analysis (Kline, 2005; West, Finch, & Curran, 1995). Further, the nonparametric assumptions of PLS improve the likelihood to perform better with non-normal data in smaller sample sizes (i.e., n=57) than covariance-based SEM (Goodhue, Lewis, & Thompson, 2012; Hair et al., 2016).

5.1.1 Pilot's Measurement Validation

Measurement validation and refinement of the proposed model (Chapter III) was based on a confirmatory factor analysis (CFA[11]). With the emergence of SEM tools, researchers use CFA to test measures of a structural model derived from theory (Hair et al., 2016). Measures used in a CFA usually follow established construct measurements or modified or developed measures, based on a review of the literature (Gefen & Straub, 2005; Hair et al., 2016).

PLS analysis follows a two-step process (Chin, 1998). First, the researcher must assess a predefined outer (measurement) model to test the reliability of measures, the convergent and discriminant validities of reflective constructs. In the case of the reflective measurement models, researchers start with the internal consistency check using Cronbach alpha (Cronbach's α), and the composite reliability (ρ_c) (Chin, 2010; Hair et al., 2016). Next convergent validity is assessed verifying the size of the indicator loading (loading > 0.70), and the average variance extracted by the construct (AVE) (AVE > 0.50). This is followed by the discriminant validity verifications where cross loadings tables (load > 0.70 into own construct & at least 0.10 less from any other construct), Fornell-Larcker criterion (square root of AVE > than correlations among constructs), and the heterotrait-monotrait method (HTMT) (HTMT < 0.85 between constructs) are used to determine discriminant validity (Chin, 2010; Hair et al., 2016). These verifications may require several iterations[12] where items that belong to reflective constructs that do not show acceptable internal consistency, convergent validity, or discriminant validity could be dropped to improve the model fit.

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[11] Tables A.3 and A.6 (Appendix) contain the items and details on the exploratory factor analysis, respectively.
[12] The validation of the measurement model required several iterations that resulted on some of the reflective constructs being dropped. Table 4.2 provides more details.

The second step involves the assessment of the inner model (structural model) that is conducted to check effect sizes and variance explanation (Chin, 1998; Fornell & Larcker, 1981; Henseler, Ringle, & Sinkovics, 2009; Peace, Galletta, & Thong, 2003).

Constructs for this study are reflective[13]. These types of constructs reflect a latent variable that should be homogeneous and unidimensional because the assumption is that the reflective items measure the same underlying concept (Vinzi, Trinchera, & Amato, 2010). On the pilot, reliability was tested with Cronbach's α and composite reliability ρ_c (Gefen, Straub, & Boudreau, 2000; Hair et al., 2010; Hair et al., 2016). Of the previous two measures, composite reliability is argued to be the better reliability measure (Hair et al., 2013; Vinzi et al., 2010). It has been indicated that Cronbach's alpha underestimates the reliability of PLS latent variables (Hair et al., 2016). In contrast, composite reliability compensates for the different loading of indicators, and its numerical value has similar interpretation to Cronbach alpha's (Henseler et al., 2009; Werts, Linn, & Jöreskog, 1974). Reliability statistics above 0.7 measure adequate internal consistency (Gefen et al., 2000; Hair et al., 2010; Hair et al., 2016; Nunnally & Bernstein, 1994). As shown in Table 5.1, all latent constructs meet the 0.7 thresholds of the Cronbach alpha and composite reliability.

Table 5.1
Pilot: Reliabilities and AVE

Construct	Cronbach's α	ρ_c	AVE	Square Root of AVE
CIO-TMT IPS	0.94	0.95	0.69	0.83
Controllability	0.76	0.87	0.68	0.83
Coercive	0.87	0.91	0.71	0.84
Positive	0.92	0.94	0.80	0.90
Proactive SAM	0.93	0.95	0.83	0.91
Reactive SAM	0.90	0.93	0.78	0.88
Strategic Orientation	0.93	0.95	0.83	0.91

CIO-TMT IPS: CIO-TMT Information Processing Structure

[13] Reactive SAM and Proactive SAM were developed for this study. Pilot and full study confirmed the reflective nature of this construct through convergent and discriminant validity statistical tests.

Convergent validity is tested using the average variance extracted statistic (AVE) and the composite reliability (Peace et al., 2003). Convergent validity tests that a set of indicators load onto one common construct (unidimensionality) (Gefen et al., 2000; Hair et al., 2010; Hair et al., 2016; Henseler et al., 2009). AVE is an appropriate measure to test convergent validity (Fornell & Larcker, 1981). Usually, an AVE statistic greater than 0.50 shows sufficient convergent validity because the latent construct explains more than 50% of the variance of its indicators, and the variance shared between the construct and indicators is larger than the measurement error variance (Hair et al., 2016; Henseler et al., 2009). Results in Table 5.1 reveal that AVE values range from 0.69 (CIO-TMT IPS) to 0.83 (Proactive SAM). Composite reliabilities are greater than 0.7 (Table 5.1). Consequently, the constructs meet the AVE and composite reliability thresholds for convergent validity.

Discriminant validity is a complementary concept to convergent validity (Henseler et al., 2009). Discriminant validity seeks to establish that constructs exhibit sufficient difference among or between them (Henseler et al., 2009; Peace et al., 2003). PLS-SEM usually employs the Fornell-Larcker criterion and construct cross-loadings to test discriminant validity (Hair et al., 2016; Henseler et al., 2009; Peace et al., 2003). The Fornell-Larcker criterion checks that latent

Table 5.2
Pilot: Correlations Among Constructs and AVE's SQRT

Construct	CIO-TMT IPS	Coercive	Controllability	Positive	Proactive SAM	Reactive SAM	Strategic Orientation
CIO-TMT IPS	**0.829**						
Coercive	0.539	**0.841**					
Controllability	0.530	0.315	**0.827**				
Positive	0.617	0.076	0.657	**0.896**			
Proactive SAM	0.609	0.272	0.649	0.723	**0.908**		
Reactive SAM	0.495	0.418	0.636	0.586	0.745	**0.881**	
Strategic. Orientation	0.668	0.372	0.562	0.584	0.556	0.465	**0.913**

Bold numbers are the square root (SQRT) of AVE. SQRT of AVE > correlation among constructs / meets discriminant validity

constructs share more variance with their assigned indicators than with other latent constructs (Chin, 1998; Fornell & Larcker, 1981; Hair et al., 2016; Henseler et al., 2009). To assess the

Fornell-Larcker criterion, the square root (SQRT) of the AVE is compared with the correlations between or among latent constructs. Thus, AVE's SQRT for each latent construct should be larger than the correlations between them. Table 5.2 shows that AVE's SQRT of each construct is greater than the correlation between them. Consequently, latent constructs have discriminant validity.

Table 5.3
Pilot: Loadings and Cross Loadings

Item	IS Strategic Orientation	CIO-TMT IPS	Coercive	Positive	Controllability	Proactive SAM	Reactive SAM
Stra01	**0.91**	0.60	0.37	0.60	0.54	0.56	0.44
Stra02	**0.92**	0.66	0.26	0.63	0.61	0.58	0.45
Stra03	**0.91**	0.54	0.34	0.40	0.41	0.44	0.39
Stra04	**0.90**	0.61	0.42	0.43	0.41	0.39	0.40
Form01	0.57	**0.89**	0.37	0.61	0.44	0.65	0.43
Form02	0.63	**0.87**	0.35	0.57	0.53	0.66	0.45
Form03	0.63	**0.78**	0.25	0.65	0.44	0.68	0.53
Part01	0.58	**0.89**	0.51	0.54	0.50	0.52	0.40
Part02	0.53	**0.89**	0.50	0.52	0.44	0.44	0.36
Part03	0.49	**0.74**	0.63	0.34	0.44	0.25	0.36
Intr01	0.51	**0.70**	0.65	0.24	0.24	0.22	0.35
Intr02	0.46	**0.84**	0.55	0.47	0.43	0.41	0.36
Inst01	0.35	0.45	**0.89**	0.08	0.35	0.28	0.46
Inst02	0.12	0.32	**0.69**	-0.07	0.10	0.04	0.14
Inst03	0.30	0.42	**0.86**	0.04	0.29	0.20	0.33
Inst04	0.39	0.58	**0.90**	0.13	0.25	0.29	0.35
PoGa03	0.58	0.60	0.12	**0.91**	0.62	0.68	0.57
PoGa05	0.51	0.59	0.18	**0.91**	0.60	0.62	0.56
PoGa06	0.50	0.51	0.01	**0.87**	0.60	0.60	0.49
PoGa10	0.50	0.52	-0.04	**0.90**	0.52	0.69	0.48
Contr01	0.52	0.37	0.07	0.62	**0.67**	0.47	0.35
Contr02	0.48	0.50	0.34	0.59	**0.90**	0.61	**0.71**
Contr03	0.39	0.44	0.36	0.41	**0.89**	0.53	0.49
PrAc01	0.52	0.55	0.22	0.64	0.57	**0.91**	0.68
PrAc02	0.50	0.59	0.27	**0.72**	0.65	**0.92**	0.70
PrAc03	0.45	0.49	0.20	0.62	0.51	**0.88**	0.65
PrAc04	0.55	0.59	0.30	0.65	0.62	**0.91**	0.68
ReAc01	0.46	0.36	0.26	0.53	0.58	0.62	**0.84**
ReAc02	0.41	0.46	0.30	0.56	0.61	**0.71**	**0.91**
ReAc03	0.40	0.42	0.44	0.46	0.55	0.62	**0.88**
ReAc04	0.38	0.50	0.47	0.51	0.54	0.67	**0.90**

All but one loading above equal or above .70 (Control 01 = 0.67)
Three items in bold letters have high loading with other constructs. However, the items load more into their intended construct, and the difference in loading is of at least an order of magnitude meeting Gefen and Straub 2005, guideline of a difference of least one order of magnitude.

At the item level, discriminant validity can be established using the cross-loading statistic (Chin, 1998; Gefen & Straub, 2005). This test seeks to establish if an indicator has a higher correlation with its theoretically assigned latent construct than with any other latent constructs in the model (Gefen & Straub, 2005; Henseler et al., 2009). Typically, if the preceding condition is met, discriminant validity at the item level can be claimed. For PLS studies, it is suggested that loading of discriminant items should be at least 0.10 units larger than any other loading (Gefen & Straub, 2005). Table 5.3 shows that Gefen and Straub's (2005) suggestion is met for items' discriminant validity.

The heterotrait monotrait (HTMT ratio is another way to assess the discriminant validity of latent constructs. HTMT is the "ratio of the between-trait correlations to the within-trait correlations" (Hair et al., 2016, p. 118) and it is recommended as the better way to estimate discriminant validity in PLS (Henseler, Ringle, & Sarstedt, 2015). Applying HTMT criterion to assess discriminant validity suggests that HTMT values below 0.85 indicate discriminant validity between constructs (Henseler et al., 2015).

Table 5.4
Pilot: Heterotrait-Monotrait Ratio

Construct	CIO-TMT IPS	Controllability	Coercive F.	Positive	Proactive SAM	Reactive SAM
CIO-TMT IPS						
Controllability	0.61					
Coercive Force	0.63	0.38				
Positive-Gain	0.64	0.79	0.12			
Proactive SAM	0.62	0.77	0.27	0.78		
Reactive SAM	0.53	0.76	0.43	0.64	0.81	
Str Orientation	0.71	0.65	0.39	0.61	0.58	0.50

Results from Table 5.4 indicate that the largest HTMT ratio is 0.81 and between reactive and proactive SAM. That ratio is below the threshold of 0.85. Consequently, according to HTMT guidelines, there is discriminant validity among constructs of the Pilot model.

5.1.2 Pilot's Structural Model

After validating the acceptable properties in the measurement model, the next step is to examine the structural model (Chin, 1998; Henseler et al., 2009). When using PLS, the predictive power of the structural model is evaluated by the R^2 coefficients of endogenous variables (Barclay et al., 1995; Chin, 1998; Peace et al., 2003). Chin (1998) asserts that R^2 values of 0.67, 0.33, and 0.19 can be considered as substantial, moderate, and weak, respectively.

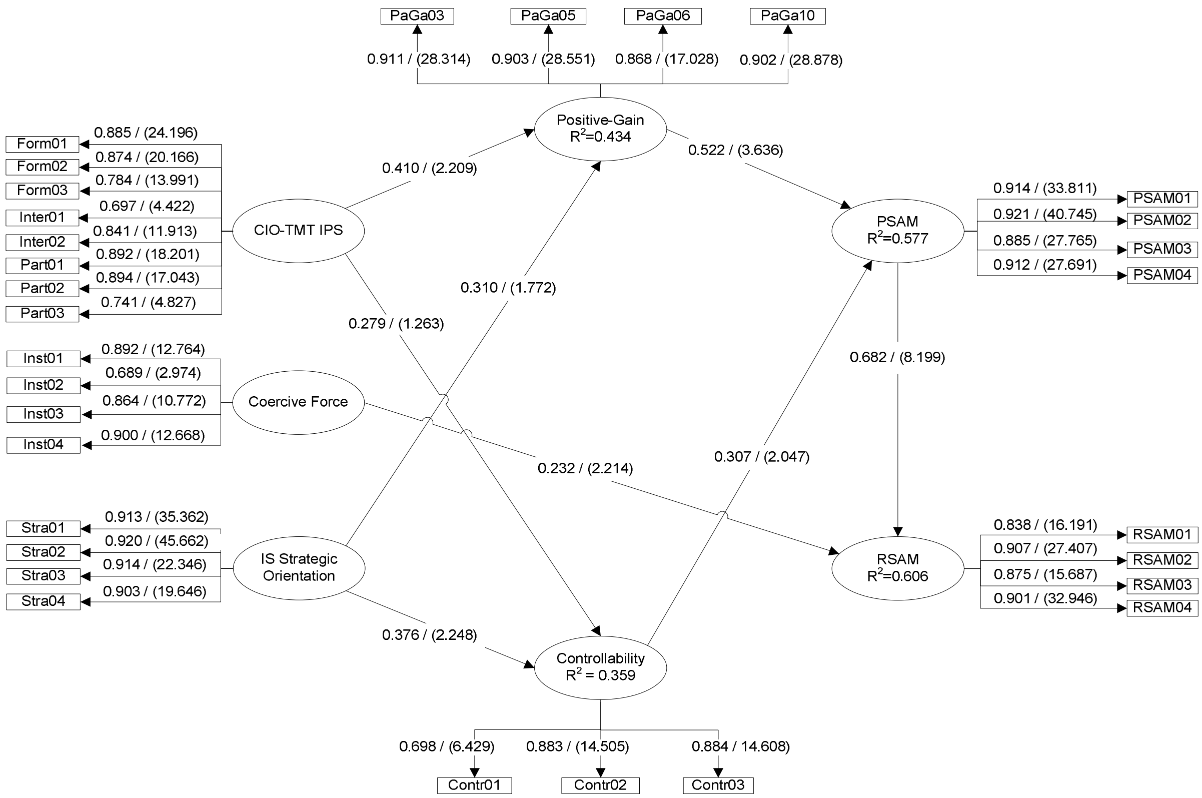

Figure 5.1 Pilot: Path Coefficients and Item Loadings

Figure 5.1 reveals that the model explains 43.4% of the variance of positive-gain and 35.9% of the controllability variance. Additionally, the model explains 57.7% of proactive SAM and 60.6% of the variance of reactive SAM. Thus, according to Chin guidelines these effects have a moderate size. To test the significance of the hypothesized paths, bias-corrected and accelerated (BCa)[14] bootstrapping with 5000 iterations (i.e., samples) was conducted (Hair et al., 2013; Henseler et al., 2009). Table 5.5 and Figure 5.1 show that the relationships between

[14] All bootstrapping performed in this study use the BCa methodology with 5000 iterations as suggested by the PLS-SEM literature (Hair et al., 2016)

Table 5.5
Pilot: Paths' T-Statistics

Relationships	Path in Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistics (|O/STDEV|)	P-Values
CIO-TMT IPS -> Controllability	0.279	0.272	0.221	1.263	0.207[ns]
CIO-TMT IPS -> Positive	0.410	0.419	0.186	2.209	0.027**
Coercive -> Reactive SAM	0.232	0.239	0.105	2.214	0.027**
Controllability -> Proactive SAM	0.307	0.311	0.15	2.047	0.041**
Positive -> Proactive SAM	0.522	0.517	0.143	3.636	0.001***
Proactive SAM -> Reactive SAM	0.682	0.683	0.083	8.199	0.001***
Strategic Orientation -> Controllability	0.376	0.389	0.167	2.248	0.025**
Strategic Orientation -> Positive	0.310	0.314	0.175	1.772	0.076 [*ns]

Bias-Corrected Accelerated (BCA) Bootstrapping with 5000 iterations
*** p < 0.001, ** p < 0.05, * p < 0.10, not significant (ns)

CIO-TMT IPS and Positive-Gain and between Strategic Orientation and Controllability are positive and significant as predicted. This lends support to H1a and H2b respectively. However, the relationships between CIO-TMT IPS and controllability and Strategic Orientation and Positive Gain are not significant. Thus, the results do not support H1b and H2a respectively.

The lack of support for the relationship between CIO-TMT IPS and Controllability contradicts previous studies that have shown that in the presence of information or a structure to process information (Kuvaas, 2002; Thomas & McDaniel, 1990), TMT perceive the opportunity of controlling strategic issues (Thomas & McDaniel, 1990; Thomas et al., 1991). A possible explanation could be that the elements of information provided in the scenario were not sufficient to elicit a perception of control of the SAM issue. Also, it is noticeable that controllability is the only latent construct with only three items as two other items were dropped during the confirmatory factor analysis.

Thus, after analyzing the pilot and considering that adjustments could be made to the dropped Controllability items, it is likely that with a larger number of observations and four reflective Controllability items that the relationship between CIO-TMT IPS and Controllability turns out significant in the full study. Consequently, the strategic sensemaking literature was reviewed to identify how to edit or replace the two dropped Controllability items. One of the items (Cont04) was worded "Feel that how the situation is resolved is a matter of chance?" and the other (Cont05) "Be constrained in how it could interpret the situation?" These two items were negatively worded with respect to the stem of choices going from "Not at all" with a value of 1 to "very great extent" with a value of 7. After reviewing the literature, it was decided to avoid mixing items that were in opposing direction to the other three items as previous research indicates these types of items cause reliability issues (Barnette, 2000). Thus, based on the strategic sensemaking literature and review with a marketing and an IS scholar, these items were replaced. The new controllability items were worded as "Possess the capability to manage it?" and "Perceive the situation as controllable?" These two items became items 4 and 5 of the controllability scale, respectively.

In the pilot, it was also found that the relationship between IS Strategic Orientation and Positive-Gain (H2a) was not significant. However, under a more relaxed criterion, the t-statistic for the relationship could be claimed to be significant at the 10 percent level. Given the small sample size and PLS bias to overestimate indicators loadings, and standard errors of paths between latent constructs (Gefen et al., 2011; Hair et al., 2016), it is likely that with a larger number of observations H2a could turn out significant[15]. An alternate explanation could be that IS strategy orientation may not influence TMT's positive or negative perception of strategic issues. A detailed review of the IS strategic orientation revealed that items five and six of the

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[15] This can be an alternate explanation for H1b, as well. With 57 observations, the model supports most of the hypothesized relationships. In addition, with a larger sample size better parameter estimates on the relationships between latent constructs can be achieved, and a more rigorous conclusion about the significance of the hypothesized paths could be stated.

pilot scale were dropped after the pilot's confirmatory factor analysis. It was decided that a revision of item 5 could be done. The original wording of the item was "Have an IS portfolio which is always growing?". After review of the IS strategy and strategic sensemaking literature, the item was reworded as "Provide continuously an IS portfolio that meets evolving organizational needs?"

Table 5.6
Pilot: Supported Hypotheses

Hypotheses	Result
H1a: Higher degree of CIO-TMT information processing structure will be positively related to the extent to which TMT will label an IS strategic issue as positive-gain.	Supported
H1b: Higher degree of CIO-TMT information processing structure will be positively related to the extent to which TMT will label an IS strategic issue as controllable	Not Supported
H2a: TMTs in organizations with domain-offensive IS-strategic orientation will be more likely to interpret a strategic issue as positive-gain compared to TMTs in organizations with domain-defensive IS strategic orientation.	Not Supported*
H2b: TMTs in organizations with domain-offensive IS-strategic orientation will be more likely to interpret a strategic issue as controllable compared to TMTs in organizations with domain-defensive IS strategic orientation.	Supported
H3: Coercive will positively influence the adoption of reactive SAM.	Supported
H4a: TMT's perception of software asset issues as an opportunity for positive gain is positively associated with the adoption of proactive SAM.	Supported
H4b: TMT's perception of software asset issues as an opportunity for controllability is positively associated with the adoption of proactive SAM.	Supported
H5: Higher degree of Proactive SAM adoption will be positively related to the adoption of reactive SAM.	Supported
* significant at 10% level	

Further, the relationships between Positive-Gain and proactive SAM, and coercive force and reactive SAM were found to be positive as predicted. Table 5.6 shows a summary of the results.

5.2 Full Study Model

As indicated in Chapter 4, the full data collection has 187 valid responses from CIOs. SmartPLS version 3 is used to analyze the collected data. Items used for the measurement model are shown in the survey used for the full data collection (see Appendix).

5.2.1 Measurement Validation

Measurement validation of the full study was based on a CFA[16] performed with PLS-SEM. Reliability of each construct was tested using statistics such as Cronbach's α and

[16] Tables A.4 and A.7 (Appendix) contain details on the items used and the exploratory factor analysis.

composite reliability ρ_c. The suggested threshold for reliabilities to indicate good internal consistency is to be equal or greater than 0.70 (Gefen et al., 2000; Hair et al., 2010; Hair et al., 2016; Nunnally & Bernstein, 1994). As Table 5.7 presents, both the Cronbach's α and the composite reliability ρ meet the minimum threshold. In the case of Cronbach α, the minimum score amounts to 0.89, and for composite reliability, the minimum is 0.92. These values suggest adequate construct reliability (Hair, Hollingsworth, Randolph, & Chong, 2017; Nunnally & Bernstein, 1994; Urbach & Ahlemann, 2010).

Table 5.7
Model 1: Reliabilities and AVE

Construct	Cronbach's α	ρ_c	AVE
CIO-TMT IPS	0.93	0.94	0.68
Coercive	0.94	0.96	0.84
Controllability	0.89	0.93	0.76
Positive	0.90	0.93	0.77
Proactive SAM	0.92	0.93	0.64
Reactive SAM	0.88	0.92	0.73
Strategic Orientation	0.97	0.97	0.91

Convergent validity was measured by the average variance extracted (AVE) (Fornell & Larcker, 1981). Information from Table 5.7 suggests that all constructs meet the threshold of AVE > 0.50 (Fornell & Larcker, 1981; Hair, Hollingsworth, et al., 2017).

Next, discriminant validity is tested with the Fornell-Larcker criterion. The Fornell-Larcker criterion requires the comparison of a construct's AVE with the square of the correlation between constructs (Henseler et al., 2015). If the AVE of a construct is greater than the square of the correlation with other constructs, discriminant validity can be argued. In practice, researchers usually report the correlation between constructs and test the Fornell-Larcker criterion by computing the square root of a construct's AVE and comparing it with the correlations between constructs (Henseler et al., 2015). A construct that shares more variance with its indicators than with another construct will have a squared root of the AVE greater than the correlations between constructs. Values from Table 5.8 corroborate the discriminant validity of the tested constructs.

Table 5.8

Model 1: Correlations Among Constructs and AVE's SQRT

	CIO-TMT IPS	Coercive	Controllability	Positive	Proactive SAM	Reactive SAM	IS. Str. Orientation
CIO-TMT IPS	**0.822**						
Coercive	0.492	**0.919**					
Controllability	0.608	0.513	**0.872**				
Positive	0.532	0.326	0.570	**0.879**			
Proactive SAM	0.650	0.498	0.676	0.668	**0.798**		
Reactive SAM	0.468	0.505	0.586	0.462	0.589	**0.857**	
IS Str. Orientation	0.687	0.321	0.552	0.531	0.583	0.336	**0.952**

Square root of a construct AVE is bolded

Table 5.9

Model 1: Loadings and Cross Loadings

Item	CIO-TMT IPS	IS Str. Orientation	Coercive	Positive	Controllability	Proactive SAM	Reactive SAM
Form01	**0.742**	0.562	0.285	0.471	0.465	0.481	0.318
Form03	**0.788**	0.617	0.312	0.510	0.513	0.549	0.331
Inter01	**0.792**	0.561	0.390	0.412	0.485	0.514	0.398
Inter02	**0.833**	0.530	0.457	0.394	0.525	0.518	0.452
Inter03	**0.857**	0.547	0.377	0.387	0.477	0.507	0.397
Part01	**0.846**	0.575	0.501	0.459	0.491	0.576	0.400
Part02	**0.879**	0.583	0.489	0.429	0.520	0.578	0.412
Part03	**0.831**	0.526	0.423	0.418	0.513	0.535	0.372
Stra01	0.651	**0.961**	0.302	0.528	0.528	0.566	0.311
Stra02	0.646	**0.929**	0.265	0.477	0.525	0.538	0.338
Stra04	0.660	**0.956**	0.306	0.495	0.505	0.569	0.328
Stra05	0.659	**0.960**	0.346	0.519	0.543	0.548	0.304
Inst01	0.447	0.314	**0.935**	0.334	0.496	0.473	0.489
Inst02	0.436	0.283	**0.931**	0.276	0.423	0.437	0.435
Inst03	0.454	0.249	**0.924**	0.236	0.464	0.427	0.485
Inst04	0.472	0.337	**0.886**	0.355	0.501	0.495	0.442
PoGa01	0.482	0.434	0.320	**0.892**	0.473	0.588	0.439
PoGa02	0.443	0.430	0.253	**0.894**	0.490	0.609	0.434
PoGa03	0.447	0.474	0.298	**0.870**	0.530	0.575	0.411
PoGa04	0.498	0.527	0.274	**0.860**	0.511	0.576	0.340
Contr02	0.540	0.472	0.428	0.523	**0.869**	0.590	0.545
Contr03	0.540	0.526	0.428	0.497	**0.859**	0.586	0.484
Contr04	0.507	0.430	0.455	0.478	**0.877**	0.609	0.524
Contr05	0.532	0.495	0.480	0.488	**0.881**	0.573	0.489
PSAM01	0.496	0.399	0.410	0.527	0.514	**0.807**	0.507
PSAM02	0.565	0.496	0.400	0.545	0.536	**0.790**	0.461
PSAM03	0.504	0.482	0.369	0.561	0.545	**0.808**	0.388
PSAM04	0.544	0.518	0.381	0.562	0.569	**0.836**	0.491
PSAM05_(CEnv01)	0.547	0.490	0.439	0.515	0.558	**0.793**	0.512
PSAM06_(P_Imp03)	0.532	0.462	0.367	0.537	0.536	**0.784**	0.442
PSAM07_(LCy07)	0.489	0.439	0.390	0.552	0.526	**0.788**	0.503
PSAM08_(OMgt01)	0.468	0.435	0.422	0.459	0.532	**0.777**	0.451
RSAM01	0.356	0.307	0.357	0.444	0.432	0.526	**0.859**
RSAM02	0.389	0.275	0.446	0.433	0.520	0.500	**0.861**
RSAM03	0.445	0.290	0.468	0.353	0.537	0.503	**0.845**
RSAM04	0.413	0.281	0.456	0.355	0.516	0.491	**0.863**

The cross-loadings table is also used to assess discriminant validity. The rationale for applying the cross-loadings methods asserts that if an item loads more into its construct than with any other construct, discriminant validity is demonstrated (Chin, 1998). Also, suggested guidelines for PLS indicate that to argue discriminant validity the loading into the associated construct should be at least an 0.10 units greater than a loading with any other construct (Gefen & Straub, 2005). Values from Table 5.9 show that discriminant validity can be claimed.

Recent methodological review for VB-SEM argues that discriminant validity assessment with Fornell-Larcker and cross-loadings criteria is not the best method for VB-SEM (Henseler et al., 2015). VB-SEM inflates the loadings of each indicator into the composite representation of a construct affecting the efficacy of the Fornell-Larcker criterion (Henseler et al., 2015). Likewise,

Table 5.10
Model 1: HTMT Discriminant Validity Test

Construct	CIO-TMT IPS	Coercive	Controllability	Positive	Proactive SAM	Reactive SAM
CIO-TMT IPS						
Coercive	0.527					
Controllability	0.665	0.560				
Positive	0.578	0.355	0.634			
Proactive SAM	0.701	0.537	0.746	0.733		
Reactive SAM	0.518	0.553	0.659	0.519	0.655	
Strategic Orientation	0.723	0.337	0.593	0.568	0.619	0.366

the cross-loadings methodology is affected by the inflated items loadings, and despite the suggestion that items should load higher onto the associated construct, no arguments based on theory or empirical evidence is provided in the literature of CB-SEM (Henseler et al., 2015).

Henseler et al. (2015) propose calculating the heterotrait-monotrait ratio (HTMT) which is the “ratio of the between-trait correlations to the within-trait correlations” (Hair et al., 2016, p. 118) as a way to estimate discriminant validity without needing to run a factor analysis. Thus since HTMT is an estimate of the correlation between the constructs, interpretation is a very direct procedure (Henseler et al., 2015). Applying HTMT criterion to assess discriminant validity suggests that HTMT values below 0.85 indicate discriminant validity between constructs (Henseler et al., 2015). Table 5.10 shows that all HTMT values are below the 0.85 threshold

Table 5.11
Standardized Root Mean Square (SRMR) and Confidence Intervals

		HI95		HI99	
Index	Original Sample	2.50%	97.50%	0.50%	99.50%
SRMR*	0.094	0.043	0.068	0.040	0.075

Table 5.11 displays the Standardized Root Mean Square (SRMR) value for the proposed model. SRMR is the root mean square discrepancy between the observed correlations and the correlations implied by the model and is used to assess the model fit (Hair et al., 2016). The use of SRMR is a new addition to PLS analysis to measure model fit. SRMR values of "0" suggest a perfect model fit. Guidelines on how to use SRMR suggest that SRMR > 0.1 indicate bad model fit (Hair et al., 2010). Further, more rigorous thresholds specify that SRMR < 0.08 are needed to show good model fit (Henseler et al., 2016; L. t. Hu & Bentler, 1999). In Table 5.11 calculations of SRMR and its positioning within 95% and 99% confidence interval are displayed. The results show that although SRMR is below the 0.1 threshold suggested by Hair et al. (2010), it does not meet the more rigorous recommendation of SRMR < 0.08 (Henseler et al., 2016; L. t. Hu & Bentler, 1999). This fit analysis will be revisited again in section 5.3 where mediation paths are tested.

5.2.2 Structural Model

After the validation of the measurement model, the next step was to analyze the structural model. The structural model was validated by analyzing R^2, paths coefficients, and statistical significance. Figure 5.4 displays the R^2 for the model's endogenous variables. The model explains 33.6% of the positive gain variance, 40.4% of the controllability variable, 57.5% of

Proactive SAM and 40.7% of Reactive SAM. Following Chin (1998) R^2 classification, it can be said that these effects are moderate.

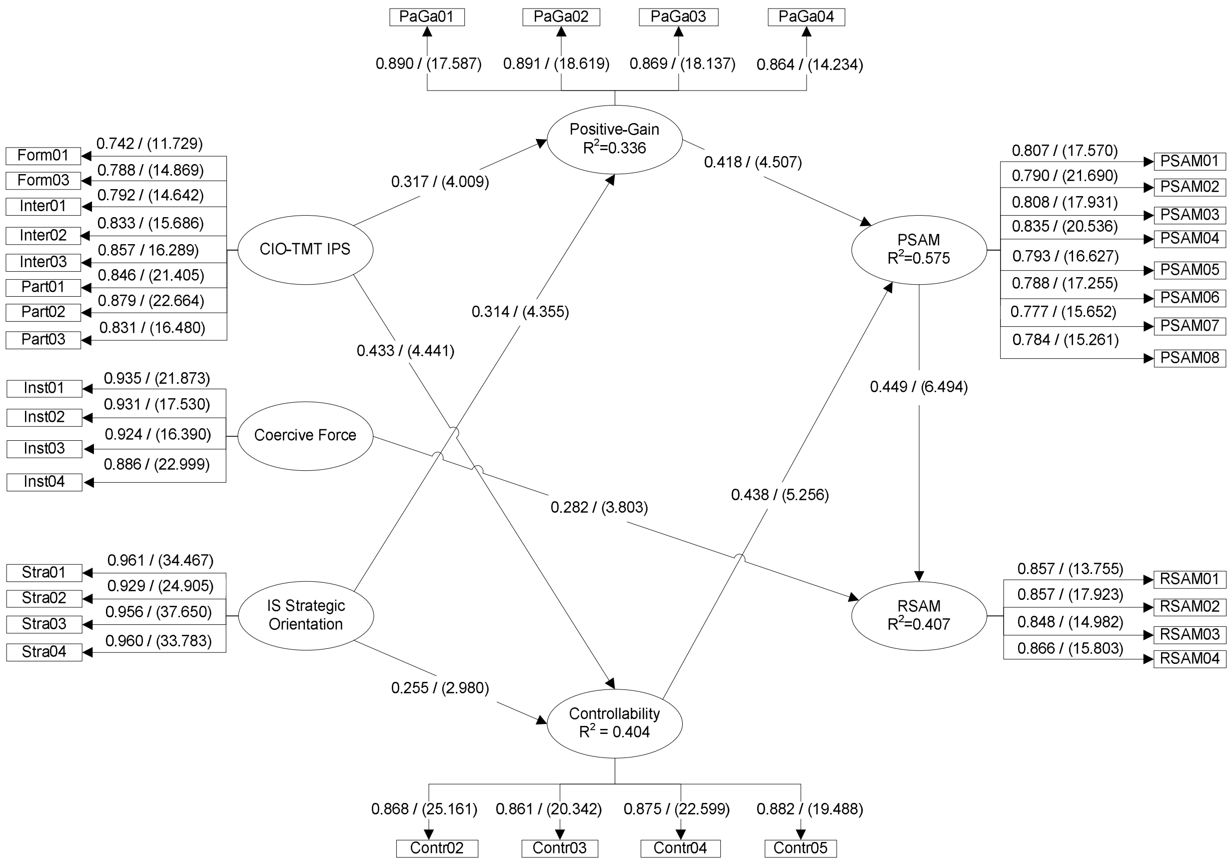

Figure 5.2 Model 1: Path Values and R^2
T values are in parenthesis

The next step analyzes path values and statistical significance. From Table 5.12 it can be inferred that the path with the lowest coefficient is the one for the relationship between IS

Table 5.12
Model 1 Path Coefficients, T-Statistics, and Significance

Relationships	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
CIO-TMT IPS -> Controllability	0.433	0.441	0.098	4.441	0.000
CIO-TMT IPS -> Positive	0.317	0.318	0.079	4.009	0.000
Coercive -> Reactive SAM	0.282	0.284	0.074	3.803	0.000
Controllability -> Proactive SAM	0.438	0.446	0.083	5.256	0.000
Positive -> Proactive SAM	0.418	0.412	0.093	4.507	0.000
Proactive SAM -> Reactive SAM	0.449	0.453	0.069	6.494	0.000
Str. Orientation -> Controllability	0.255	0.251	0.086	2.980	0.003
Str. Orientation -> Positive	0.314	0.315	0.072	4.355	0.000

Strategic Orientation and controllability with a coefficient = 0.255 (t-statistics = 2.980 / p-val = 0.003). On the other hand, the path from CIO-TMT IPS to controllability has the largest coefficient among the path influencing the interpretation. This path value suggests that exchange of information among CIO and TMT members is important to develop a sense of control of SAM

Table 5.13
Model 1: Supported Hypotheses

Hypotheses	Result
H1a: Higher degree of CIO-TMT information processing structure will be positively related to the extent to which TMT will label an IS strategic issue as positive-gain.	Supported
H1b: Higher degree of CIO-TMT information processing structure will be positively related to the extent to which TMT will label an IS strategic issue as controllable	Supported
H2a: TMTs in organizations with domain-offensive IS-strategic orientation will be more likely to interpret a strategic issue as positive-gain compared to TMTs in organizations with domain-defensive IS strategic orientation.	Supported
H2b: TMTs in organizations with domain-offensive IS-strategic orientation will be more likely to interpret a strategic issue as controllable compared to TMTs in organizations with domain-defensive IS strategic orientation.	Supported
H3: Coercive will positively influence the adoption of reactive SAM.	Supported
H4a: TMT's perception of software asset issues as an opportunity for positive gain is positively associated with the adoption of proactive SAM.	Supported
H4b: TMT's perception of software asset issues as an opportunity for controllability is positively associated with the adoption of proactive SAM.	Supported
H5: Higher degree of Proactive SAM adoption will be positively related to the adoption of reactive SAM.	Supported

as a strategic issue. Also, Positive-Gain and Controllability have significant relationships with Proactive SAM, and that suggests that both dimensions of the opportunity interpretation are important for the willingness to conduct Proactive SAM actions. Further, all the hypothesized paths are significant as shown in Figure 5.2, Table 5.12, and Table 5.13).

Under the traditional PLS guidelines, it could be said that Model 1 provides support to all the proposed hypotheses. However, this study seeks to use the newest and more rigorous PLS analysis standard and, and it will incorporate the latest guidelines for PLS analysis. Hence, SRMR results from section 5.2.1 imply that a better fit can be achieved. Thus, to assess if the model fit can be improved the study analyzes Model 2 which includes the mediation of the independent variables (CIO-TMT IPS, IS strategic orientation, and Coercive Force). This potential mediation of independent variables was not included in Model 1 because the sensemaking theory suggests that manages categorize scanned information to interpret and take organizational action, and because institutional force suggests that coercive force generates organizational adaptation without the mediation of managerial interpretation.

Further, the analysis of Model 2 will be conducted with consistent PLS (PLSc) which is the specific methodology that the new PLS guidelines recommend using when analyzing reflective models (Dijkstra & Henseler, 2015; Henseler et al., 2016).

5.3 Mediation Model

In this section, Model 2 is tested (Figure 5.3). In addition to the hypothesized paths of Model 1, Model 2 includes the mediation of the independent variables.

Fit indices and consistent PLS (PLSc), a recent state of the art technique for purely reflective constructs, is used to test this model (Dijkstra & Henseler, 2015; Henseler et al., 2014; Henseler et al., 2016).

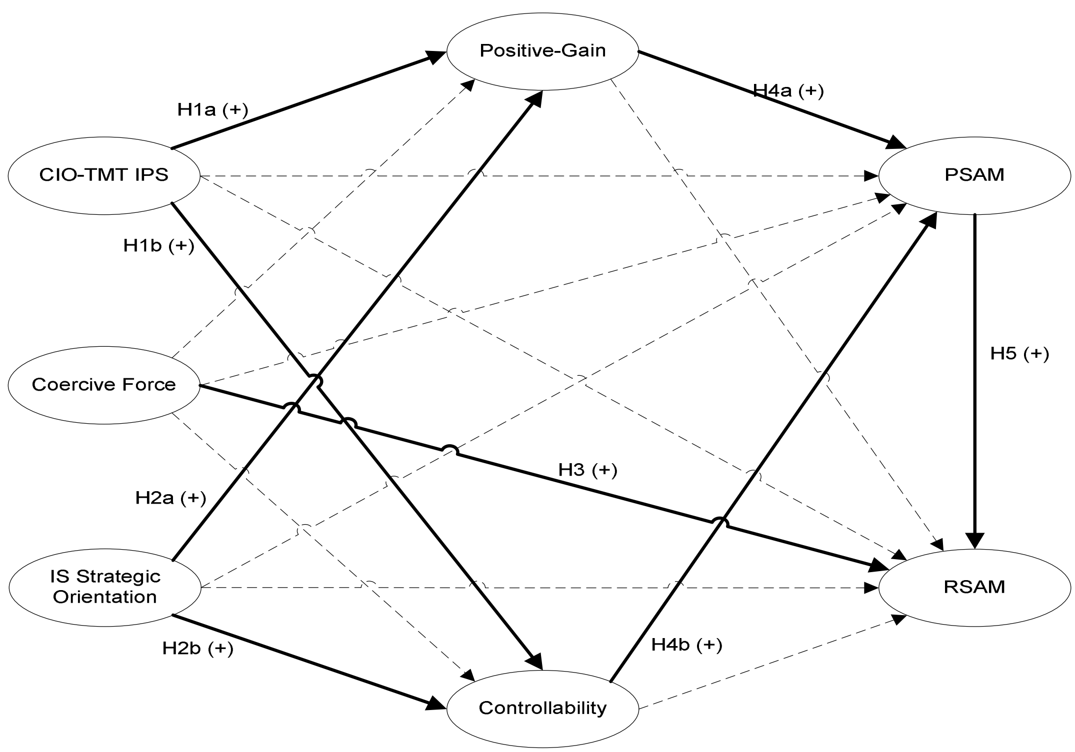

Figure 5.3 Model 2: Mediation Model
Dotted lines are used to test mediation; solid lines are the hypothesize paths

5.3.1 Measurement Model

The assessment of the structural model includes the verification of constructs' reliability, AVE, Fornell-Larcker criterion, HTMT, outer loadings and model fit. Construct reliability is tested with Cronbach's α, composite reliability $\rho_{c,}$ and Dijkstra-Henseler's ρA. ρA is a consistent reliability measure that has been added to PLS-SEM to provide consistent estimators of constructs' reliability. Researchers have established that reliability is underestimated by Cronbach's α and overestimated by composite reliability ρ_c (Dijkstra & Henseler, 2015; Hair et al., 2016; Sijtsma, 2009).

Cronbach's α is calculated with the assumption that indicators form a unidimensional group and that there is tau equivalency (equal covariances) (Dijkstra & Henseler, 2015). Small sample sizes or violations to tau equivalency affects Cronbach's α assumptions. Hence, since PLS does not test for tau equivalency and often it is used with small samples, using Cronbach's α may be problematic and results in a low-end estimation of the reliability (Dijkstra & Henseler, 2015; Hair et al., 2016).

Further, although composite reliability ρ_c is claimed to be a better measure of reliability for PLS (Chin, 2010), it has issues as well. The calculation of Composite reliability ρ_c uses indicator loadings, and studies indicate that PLS indicator loadings are biased upward (Dijkstra & Henseler, 2015; Hair et al., 2016). As a result, composite reliability ρ_c is likely to be an upper-level estimate of the reliability (biased upward) (Dijkstra & Henseler, 2015; Hair et al., 2016).

To address the consistency issues with reliability, the Dijkstra and Henseler ρ_A reliability index has been proposed (Dijkstra & Henseler, 2015). This index is computed using item weights as they have been found to be proportional to the true loadings (Dijkstra, 2010; Dijkstra & Henseler, 2015). Hence, the assumption is that the availability of a consistent reliability estimator makes possible the correction of PLS' original latent variable correlations and achieve consistent variable correlations, paths, and loadings. Consequently, the consistent PLS (PLSc) correction addresses traditional PLS overestimation of item loadings, underestimation of path coefficients and calculation of model fit indices (Dijkstra & Henseler, 2015; Henseler et al., 2016). Thus, because of the above-exposed rationale, this study uses Dijkstra and Henseler ρ_A reliability and PLSc to assess models 2 and 3.

Updated guidelines for reporting construct reliability suggest the use of Cronbach's α, composite reliability ρ_c, as they are claimed to represent lower, upper, or consistent values of reliability (Dijkstra & Henseler, 2015). However, regardless of the different methods employed, these reliability indices are expected to be greater than 0.7 (Dijkstra & Henseler, 2015; Henseler et al., 2016). Values from Table 5.14 show that the three type of reliabilities (*α, ρA, and* ρ_c) exceed the established 0.7 threshold (Nunnally & Bernstein, 1994).

Table 5.14
Model 2: Reliabilities and AVE

Construct	Cronbach's α	ρ_A	ρ_c	AVE
CIO-TMT IPS	0.931	0.932	0.931	0.629
Coercive	0.939	0.941	0.938	0.791
Controllability	0.895	0.895	0.895	0.680
Positive	0.902	0.902	0.902	0.696
Proactive SAM	0.919	0.919	0.918	0.585
Reactive SAM	0.880	0.880	0.879	0.646
IS Str. Orientation	0.965	0.966	0.965	0.875

Convergent validity was assessed with AVE. Information from Table 5.14 suggests that all constructs met the cutoff AVE > 0.50 with a lower bound value for CIO-TMT IPS' AVE = 0.629 and an upper bound of IS Strategic Orientation's AVE = 0.875. Thus, convergent validity is plausible for the mediation model.

Convergent validity can also be assessed with the item loadings presented in Table 5.15. Values for item loadings into the associated construct calculated with the PLSc algorithm are greater than 0.7. This implies that there is more shared variance between the item and its associated construct than with error variance (J. Hulland, 1999).

Table 5.15
Model 2: Outer Loadings

Items	CIO-TMT IPS	IS Str. Orientation	Coercive	Positive	Controllability	Proactive SAM	Reactive SAM
Form01	0.726						
Form03	0.797						
Inter01	0.776						
Inter02	0.808						
Inter03	0.757						
Part01	0.844						
Part02	0.847						
Part03	0.784						
Stra01		0.942					
Stra02		0.910					
Stra04		0.935					
Stra05		0.953					
Inst01			0.929				
Inst02			0.834				
Inst03			0.844				
Inst04			0.947				
PoGa01				0.841			
PoGa02				0.817			
PoGa03				0.841			
PoGa04				0.838			
Contr02					0.836		
Contr03					0.826		
Contr04					0.810		
Contr05					0.824		
PSAM01						0.746	
PSAM02						0.786	
PSAM03						0.745	
PSAM04						0.802	
PSAM05 (CEnv01)						0.800	
PSAM06 (P_Imp03)						0.753	
PSAM07 (LCy07)						0.758	
PSAM08 (OMgt01)						0.725	
RSAM01							0.771
RSAM02							0.817
RSAM03							0.827
RSAM04							0.800

Next discriminant validity is assessed using the Fornell-Larcker criterion (Fornell & Larcker, 1981) and the HTMT test (Henseler et al., 2015). As presented in Table 5.16 the square root of the AVE is larger than the correlation between constructs denoting that Model 2 has enough discriminant validity according to the Fornell-Larcker criterion. Further, discriminant validity is also tested with the HTMT criterion (Hair, Hollingsworth, et al., 2017; Henseler et al., 2016; Henseler et al., 2015). From Table 5.17 the largest HTMT value measures the discriminant

Table 5.16
Model 2: Fornell-Larcker Criterion and AVE's SQRT

	CIO-TMT IPS	Coercive	Controllability	Positive	Proactive SAM	Reactive SAM	IS Str Orientation
CIO-TMT IPS	**0.793**						
Coercive	0.530	**0.890**					
Controllability	0.665	0.561	**0.824**				
Positive	0.577	0.358	0.635	**0.834**			
Proactive SAM	0.702	0.538	0.746	0.733	**0.765**		
Reactive SAM	0.519	0.554	0.660	0.518	0.655	**0.804**	
IS Str Orientation	0.722	0.339	0.594	0.569	0.620	0.365	**0.935**

Square root of AVE in bold numbers

validity between Proactive SAM and Reactive SAM, and it amounts to 0.746 which is well below HTMT's cutoff < 0.85[17].

Table 5.17
Model 2: HTMT Discriminant Validity Test

	CIO-TMT IPS	Coercive	Controllability	Positive	Proactive SAM	Reactive SAM
CIO-TMT IPS						
Coercive	0.527					
Controllability	0.665	0.560				
Positive	0.578	0.355	0.634			
Proactive SAM	0.701	0.537	0.746	0.733		
Reactive SAM	0.518	0.553	0.659	0.519	0.655	
IS Str Orientation	0.723	0.337	0.593	0.568	0.619	0.366

As Model 2 tests the potential mediation of the endogenous variables, that is CIO-TMT IPS, IS Strategic-Orientation, and Coercive force, the plausibility that the theoretical model represents the relationships supported by the data is tested with different fit indices. SRMR measures the difference between the observed correlations and model's implied correlation matrix (Hair et al., 2016; L. t. Hu & Bentler, 1999). The geodesic distance (d_G), and the squared Euclidean distance (d_ULS) measure differences between the empirical covariance matrix and the covariance matrix of the proposed composite factor model (Dijkstra & Henseler,

[17] PLS methodological literature suggests a threshold < 0.90 for the HTMT ratio of closely related constructs but also prescribes HTMT < 0.85 as a more rigorous cutoff value (Hair et al., 2016; Henseler et al., 2015).

2015). The cutoff value for SRMR should be less than 0.08 for a good fitting model in VB-SEM (Henseler, 2017; Henseler et al., 2015). Fit indices also require bootstrapping to establish the confidence under which they are plausible. Suggestions of 95% (HI95) (Henseler et al., 2016) and 99% (HI99) (Henseler, 2017; van Riel, Henseler, Kemény, & Sasovova, 2017) confidence intervals are prescribed in the literature as acceptable to assess SRMR, d_ULS, and d_G of models to test for good fit. Values from Table 5.18 indicate that the HI99 cutoff values are met for the three indices as their respective original sample values lie between the upper and lower bound of the HI99, respectively. Further for the HI95 cutoff only d_G value lies between the

Table 5.18
Model 2: Fit Indices of Estimated Model

		HI95		HI94*		HI99	
Index	Original Sample	2.50%	97.50%	2.00%	98.00%	0.50%	99.50%
SRMR	0.050	0.031	0.049	0.031	0.05	0.029	0.053
d_ULS	1.637	0.652	1.605	0.643	1.638	0.566	1.858
d_G	1.440	0.884	1.726	0.883	1.796	0.800	2.069

* Using five decimals, SRMR HI94 upper limit value is 0.04960 and SRMS original sample value is 0.04957

upper and lower bound but SRMR; however, d_ULS passed the upper bound by 0.032 units and SRMR by .01 units. HI94 was also tested, and it was found that all indices lie within boundaries of the confidence interval. Consequently, based on the evidence presented in Table 5.18, the mediation model has an adequate fit as shown by the theoretical correlation matrix which does not differ significantly (4 percent level) from the empirical correlation matrix (Henseler, 2017; van Riel et al., 2017).

5.3.1 Structural Model

After the corroboration of acceptable properties of the measurement model, the step that follows is the assessment of the structural properties of the mediation model. The initial assessment focuses on endogenous variables and the percentage of variance explained. As shown in Figure 5.4, Positive Gain has an R^2 of 38.8%, Controllability 53.6%, Proactive SAM 71.8% and Reactive SAM 54.1%.

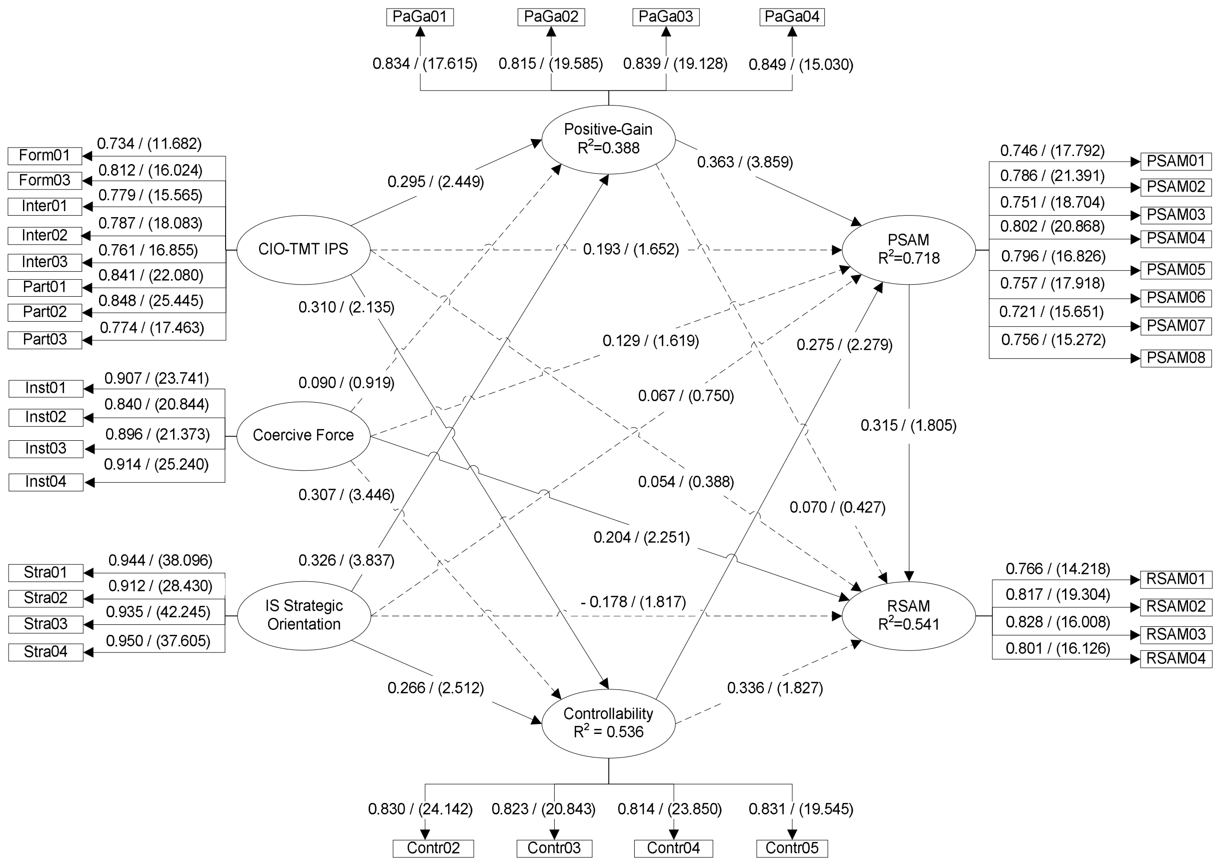

Figure 5.4 Model 2: Item loadings, Path Values. T-values, and R^2
Path with solid lines are hypothesized, t-values inside parentheses

To test the significance of the different paths illustrated in Model 2, BCa bootstrap with 5000 samples was performed. Paths between CIO-TMT IPS and positive-gain and controllability and IS Strategic Orientation and positive gain and controllability are significant as anticipated. Similarly, paths between IS Strategic Orientation and positive gain and controllability are significant. Further, the hypothesized relationships between positive gain and proactive SAM and controllability and proactive SAM were significant as well. Moreover, the relationship between coercive force and reactive SAM is significant as hypothesized. On the contrary, the hypothesized relationship between proactive SAM and Reactive SAM is not significant for Model 2. Figure 5.4 and Table 5.19 present coefficients, p values and t statistics.

Table 5.19
Model 2: Path Coefficients, T-Statistics, and Significance

Relationship	Original Sample	Sample Mean	Standard Deviation	|T Statistics|	P Values*
CIO-TMT IPS -> Controllability	0.310	0.320	0.145	2.135	**0.033**
CIO-TMT IPS -> Positive	0.295	0.287	0.121	2.449	**0.014**
CIO-TMT IPS -> Proactive SAM	0.193	0.181	0.117	1.652	0.099
CIO-TMT IPS -> Reactive SAM	0.054	0.076	0.138	0.388	0.698
Coercive -> Controllability	0.307	0.300	0.089	3.446	**0.001**
Coercive -> Positive	0.090	0.094	0.098	0.919	0.358
Coercive -> Proactive SAM	0.129	0.132	0.080	1.619	0.105
Coercive -> Reactive SAM	0.204	0.209	0.090	2.251	**0.024**
Controllability -> Proactive SAM	0.275	0.289	0.121	2.279	**0.023**
Controllability -> Reactive SAM	0.336	0.292	0.184	1.827	0.068
Positive -> Proactive SAM	0.363	0.360	0.094	3.859	**0.000**
Positive -> Reactive SAM	0.070	0.097	0.165	0.427	0.669
Proactive SAM -> Reactive SAM	0.315	0.325	0.175	1.805	0.071
IS Str Orientation -> Controllability	0.266	0.260	0.106	2.512	**0.012**
IS Str Orientation -> Positive	0.326	0.331	0.085	3.837	**0.000**
IS Str Orientation -> Proactive SAM	0.067	0.065	0.089	0.750	0.453
IS Str Orientation -> Reactive SAM	-0.178	-0.182	0.098	1.817	0.069

*P-values for significant relationships are shown in bold characters

5.3.4 Common Method Bias

Common method bias is a threat to this research since it uses CIOs as a single source of information (e.g., Gerow et al., 2015; Lai, Lee, & Hsu, 2009). Common method bias due to single respondent could be mitigated using procedural measures such as protecting respondents' anonymity, and reassuring them that there are no right or wrong answers because it should reduce the respondents' social desirability biases (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Consequently, this study takes measures to reassure respondents of the anonymous nature of the survey instrument and that there is no right or wrong answer.

Also, as a post hoc measure, Harman's single factor test was applied with an unrotated principal component analysis (Podsakoff et al., 2003). For the pilot, the principal component analysis resulted in six factors, with Eigen values greater or equal to one, that accounted for 79 percent of the variance, and with no single factor accounting for more than 50% of the variance.

For the full data collection, the principal component analysis showed a structure with seven factors, with Eigen value greater than one, which accounted for 75 percent of the variance, and with no single factor accounting for more than 50% of the variance. Harman's test results from the pilot and the full study suggest that common method variance was not an issue (Chengalur-Smith, Nevo, & Demertzoglou, 2010; Han, Ada, Sharman, & Rao, 2015; Xu, Benbasat, & Cenfetelli, 2014).

Further, a second posthoc test was performed to check for common method variance. Kock (2015) proposed to measures collinearity between constructs with variance inflation factors (VIFs) to assess common method bias in models tested with PLS. The suggested method posits that models using PLS algorithm are unlikely to suffer from common method variance if the variance inflation factors (VIFs) between constructs have a value of less than 2.5 in the case of the standard PLS algorithm and 5 for the model using PLSc. For the analyzed model no VIF is greater than 1.80 in the pilot (standard PLS) and no greater than 3.54 for the full-scale model (PLSc). Consequently, Kock's (2015) method also supports that it is plausible that common method variance was not an issue during the pilot stage.

5.3.5 Mediation Analysis

Results for Model 2 are not completed without a mediation analysis. Improving the fit of the original model required adding mediation paths for the exogenous variables of the model. PLS-SEM is a technique suitable for testing complex path models (Chin, 2010; Nitzl et al., 2016) such as the one where mediation takes place. Mediation occurs when there is a variable that can account or intervene in the relationship between exogenous and endogenous variable (Baron & Kenny, 1986). Understanding this indirect effect on the endogenous variable provides a complete understanding of the relationships between variables (Preacher & Hayes, 2004).

Often, mediation analysis follows guidelines specified by Baron and Kenny (1986) on how to conduct the mediation procedure developed by Sobel (1982) (Preacher & Hayes, 2004).

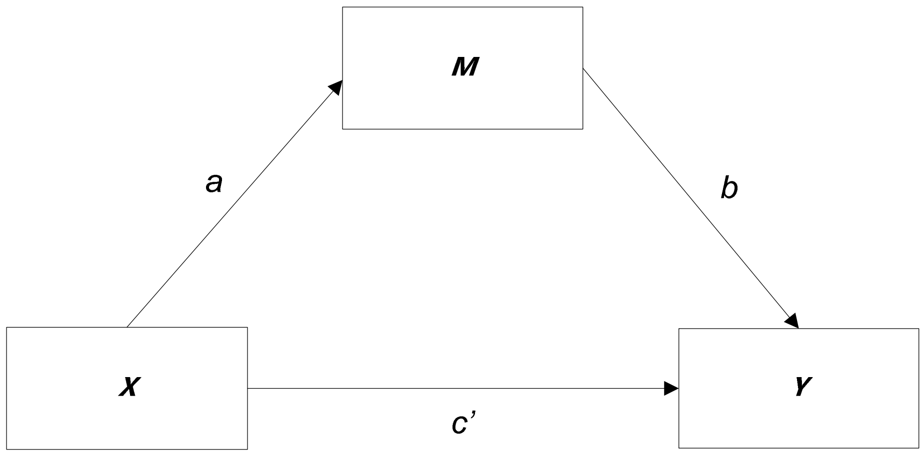

Figure 5.5 Mediation Diagram

Figure 5.5 shows the classic mediation context. An exogenous variable *X* has a direct effect *c'* on *Y* but also an indirect effect *X* → *M* → Y where the product *a* * *b* is the indirect effect of *X* on *Y* (Preacher & Hayes, 2004). Reviews of the Sobel test indicate that it is not adequate for the analysis of mediation (indirect effects) because it rests on the assumption that the product *a*b* is normally distributed when it is not, especially for situations in the context of PLS where small sample sizes are widespread (Hair et al., 2016; Nitzl et al., 2016; Shrout & Bolger, 2002). Consequently, methods that apply bootstrap routines are suggested because they do not rest on distributional assumptions (Chin, 2010; Nitzl et al., 2016).

In their review of mediation analysis, Preacher and Hayes (2004) proposed an alternate procedure to Sobel's test. Preacher and Hayes (2004) methodology uses the variables' latent scores combined with bootstrapping (Nitzl et al., 2016). However, it has been stated that this method has issues in the PLS context because it fixes the value of the constructs' variances and PLS-SEM is a method that is variance based (Nitzl et al., 2016). Thus, in the context of PLS-SEM, it is better to avoid using the construct's latent score by taking advantage of how PLS uses

Table 5.20

Model 2: Mediation Analysis

Direct Effects						Indirect Effects				Conclusion
Relationship	Direct Effect	2.50%	97.50%	T Statistic	P Value	Mediation Path	Indirect Effect	2.50%	97.50%	
CIO-TMT IPS→ Controllability	0.310	0.014	0.594	2.111	**0.035**					
CIO-TMT IPS → Positive	0.295	0.049	0.512	2.485	**0.013**					
CIO-TMT IPS → Proactive SAM	0.193	-0.038	0.419	1.667	0.096	CIO-TMT IPS → Controllability → Proactive SAM	**0.085**	0.084	0.087	**Full Mediation**
						CIO-TMT IPS → Positive → Proactive SAM	**0.107**	0.106	0.109	**Full Mediation**
CIO-TMT IPS→Reactive SAM	0.054	-0.239	0.329	0.375	0.708	CIO-TMT IPS → Controllability → Reactive / Not Tested Controllability → Reactive^{NS}				No Mediation
						CIO-TMT IPS → Positive → Reactive / Not Tested Positive → Reactive^{NS}				No Mediation
						CIO-TMT IPS → Proactive → Reactive SAM / Not Tested CIO-TMT IPS → Proactive^{NS}				No Mediation
Coercive → Controllability	0.307	0.129	.480	3.400	**0.001**					
Coercive → Positive-Gain	0.090	-0.101	0.282	0.917	0.359					
Coercive → Proactive SAM	0.129	-0.034	0.295	1.556	0.120	Coercive → Controllability → Proactive SAM	0.084	0.083	0.085	**Full Mediation**
						Coercive → Positive → Proactive SAM / Not Tested Coercive → Positive^{NS}				No Mediation
Coercive → Reactive SAM	0.204	0.020	0.375	2.252	**0.024**	Coercive → Controllability --> Reactive SAM / Not Tested Controllability → Reactive^{NS}				No Mediation
						Coercive→ Positive → Reactive SAM^{NS}				No Mediation
						Coercive → Proactive → Reactive SAM^{NS}				No Mediation
Controllability → Proactive SAM	0.275	0.068	0.545	2.313	**0.021**					
Controllability → Reactive SAM	0.336	-0.097	0.591	1.824	0.068	Controllability → Proactive → Reactive SAM	0.087	0.085	0.089	Mediation*
Positive-Gain→ Proactive SAM	0.363	0.153	0.528	3.842	**0.000**					
Positive-Gain → Reactive SAM	0.070	-0.216	0.425	0.417	0.677	Positive → Proactive → Reactive SAM	0.115	0.113	0.116	Mediation*
Proactive SAM → Reactive SAM	0.315	-0.098	0.595	1.845	0.065					
Str Orientation → Controllability	0.266	0.067	0.478	2.504	**0.012**					
Str Orientation →Positive	0.326	0.160	0.491	3.878	**0.000**					
Str Orientation → Proactive SAM	0.067	-0.101	0.255	0.752	0.452	Str Orientation → Controllability → Proactive SAM	0.073	0.072	0.074	**Full Mediation**

Table 5.20

Model 2: Mediation Analysis

Direct Effects						Indirect Effects				Conclusion
Relationship	Direct Effect	2.50%	97.50%	T Statistic	P Value	Mediation Path	Indirect Effect	2.50%	97.50%	
						Str Orientation → Positive → Proactive SAM	0.118	0.117	0.120	**Full Mediation**
Str Orientation → Reactive SAM	-0.178	-0.393	-0.002	1.811	0.070	Str Orientation → Controllability → Reactive SAM / Not Tested Controllability → Reactive SAM^{NS}				No Mediation
						Str Orientation → Positive → Reactive SAM Positive → Reactive SAM^{NS}				No mediation
						Str Orientation → Proactive → Reactive SAM / Not Tested Str Orientation → Proactive^{NS}				No mediation

BCa Bootstrap was used with 5000 samples, α = 0.05, bold p-values indicate significant relationships
NS = not significant
*path between proactive and reactive is marginal significant

bootstraps to calculate path models so that at the same time the mediation analysis can fully consider the variance of the constructs (Chin, 2010; Nitzl et al., 2016; Sosik, Kahai, & Piovoso, 2009)

Based on the work of previous researchers (Zhao, Lynch Jr, & Chen, 2010), Hair et al. (2016) provide guidelines for interpreting the mediation analysis. The authors postulate that if the product of *a*b* is not significant a direct effect or no effect are the outcomes. Further, if the product *a*b* is significant and a *c'* exist then complementary (equal signs for *a*b*, and *c'*) or competitive mediation (different signs for *a*b* and *c'*), which are both a form of partial mediation. Otherwise, if *c'* is not significant but *a*b* is significant, then evidence suggests full mediation.

Table 5.20 contains the mediation analysis. The table groups the seventeen direct effects and indirect effects along with their 95% confidence interval, t statistics, and p values. The analysis reveals that Positive-Gain fully mediates the influence of CIOT-TMT IPS and IS Strategic Orientation on Proactive SAM. Also, Controllability fully mediates the influence of Coercive force on Proactive SAM.

Consequently, as evidenced by results provided in Tables 5.19 and 5.20 and Figure 5.4 Hypotheses 1 to 4 are supported and only Hypothesis 5 is not supported. Table 5.21 presents the summary of supported and unsupported hypotheses.

Table 5.21
Model 2: Supported Hypotheses

Hypotheses	Result
H1a: Higher degree of CIO-TMT information processing structure will be positively related to the extent to which TMT will label an IS strategic issue as positive-gain.	Supported
H1b: Higher degree of CIO-TMT information processing structure will be positively related to the extent to which TMT will label an IS strategic issue as controllable	Supported
H2a: TMTs in organizations with domain-offensive IS-strategic orientation will be more likely to interpret a strategic issue as positive-gain compared to TMTs in organizations with domain-defensive IS strategic orientation.	Supported
H2b: TMTs in organizations with domain-offensive IS-strategic orientation will be more likely to interpret a strategic issue as controllable compared to TMTs in organizations with domain-defensive IS strategic orientation.	Supported
H3: Coercive Force will positively influence the adoption of reactive SAM.	Supported

Table 5.21
Model 2: Supported Hypotheses

Hypotheses	Result
H4a: TMT's perception of software asset issues as an opportunity for positive gain is positively associated with the adoption of proactive SAM.	Supported
H4b: TMT's perception of software asset issues as an opportunity for controllability is positively associated with the adoption of proactive SAM.	Supported
H5: Higher degree of Proactive SAM adoption will be positively related to the adoption of reactive SAM.	Marginally Supported

5.4 Control Variables

The influence of control variables was also tested. The study controlled[18] the endogenous variables using organization size by number of employees*, industry sector, IT governance type*, the percentage of SaaS use, and formal structural power of the CIO in the organization. In chapter 4's methodology section, details were provided about these control variables.

Table 5.22 shows a summary of the results for the different models tested. Model 1 is a model that employs the final observations with the same relationships used in the pilot. Model 2 adds mediation of the exogenous variables and is run with PLSc which is the suggested PLS methodology for models that only use reflective constructs (factor models). Model 3 is also run with PLSc and incorporates the control variables mentioned in the previous paragraph. For this model, only the controls with a significant influence are shown. Table 5.22 shows that IT Governance 1 (C-level participation), IT-Governance 4 (IT duopoly) and organization size (by number of employees) have a significant effect on some of the endogenous variables. Specifically, organization size by number of employees suggests that the larger the organization, the more TMT members see SAM as a controllable IS strategic issue. Further, controlling by IT Governance type-1 suggests that organizations, where the top management executives have active participation in the IT governance processes, have a positive association with Proactive

[18] Organization size (employees) and two IT Governance type are significant controls. See Table 5.22.

Table 5.22

Summary of Results

Relationship	Proposed Model[§]		Mediation Model*		Control Variables Check*						Conclusion / Remarks
	Model 1		Model 2		Model 3A		Model 3B		Model 3C		
	Path Value	p-value	Path Value	p-value	Path Value	p-value	Path Value	p-value	Path Value	p-value	
CIO-TMT IPS --> Positive Gain	**0.318**	**0.000**	**0.295**	**0.013**	**0.290**	**0.016**	**0.293**	**0.013**	**0.301**	**0.015**	H1a supported / all models
CIO-TMT IPS --> Controllability	**0.441**	**0.000**	**0.310**	**0.034**	**0.288**	**0.047**	**0.313**	**0.032**	**0.325**	**0.030**	H1b supported / all models
Strategic Orientation --> Positive Gain	**0.315**	**0.000**	**0.326**	**0.000**	**0.323**	**0.000**	**0.332**	**0.000**	**0.317**	**0.001**	H2a supported / all models
Strategic Orientation --> Controllability	**0.251**	**0.003**	**0.266**	**0.012**	**0.254**	**0.013**	**0.260**	**0.015**	**0.246**	**0.026**	H2b supported / all models
Coercive --> Reactive SAM	**0.284**	**0.000**	**0.204**	**0.023**	**0.195**	**0.039**	**0.196**	**0.030**	**0.190**	**0.037**	H3 supported / all models
Positive Gain --> Proactive SAM	**0.412**	**0.000**	**0.363**	**0.022**	**0.367**	**0.000**	**0.371**	**0.000**	**0.363**	**0.003**	H4a supported / all models
Controllability --> Proactive SAM	**0.446**	**0.000**	**0.275**	**0.024**	**0.252**	**0.041**	**0.268**	**0.019**	**0.263**	**0.023**	H4b supported / all models
Proactive SAM --> Reactive SAM	**0.453**	**0.000**	0.315	0.079	0.325	0.061	0.331	0.055	**0.387**	**0.024**	H5 marginally supported*
CIO-TMT IPS --> Proactive SAM			0.193	0.103	0.186	0.099	0.194	0.086	**0.241**	**0.040**	Supported when controlling for Size
CIO-TMT IPS --> Reactive SAM			0.054	0.703	0.055	0.698	0.049	0.722	-0.018	0.909	
Coercive --> Controllability			**0.307**	**0.001**	**0.318**	**0.013**	**0.308**	**0.001**	**0.307**	**0.001**	Supported in Models 2 and 3
Coercive --> Positive Gain			0.090	0.344	0.092	0.348	0.088	0.365	0.090	0.353	
Strategic Orientation --> Proactive SAM			0.067	0.449	0.066	0.468	0.043	0.624	0.010	0.906	
Strategic Orientation --> Reactive SAM			-0.178	0.067	-0.178	0.065	-0.167	0.094	-0.115	0.283	
Employee No. --> Proactive SAM					0.076	0.063					
Employee No. --> Reactive SAM					-0.041	0.499					
Employee No. --> Positive Gain					0.035	0.608					
Employee No. --> Controllability					**0.139**	**0.009**					Size influences TMT's perception of Controllability
IT Governance_1 --> Controllability SAM							0.022	0.684			
IT Governance_1 --> Positive Gain SAM							-0.033	0.588			
IT Governance_1 --> Proactive SAM							**0.100**	**0.027**			C-level executive participation in IT Governance positively influences Proactive SAM
IT Governance_1 --> Reactive SAM							-0.052	0.356			
IT Governance_4 --> Controllability SAM									-0.046	0.458	
IT Governance_4 --> Positive Gain SAM									-0.023	0.762	
IT Governance_4 --> Proactive SAM									**-0.138**	**0.003**	
IT Governance_4 --> Reactive SAM									**0.164**	**0.014**	

Model 1 (Initial Model), Model 2 (Mediation Model), Model 3 (Mediation Model + Controls)
§ PLS algorithm. Models 2 and 3 use PLSc algorithm
* H5 is marginally supported

SAM. Also, when IT and business units (IT-Governance 4 / Duopoly) share responsibility for IT Governance, data suggests that the emphasis is placed on Reactive SAM (positive relationship) rather than on Proactive SAM actions (negative relationship). It is important to stress that after applying the control variables H1- H4 remained significant and H5 was significant at the 5 percent level, only when controlling for IT Governance 4. Table 5.23 shows the summary of hypotheses results based on evidence from Table 5.21.

Table 5.23
Supported Hypotheses

Hypotheses	Result
H1a: Higher degree of CIO-TMT information processing structure will be positively related to the extent to which TMT will label an IS strategic issue as positive-gain.	Supported
H1b: Higher degree of CIO-TMT information processing structure will be positively related to the extent to which TMT will label an IS strategic issue as controllable	Supported
H2a: TMTs in organizations with domain-offensive IS-strategic orientation will be more likely to interpret a strategic issue as positive-gain compared to TMTs in organizations with domain-defensive IS strategic orientation.	Supported
H2b: TMTs in organizations with domain-offensive IS-strategic orientation will be more likely to interpret a strategic issue as controllable compared to TMTs in organizations with domain-defensive IS strategic orientation.	Supported
H3: Coercive will positively influence the adoption of reactive SAM.	Supported
H4a: TMT's perception of software asset issues as an opportunity for positive gain is positively associated with the adoption of proactive SAM.	Supported
H4b: TMT's perception of software asset issues as an opportunity for controllability is positively associated with the adoption of proactive SAM.	Supported
H5: Higher degree of Proactive SAM adoption will be positively related to the adoption of reactive SAM.	Marginally Supported

Finally, implications of the results presented in Chapter 5 are discussed in the next chapter.

CHAPTER VI

DISCUSSION AND CONCLUSIONS

This chapter develops the discussion of results previously reported. The discussion is framed in the context of the research questions, theory, and proposed hypotheses. Next, implications for theory and practice are presented. Subsequently, the limitations of this investigation are listed. Finally, future research directions and conclusions are presented.

6.1 Discussion of Results

Information Technology is a top expenditure in organizations and between software and hardware assets software usually ranks as the largest recipient of IT disbursements (Forrester, 2015; Maizlish & Handler, 2010). Hence, given the importance and large magnitude of software assets disbursements, practitioners and scholars purport that software asset management should concern the top management of organizations (Barber et al., 2016).

Despite the identified degree of importance of software assets, the literature investigating the processes leading to organizational actions supporting comprehensive SAM in organizations is scant. Consequently, the objective of this study is to understand organizational processes leading to the adoption of SAM actions by answering the following research questions: (1) Do TMTs differ in the way they interpret SAM issues? (2) Do CIO-TMT information processing structure and IS strategic orientation explain differences in TMT interpretation of SAM issues? (3) Does the interpretation of SAM issues influence the type of SAM implementation? (4) Does coercive force influence the implementation of reactive SAM? To investigate the answers to the proposed research questions, this study used the strategic sensemaking theory along with institutional theory to understand what makes organizations adopt different SAM actions.

6.1.1 Antecedents and Interpretation

The strategic sensemaking theory postulates that TMTs scan the organization's environment and identify strategic issues (Dutton & Jackson, 1987; Thomas et al., 1993). The underlying premise of this theory is that TMT plays a central role in the strategic choices and actions that organizations take to adapt to the environment (Child, 1972; Hambrick & Mason, 1984; Thomas & McDaniel, 1990). Scholarly work developing the strategic sensemaking theory highlights the important contextual factors such as the information processing structure and the strategic orientation of the organization as important antecedents of TMT's sensemaking (Daft & Lengel, 1986; Daft & Weick, 1984; Knight & McDaniel, 1979; Kuvaas, 2002; Plambeck & Weber, 2010; Thomas & McDaniel, 1990).

As this study drew from previous strategic sensemaking studies, it adapted the Information Processing Structure (IPS) to account for the inclusion of the CIO, and the Strategic Orientation to the context of IS strategy. The CIO-TMT IPS and the IS Strategic Orientation act as filters of the information that TMT processes when considering an IS strategic issue, which in this investigation focuses on SAM.

IPS is an important structure that provides TMT a mechanism to acquire, exchange, and process scanned information informing their decision-making process (Thomas & McDaniel, 1990). It has been postulated that information is a filter that informs TMTs on what issues they should pay attention to and the meaning they can assign to environmental information (Bundy, Shropshire, & Buchholtz, 2013; Narayanan, Zane, & Kemmerer, 2011; Thomas & McDaniel, 1990). Thus, organizations that provide TMTs with a high degree of IPS capacity are more likely to identify opportunities, that is Positive-Gain and Controllability when evaluating strategic issues (Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas et al., 1991).

In this study, the IPS is extended to account for the specialized knowledge required to analyze IS strategic issues with the participation, interaction, and formalization of the CIO within the TMT structural mechanism (Kuvaas, 2002; Thomas & McDaniel, 1990). Such adaptation of the IPS is an extension to prior management literature (Kuvaas, 2002; Thomas et al., 1993; Thomas & McDaniel, 1990; Thomas et al., 1994). The extension is based on insights from the IS literature suggesting the importance of including CIOs[19] within the TMT strategic decision-making processes to ensure that IT Governance and IS strategy are aligned and support organizational objectives (Preston et al., 2008; Preston et al., 2006). The participation of the CIO in the decision-making structure of the TMT exposes the CIO to understand the organization's strategy and provides information required to facilitate the alignment of IT to support the overall business strategy (Armstrong & Sambamurthy, 1999; Leidner & Mackay, 2007). Also, the inclusion of the CIOs in the IPS is likely to enable them to identify, prioritize and conduct a rational pursuit of IS strategic opportunities that could support the achievement of organizational objectives (Bundy et al., 2013; Polletta & Jasper, 2001).

The empirical findings corroborated the proposed relationships between CIO-TMT IPS and IS Strategic Orientation and Positive-Gain and Controllability. For instance, CIO-TMT IPS has a significant relationship with Positive-Gain (0.295 / t-stat =2.135 / p-val=0.014 / R^2 =

[19] A control for the structural power of CIO was conducted using (Preston et al., 2008) structural power formative measure (TMT member status, and reporting distance from CIO). No significant influence of CIO structural power was found on positive gain, controllability, Proactive SAM or Reactive SAM.

38.8%)[20] and a Controllability (0.310 / t-stat=2.135 / p-val=0.023 / $R^2 = 53.6\%$). Also, the organization's IS Strategic Orientation has a significant relationship with Positive-Gain (0.326 / t-stat=3.837 / p-val=0.001 / $R^2 = 38.8\%$) and Controllability (0.266 / t-stat=2.512 / p-val=0.012 / $R^2 = 53.6\%$) as well. The relationship of the CIO-TMT IPS and controllability is not unexpected. In the context of strategic decision making Thomas and McDaniel (1990) posited that the IPS structure nurtures an in-depth processing and use of information to understand strategic issues. This in-depth processing of information is likely to reduce the complexity of the analyzed situation (Hahn, Preuss, Pinkse, & Figge, 2014), and increases TMT's sense of mastery leading to feelings of confidence about being able to control the strategic issue; and which will allow TMT members to cope better with the issue at hand and feel confident in their capability to control it (Thomas & McDaniel, 1990).

Empirical findings have mixed results on the importance of the Strategic Orientation to influence the positive or negative perception about strategic issues (Dutton, 1993; Plambeck & Weber, 2010). For instance, Ginsberg and Venkatraman (1992) found that organizations with domain-offensive strategic orientation with regards to efficiency, perceived the strategic issue at hand as an opportunity leading to positive gains for the organization. Also, although Thomas and McDaniel (1990); Thomas et al. (1991) postulated a positive relationship between Domain-Offensive Strategic Orientation and Positive -Gain perceptions, empirical data from their study did not find a significant relationship. Further, Plambeck and Weber (2010) found in their study that clear Domain-Offensive Orientation in organizations leads to Positive TMT interpretations.

[20] Reported values as calculated by Model 2. The first value inside the parentheses represents the standardized coefficient, the second is the t-statistic, and the third is the p-value

The results from this study are in line with Ginsberg and Venkatraman (1992) empirical findings as it was found that strategic orientation has a positive significant relationship with a Positive-Gain evaluation of the strategic issue (0.326 / t-stat=3.878 / p-val=0.001). The Strategic Orientation of the organization defines bounds that influence how managers assign meaning and emphasize the importance of an organizational issue (Dutton, 1993). This is supported by findings that managers pay attention to information that confirms beliefs embedded into the organization's strategic orientation (Daft & Weick, 1984; Thomas & McDaniel, 1990). Also, previous work posits that organizations with Domain-Offensive Strategic Orientations are susceptible to perceive the environment as a source of opportunities to realize gains from a strategic issue rather than negative outcomes (Plambeck, 2012; Thomas & McDaniel, 1990; Thomas et al., 1991). Consequently, the previous explanation may explicate why the IS Strategic Orientation of the organization resulted in a more significant predictor of a Positive-Gain interpretation of the IS Strategic Issue than the CIO-TMT IPS.

Further, while conducting the mediation analysis of the independent variables, it was found that Coercive Force had a significant positive relationship with Controllability (0.307 / t-stat=3.446 / p-val=0.001). This relationship was not hypothesized in the original model, and it will be discussed in more detail in the next section.

6.1.2 Coercive Force and Organizational Action

Understanding organizational action as an outcome of TMT interpretation is an important outcome of this study. It was established that SAM actions could be classified as proactive or reactive. Reactive SAM actions were defined as those basic or ad hoc activities that seek to track software inventory and software usage on licensing entitlement. The main goal of Reactive SAM is to ensure that organizations meet the expectations from copyright law and software licenses.

Proactive SAM seeks processes that aim to manage the lifecycle of software so that the organization can realize improved software operating costs, better efficiencies, and better control of risks when operating software assets (Canavan, 2012; Rudd, 2009).

Institutional Theory provides an explanation for decisions that organizations make to meet the expectation set by the law. In the context of this investigation, coercive force is the pressure exerted by the government or software providers through software licenses and contracts supported by law. Organizations choose to submit to the influence of coercive force because they seek to achieve legitimacy and acknowledge that the source of the pressure holds resources that are valuable for the organization's viability. As a result, organizations adopt a utilitarian stance and usually react to meet the minimum expectations which in the case of software assets is to demonstrate ceremonial conformance with the copyright of software developers.

Demonstrating compliance usually requires supporting the entitlement to use software licenses through software inventory and verification processes that match software acquisition and documented entitlement with usage. The analysis of the empirical data confirms the relationship between coercive force and Reactive SAM (0.204 / t-stat=2.252 / p-val=0.024). The significant relationship between coercive force and Reactive SAM lends support for the hypothesized positive influence of coercive force to drive organizations to adopt Reactive SAM actions that ensure that organizations can demonstrate appropriate software entitlement and license management (Verma & Kumar, 2015). Consequently, the relationship corroborates the importance that copyright legislation exerts on organizations' decision to conduct basic controls on software assets. Further, while testing the mediation (Model 2), although not hypothesized, it was found that coercive force does not have a direct effect on Proactive SAM.

6.1.3 Interpretation and Organizational Action

TMTs usually categorize strategic issues as opportunities or threats (Dutton & Jackson, 1987; Sharma, 2000). TMTs' evaluation of strategic issues as an opportunity have a critical influence on subsequent organizational actions (Barreto, 2012; Dutton & Jackson, 1987). When TMTs evaluate a strategic issue as an opportunity, the interpretation dampens perceptions of threat and that stimulates managers to identify benefits associated with the issue (Jackson & Dutton, 1988), motivates creativity and generation of ideas (Dutton, 1993), and leads to detailed identification of different alternatives that can be implemented to take advantage of the perceived opportunity (Grawitch et al., 2003).Also, like in previous studies, it was found that opportunity interpretation impacts the magnitude of the response that an organization will take (Sharma, 2000).

Empirical research has measured this dichotomy (opportunity/threat) assessing the perception of Positive-Gain/Negative-Gain and Controllable/Uncontrollable among top managers (e.g., Plambeck & Weber, 2010; Sharma, 2000; Thomas et al., 1993; Thomas & McDaniel, 1990). Specifically, empirical studies found that the degree of opportunity perception had a positive influence on the extent of implemented actions aimed to take advantage of the opportunity; in contexts such as healthcare, environmental management, and marketing response (Sharma, 2000; Thomas et al., 1993; White et al., 2003). The environmental management literature presents examples on how organizations decide to move from reactive to proactive stances when perceiving an opportunity of positive-gain and controllability when TMT analyze strategic issues (Sharma, 2000).

Results from the study lend support for the hypothesized relationship between the two dimensions of opportunity; that is the relationship between Positive-Gain and Proactive SAM (0.365 / t-val=3.842 / p-val=0.000) and the relationship between Controllability and Proactive SAM (0.275 / t-val=2.313 / p-val=0.021). The relationship from Positive-Gain to Proactive SAM is stronger than the relationship between Controllability and Proactive SAM.

Such difference in magnitude seems to suggest that Positive-Gain Interpretation is the more important dimension of opportunity influencing organizations to adopt Proactive SAM measures going beyond standard license management. Proactive SAM seeks to address the lifecycle management of software establishing a controlled environment, planning and internal auditing controls that ensure the use of software assets is efficient and aligned with the generation of organizational value. Such inference can be supported with an instrumental logic of strategy which prioritizes the use of rationality to identify positive opportunities using a cost or benefit assessment of the strategic actions that can be taken by the organization (Bundy et al., 2013). Proactive SAM measures emphasize the lifecycle of software assets, and the objective is to gain efficiency, reduce costs, mitigate risks when operating software. Hence, TMT's instrumental logic facilitates the anticipation of potential Positive-Gains and that can explain the strong relationship between Positive-Gain Interpretation and Proactive SAM.

Further, the hypothesized relationship positing a positive influence of Proactive SAM on Reactive SAM was marginally supported. Model 3B which controlled for the influence of IT Governance (IT Governance-1/business monarchy) shows that the path between Proactive SAM and Reactive SAM has a coefficient of 0.331 with a significance level of 0.055 percent. This could suggest that organizations where TMT participates of the IT governance processes (IT-Governance-1) are likely to show a positive influence of Proactive SAM on Reactive SAM.

Future studies, with a larger sample size, could further explore how the influence of IT governance can lead to Proactive SAM positively influencing Reactive SAM.

6.2 Implications

6.2.1 Theoretical Implications

Theoretical contributions to software asset management are scant. Gregor (2006) proposed a taxonomy to classify IS theoretical contributions. This taxonomy specifies five types of theoretical contributions in term of how they investigate a given phenomenon. Theories for analyzing (I), for explaining (II), for predicting (III), for explaining and predicting (IV), and for design and action (V) are defined by Gregor's work. Positivist research, often generates theories for predicting and theories for explaining and predicting. Theories for predicting a phenomenon have testable predictions studied with empirical methods but do not develop elaborate causal explanations. Theories for explaining and predicting a phenomenon combine theory types II and III and not only attempt to predict a phenomenon with a testable proposition (type III) but also develop causal explanations based on theory (Gregor, 2006).

Grounded on Gregor's (2006) taxonomy of theories in IS, it can be said that previous scholar work focuses on analysis theories that describe what SAM is (e.g. Ben-Menachem, 2008; Bequai, 1998; R. S. Glass & Wood, 1996; Holsing & Yen, 1999), design and action theories proposing methods to conduct SAM (e.g. Albert et al., 2013; Dery & Abran, 2004), or SAM explanations based on case studies (e.g. Bean, 2013; McCarthy & Herger, 2011). However, this study adds to SAM literature with a Type IV theory (explaining and predicting) because to the best of my knowledge no previous research work has analyzed SAM developing a model with testable hypotheses, grounded on theory, and tested with empirical data.

To study SAM, this investigation applied the strategic sensemaking theory in the context SAM at organizations. Previous IS scholar work has used sensemaking to understand the adoption of Green IS systems (Butler, 2011), or as a way to compare the managerial perception of performance versus actual measures of performance within an IS context (Tallon & Kraemer, 2007). However, this study extends the use of the sensemaking theory, within the IS domain, to understand how CIOs and TMTs evaluate IS strategic issue as an opportunity, and how the degree of identified opportunity influences the adoption of organizational actions.

In addition, the strategic sensemaking theory was used to account for the inclusion of the CIO within the top management team. Previous studies in IS have accounted for the inclusion of the CIO in the top managerial structures measuring variables such as systems of knowing (Armstrong & Sambamurthy, 1999), structural power (Preston et al., 2008; Preston et al., 2006), structural social capital , relational social capital and cognitive social capital (Karahanna & Preston, 2013). The inclusion of the CIO in the top managerial structures assumes that top managerial echelons facilitate the exchange of information and sharing of understanding and knowledge required to make decisions seeking the alignment of IS strategy with business objectives in order to contribute to the generation of organizational value (Armstrong & Sambamurthy, 1999; Karahanna & Preston, 2013; Preston & Karahanna, 2009; Preston et al., 2006). Thus, the adaptation of the Information Processing Structure into the CIO-TMT IPS could be used in future research work that needs to assess the influence of the managerial structure that decides on IS issues.

Further, based on the review of the SAM literature, this study developed an instrument to measure SAM in organizations. SAM is not a technology fad, and it can benefit organizations by ensuring that the IT asset that draws more investments is managed with a lifecycle focus that maximizes its efficient use in the organization. Clearly, SAM is a critical strategic issue (Barber et al., 2016; Forrester, 2015) with serious ramifications for related domains such as information security, software piracy, and IT audit and controls. Albeit since the 1990s and early 2000s, practitioners and IS scholars indicated the importance of top managers' responsibility for SAM (e.g., Adams 2003; Hoffman 1993; Holsing and Yen 1999), SAM has received limited scholarly research. Scholars interested in investigating SAM and its relationships with IT governance, information security, software piracy, and other related domains may be held back by the lack of a validated instrument for measuring SAM. Hence, the development of an instrument to measure SAM can contribute to future scholarly work investigating this topic.

6.2.2 Practical Implications

This study has practical implications for SAM. Organizations are under pressure to deliver IT at reduced cost and improved efficiency. Software assets capture a significant percent of IT expenditures and organizations are expected to manage software assets in a cost effective way that ensures the support of business strategies and in conformance with the copyright of software developers. SAM is a collection of activities that can address organizational needs to manage software meeting efficiency, cost, and copyright expectations.

Although SAM has been a subject of practitioners' interest since the 1990s (T. Hoffman, 1993; Radding, 1994), recent reports are highlighting that SAM is at early stages of adoption (Forrester, 2015). Several practitioner studies indicate that involving the top management team in the analysis of SAM is important if organizations are to manage software assets in accordance with the large amount of investment they draw from the organization (Barber et al., 2016; Forrester, 2015).

This study provides empirical support to practitioners claim on the importance of CIO inclusion and TMT involvement on software asset management. Organizations that have a high degree of CIO-TMT information processing structure and IS Domain-Offensive Strategic Orientation presented a pattern of seeing SAM as an issue that could be Controllable and of Positive-Gain for the organization. Both of the previous perceptions lead to the intention to adopt Proactive SAM actions.

The finding underscores the importance that organizations develop structures and processes for the TMT and CIO to discuss and exchange information about IS strategic issues such as SAM and create the conditions for an informed analysis of the opportunities that organizations could act on to take the best possible advantage of software assets. Further, when controlling for the IT Governance structure of organizations, the study also found a positive relationship between an IT Governance structure including the chief executives and intention to adopt Proactive SAM. Thus, the finding seems to confirm practitioners' literature positing that support from top management is fundamental if organizations are to implement a comprehensive SAM program.

6.3 Limitations and Future Research

Although this investigation makes significant contributions, it is important to discuss the limitations of this work and future research opportunities.

First, a limitation of this study is that it uses a nonprobabilistic sample from ResearchNow's CIO panel and that limits the generalization of the findings. ResearchNow panels have people who opt-in to participate in online surveys. The assembly of most opt-in panels does not involve probability-based recruitment (Baker et al., 2010). People that opt-in to participate in internet research panels provide demographic information that is later used by

ResearchNow to identify and verify potential respondents for a given survey panel (Klar, 2016). In exchange for the completion of a survey, ResearchNow provides to survey respondents points that provide access to loyalty rewards (ResearchNow, 2016). It is possible then that the panel of CIO respondents available from ResearchNow have a coverage sample bias as some CIOs may not be interested in participating of research panels. Also, although the response rate for this study is comparable with that of previous studies (Gerow et al., 2015), nonresponse bias cannot be ruled out. However, there is a growing use of online surveys to investigate IS phenomena (e.g. Angst & Agarwal, 2009; Gerow et al., 2015; Preston & Karahanna, 2009) when researchers seek to address a specialized population, such as in the case of CIOs.

Second, this investigation applies the strategic sensemaking theory and the institutional theory to assess the degree to which organizations would be inclined to implement SAM action in their organizations. While the literature shows the use of a case scenario to measure managerial perceptions of hypothetical situations deemed to be strategic (e.g. Ginsberg & Venkatraman, 1992; Kuvaas, 2002; Thomas et al., 1993), using a case scenario resulted in the collection of cross-sectional survey data. If possible, it would have been desirable to combine the TMT's measures of cognitive perceptions with actual measures such as findings from an audit assessing the degree of implementation of SAM. However, such study could be challenged by the willingness of organizations to share private information which in turn could negatively affect the sample size of a given study. Future research may explore the possibilities of using a research design that could combine perceptual and actual measures.

Third, this study has been conducted in an institutional context where there is a high degree of respect for intellectual property rights (Levy-Carciente, 2017). Institutional scholars indicate that the institutional environment determines the forces that will influence organizations to adopt organizational actions (DiMaggio & Powell, 1983). Generalizing the findings of this study to a different institutional environment should be exercised with caution because institutional forces may emerge from different sources not considered in this study. Also, contextualizing this research to a different institutional environment could extend the findings of this investigation.

Fourth, while controlling for IT Governance structure, it was found that organizations with IT governance exerted by the TMT are more likely to have Proactive SAM. Future studies could investigate the reasons why a given IT governance configuration may have an incidence on the organization's willingness or actual decisions to have a comprehensive SAM with Proactive SAM measures.

Finally, SAM research is scant despite suggestions of important benefits for organizations. However, this study developed and validated a SAM instrument that could be used in future studies to investigate the relationships between SAM and other relevant domains such as IS security, software piracy, and IT audit and controls. The answers of such studies could have practical implications because methodologies and strategies could be developed to improve the way organizations manage the lifecycle of software while reducing liability and security risks.

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APPENDIX

Table *A.1*
ISO 19770 Process definitions (ISO/IEC, 2012)

#	Type of Process	#	Process	
1	Control Environment Extent to which the organization executes a management system (i.e. governance, policies, and roles) supporting the implementation of SAM processes	1	Corporate Governance	Extent to which the organization defines a clear SAM corporate statement
		2	Roles and responsibilities	Extent to which roles and responsibilities for software and related assets are clearly defined, maintained and understood by all personnel
		3	Policies, processes, procedures	Extent to which organizations has implemented policies, processes, and procedures for SAM processes
		4	Competence	Extent to which competence and expertise in SAM is available and applied
2	Planning and Implementation (Captures the planning and implementation processes to facilitate effective and efficient accomplishment of SAM's objectives)	5	Planning for SAM	Extent to which preparation for effective and efficient accomplishment of SAM objectives is performed
		6	Implementation of SAM	Extent to which implementation of SAM processes is accomplished
		7	Monitoring and Review	Extent to which SAM processes are monitored and reviewed to ensure that SAM objectives are being achieved
		8	Continual improvement	Extent to which the organization identifies improvement of SAM processes
3	Inventory Processes Degree to which storage and records for software and related assets are kept ensuring the integrity of control on software and related assets	9	Software asset Identification	Extent to which the organization has formally defined the type of assets and information required to conduct SAM
		10	Software asset inventory management	Extent to which physical instances of software assets are stored and that data about the characteristics of software and related asset is accurately recorded through the lifecycle
		11	Software asset control	Extent to which control mechanisms such as audit trails, policies and procedures are developed, approved, and issued to control new versions and releases
4	Verification and Compliance Extent to which verification and compliance processes audit, assess, and detect deviations with SAM policies, processes, procedures, software asset security, and license usage rights	12	Software asset records verification	Extent of accuracy, completeness, change control of records on software assets
		13	Software licensing compliance	Extent to which the organization has processes to demonstrate compliance with intellectual property rights used by the organization in accordance with licenses or terms of use
		14	Software asset security compliance	Extent to which information security requirements for software assets are complied with
		15	Conformance verification	Extent to which there is evidence of internal verification of the compliance with defined policies, processes, and procedures
5	Operations Management and Interfaces (Captures the extent of execution of operational management functions on relationship and contract management, financial management, service level, and security of SAM processes which are essential to achieving SAM objectives and benefits.)	16	Relationship and contract management	Extent to which the organization manages relationship, and contracts with internal and external organizations to ensure the provision of quality software and related assets and services
		17	Financial management	Extent to which SAM generates information for budgeting, financial reporting, tax planning, cost of ownership, and return on investment
		18	Service level management	Extent to which software service levels are defined, recorded, and managed by SAM

#	Type of Process	#	Process	
		19	Security management for SAM	Extent to which information security and approval requirement for SAM processes are managed
6	Life Cycle Process interfaces Extent to which the organization executes life cycle processes for change management, acquisition, development, release management, deployment, incident management, problem management, and retirement of software	20	Change Management	Extent to which all changes to software with impacts on SAM are assessed, approved, implemented, controlled, recorded and reviewed
		21	Acquisition Process	Extent to which software and related assets are acquired in a controlled and properly recorded manner
		22	Software development	Extent to which software development considers SAM requirements (architecture, configurations, license constraints and dependencies)
		23	Software release management	Extent to which there is a formal process to manage software release in a planned way that supports SAM requirements
		24	Software deployment	Extent to which software deployment and redeployment follows SAM requirements
		25	Incident Management	Extent to which the organization has a formal process of incident management to monitor and respond to incidents in ongoing operations of software and related assets
		26	Problem Management	Extent to which there is a formal process of problem management to identify and analyze cause of incidents to address the underlying issues
		27	Retirement	Extent to which organizations have a formal process to remove software and related assets from use in accordance with policies and record keeping requirements

Table *A.2*

Information Cues Used in Case Scenario

		Formal	Informal
Internal	(+)	The CFO has acknowledged the need to control software costs because they are among the top IT expenses. (2) The CFO thinks that your firm can reduce software costs by 25% during the first year by adopting a comprehensive SAM program. (9)	Recently, the procurement personnel found that bulk discounts are possible on purchase of volume licenses if accurate information on use of software assets is available. (8) The IT technicians have heard rumors about a department using a cloud based analytics tool even though it is not reported in your software inventory. (14)
Internal	(-)	Your internal auditors have cautioned that the organization's SAM execution has been inadequate. (11) Internal auditors found 11% excess use of Microsoft Word licenses. (12)	Some managers have expressed concern that a negative SAM audit will adversely affect your organization's reputation with key stakeholders. (7) The helpdesk technicians agree and think that tracking and executing software requests can be done more effectively if they had access to a similar tool in the organization. (16)
External	(+)	Gartner, a leading IT research firm, reported that organizations are more efficient in managing strategic software when chief executives sponsor SAM programs. (3) Likewise, your external auditor suggested that effective software support and maintenance can yield yearly savings of about 10%. (10)	CNN Money mentioned that good SAM strategy is one that aligns current and future business demand of software. (1) A software vendor mentioned that specialized SAM software can generate accurate audits of software assets. (15)
External	(-)	External auditors affirmed that inaccurate information about software assets exposes your organization to greater security and liability risks. (6) A recent article in a top IT publication suggests that running software on local, virtualized, and cloud environments has increased the complexity of SAM. (13)	An IT consultant said that organizations frequently face vendor audits and involuntary license violation resulting in compensation payments to software vendors. (4) Recently, your main competitor settled a software license violation case by paying $450,000 to Oracle. (5)

Table *A.3*
Items Used in the Confirmatory Factor Analysis(Pilot)

Construct	Initial Items	Items*	Acronym	Used Items
Coercive	4	4	Inst	**Inst01** It is important for my organization to comply with government intellectual property regulations **Inst02** My organization is aware of severe penalties for noncompliance with government regulations on intellectual property rights **Inst03** My organization knows that the government requires our firm to acquire software licenses legally **Inst 04** My organization is concerned to meet contractual obligations stipulated in software licenses
Strategy	6	4	Stra	**Stra01** Try to be the first to offer innovative Information Systems (IS)? **Stra02** Pursue early adoption of new IS technologies? **Stra03** Endeavor to develop new IS offerings? **Stra04** Respond rapidly to early external signs of IS opportunities?
CIO-TMT Information Processing Structure	9	8	Form, Intr, Part	**Part01** Encourage the CIO to participate with TMT in the analysis of IS strategic issues? **Part02** Expect the CIO to provide advice to TMT before making decisions on IS strategic issues? **Part03** Expect the CIO to play an active role when TMT make decisions on IS strategic issues? **Intr01** Expect the CIO to interact with TMT members on an informal basis? **Intr02** Expect the CIO and TMT to interact in the decision making of IS strategic issues? **Form01** Follow written rules and procedures when the CIO and TMT address IS strategic issues? **Form02** Have rule oriented decision-making procedures when CIO and TMT address IS strategic issues? **Form03** Require formal committees or task groups when CIO and TMT deal with IS strategic issues?
Positive Gain[21]	10	4	PoGa	**PoGa03** Evaluate the situation as a potential gain? **PoGa05** Assess the situation as something positive? **PoGa05** Feel the future will be better because of the situation? **PoGa10** Feel that there is a high probability of gaining a great deal?
Controllability	5	3	Contr	**Contr01** Have a choice about whether or not to address the situation? **Contr02** Feel it has the capability to address the situation? **Contr03** Feel that it can manage the situation instead of the situation managing the organization?
Proactive SAM	20	4	PrAc	**PrAc01** (CoEn01) Expect top management or equivalent body to define a corporate statement scoping SAM? **PrAc02** (PaIm02) Expect top management to review reports measuring SAM implementation progress against plan? **PrAc03** (LyIn06) Execute problem management to identify and solve issues with software assets through their lifecycle? **PrAc04** (OpMa01) Engage in managing service level of software assets by defining agreements with relevant entities?
Reactive SAM	8	4	ReAc	**ReAc01** (InCn03) Store physical copies of software assets? **ReAc02** (InCn04) Record information on characteristics of software and related assets? **ReAc03** (VeCo01) Formally verify and reconcile documentation on software licenses, inventory, or location? **ReAc04** (VeCo04) Regularly verify compliance with software licensing terms (i.e. actual use vs. permitted use)?
Total	62	31		

* Items that remained after confirmatory factor analysis
Controllability (Contr), Formalization (Form), Institutional (Inst), Interaction (Intr), Participation (Part), Positive-Gain (PoGa), Proactive(PrAc), Reactive (ReAc), and Strategy (Stra)

[21] Although Thomas and McDaniel (1990)proposed 10 items to measure positive-gain interpretation, other researchers have use less items to measure positive gain (i.e., Sharma (2000) / 2 items; Plambeck and Weber (2010) 2 items)

Table *A.4*

Items Used in the Confirmatory Factor Analysis (Full Study)

Construct	Items	Acronym	Used Items
Coercive	4	Inst	**Inst01** It is important for my organization to comply with government intellectual property regulations
			Inst02 My organization is aware of severe penalties for noncompliance with government regulations on intellectual property rights
			Inst03 My organization knows that the government requires our firm to acquire software licenses legally
			Inst 04 My organization is concerned to meet contractual obligations stipulated in software licenses
Strategy	4	Stra	**Stra01** Try to be the first to offer innovative Information Systems (IS)?
			Stra02 Pursue early adoption of new IS technologies?
			Stra04 Respond rapidly to early external signs of IS opportunities?
			Stra05 Provide continuously and IS portfolio that meets evolving organizational needs?
CIO-TMT Information Processing Structure	8	Form, Inter, Part	**Part01** Encourage the CIO to participate with TMT in the analysis of IS strategic issues?
			Part02 Expect the CIO to provide advice to TMT before making decisions on IS strategic issues?
			Part03 Expect the CIO to play an active role when TMT make decisions on IS strategic issues?
			Inter01 Expect the CIO to interact with TMT members on an informal basis?
			Inter02 Expect the CIO and TMT to interact in the decision making of IS strategic issues?
			Inter03 Have an open exchange of ideas between CIO and TMT when analyzing IS strategic issues?
			Form01 Follow written rules and procedures when the CIO and TMT address IS strategic issues?
			Form03 Require formal committees or task groups when CIO and TMT deal with IS strategic issues?
Positive Gain	4	PoGa	**PoGa01** Evaluate the situation as a potential gain?
			PoGa02 Assess the situation as something positive?
			PoGa03 Feel the future will be better because of the situation?
			PoGa04 Feel that there is a high probability of gaining a great deal?
Controllability	4	Contr	**Contr02** Feel it has the capability to address the situation?
			Contr03 Feel that it can manage the situation instead of the situation managing the organization?
			Contr04 Possess the capability to manage it?
			Contr05 Perceive the situation as controllable?
Proactive SAM	8	PSAM	**PSAM01** Expect top management or equivalent body to define a corporate statement scoping SAM?
			PSAM02 Expect top management to review reports measuring SAM implementation progress against plan?
			PSAM03 Execute problem management to identify and solve issues with software assets through their lifecycle?
			PSAM04 Engage in managing service level of software assets by defining agreements with relevant entities?
			PSAM05 (CEnv01) Assign and communicate employees' roles and responsibilities in the SAM system?
			PSAM06 (P_Imp03) Modify SAM planning and implementation when identifying improvements?
			PSAM07 (LCy07) Execute software development processes so that architecture, configuration, and licensing are under SAM control before live deployment?
			PSAM08 (OMgt1) Manage information security of all SAM processes? (i.e. physical/logical /procedural)
Reactive SAM	4	RSAM	**RSAM01** Store physical copies of software assets?
			RSAM02 Record information on characteristics of software and related assets?
			RSAM03 Formally verify and reconcile documentation on software licenses, inventory, or location?
			RSAM04 Regularly verify compliance with software licensing terms (i.e. actual use vs. permitted use)?
Total	36		

Controllability (Contr), Formalization (Form), Institutional/Coercive (Inst), Interaction (Inter), Participation (Part), Positive-Gain (PoGa), Proactive SAM(PSAM), Reactive (RSAM), and Strategy (Stra), Control Environment (CEnv), Planning and Implementation (P_Imp), Lifecycle (LCy), and Operations Management (OMgt)

Table *A.5*
Missing Values

																Missing Data by Observation	
Rec_no	Stra03	Part02	Inter01	Inter02	Inter03	Form01	Form03	Inst02	PoGa02	PoGa03	Contr02	Contr03	Contr04	PSAM03	LCy07	Total	Percent
1										x						1	2.78%
13															x	1	2.78%
26												x				1	2.78%
28											x					1	2.78%
37				x												1	2.78%
55							x									1	2.78%
57													x			1	2.78%
71				x												1	2.78%
74	x															1	2.78%
87				x												1	2.78%
118		x														1	2.78%
132						x										1	2.78%
133														x		1	2.78%
137			x													1	2.78%
141					x											1	2.78%
145							x									1	2.78%
148			x													1	2.78%
155									x							1	2.78%
187								x								1	2.78%
Missing data by variable	1	1	2	3	1	1	2	1	1	1	1	1	1	1	1	Total Missing Values in data set	
Percent	0.53%	0.53%	1.07%	1.60%	0.53%	0.53%	1.07%	0.53%	0.53%	0.53%	0.53%	0.53%	0.53%	0.53%	0.53%	Number	Percent
																19	0.28%

n = 187, items = 36. Maximum number of possible observations = 6732

Table *A.6*

Principal Component Analysis of SAM Instrument (Pilot)

	Component		Comment
	Proactive	Reactive	
InCn01	.524	.669	
InCn02	.533	.644	
InCn03 / ReAc01		.657	
InCn04 / ReAc02	.481	.721	
VeCo01 / ReAc03		.881	
VeCo02	.481	.670	
VeCo03	.704	.491	
VeCo04 / ReAc04	.414	.798	
CoEn01 / PrAc01	.812		
CoEn02	**.797**		
CoEn03	**.817**		
CoEn04		.743	Not supported by SAM framework
PaIm01	.741	.551	
PaIm02 / PrAc02	.817		
PaIm03	**.776**	.437	
PaIm04	**.741**	.527	
LyIn01	.590	.580	
LyIn02	.730	.482	
LyIn03	.671	.526	
LyIn04	.514	.485	
LyIn05	**.736**	.479	
LyIn06 / PrAc03	.746	.408	
LyIn07	**.750**	.475	
LyIn08	.706	.495	
OpMa01 / PrAc04	.787		
OpMa02	**.799**		
OpMa03	.797		
OpMa04	.732	.501	

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization
Loadings below 0.40 are not shown
Shaded cells highlight CFA items examined with PLS in a different analysis

Table *A.7*

Principal Component Analysis of SAM Instrument (Full Study)

	Component	
	Proactive	Reactive
RSAM01		.816
RSAM02		.825
RSAM03		.794
RSAM04		.829
PSAM01	.747	
PSAM02	.751	
PSAM03	.822	
PSAM04	.794	
PSAM05 (CEnv01)	.718	
PSAM06 (P_Imp03)	.756	
PSAM07 (LCy07)	.720	
PSAM08 (OMgt01)	.741	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Loadings below 0.40 are not shown

Pilot Survey

Instructions

Please answer the questions of the accompanying survey based on what your organization would do (not you personally). There are no right or wrong answers.

Definitions of terms used in the survey are shown below.

Strategic Issues are situations that could alter the position of the organization, affect the whole organization, or impact the purposes or goals of the organization.

Software asset management (SAM) is the integration of people, processes, information, and infrastructure required for the lifecycle management, protection, and efficient utilization of software assets by an organization.

The top management team (TMT) is the group of the highest-level executives with a responsibility to interpret information and make decisions about the formulation, articulation, and execution of strategy and tactics implemented by an organization.

(IS Strategic Orientation)[22]

#	For each question, select the answer that best represents the decision-making process about IS strategic issues in your organization. To what extent does your organization …	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
1	Try to be the first to offer innovative Information Systems (IS) solutions?	1	2	3	4	5	6	7
2	Is usually among the early adopters of new IS technologies?	1	2	3	4	5	6	7
3	Always endeavor to develop new IS offerings?	1	2	3	4	5	6	7
4	Respond rapidly to early external signs of IS opportunities?	1	2	3	4	5	6	7
5	Have an IS portfolio which is always growing?	1	2	3	4	5	6	7
6	Enter in partnership with external IS partners?	1	2	3	4	5	6	7

(Participation)

#	For each question, select the answer that best represents the decision-making process about IS strategic issues in your organization. To what extent does your organization...	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor	Somewhat Agree	Agree	Strongly Agree
7	Encourage the CIO to participate with TMT in the analysis of IS strategic issues?	1	2	3	4	5	6	7
8	Expect the CIO to provide advice to TMT before making decisions on IS strategic issues?	1	2	3	4	5	6	7

[22] Paper and online versions of the pilot and full study that were administered to respondents do not show the question number nor the underlying construct it researches. That information is only available in this version for illustration purposes.

9	Expect the CIO to play an active role when TMT make decisions on IS strategic issues?	1	2	3	4	5	6	7

(Interaction) CIO-TMT Interaction.

#	For each question, select the answer that best represents the decision-making process about IS strategic issues in your organization. To what extent does your organization...	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor	Somewhat Agree	Agree	Strongly Agree
10	Expect the CIO to interact with TMT members on an informal basis?	1	2	3	4	5	6	7
11	Expect the CIO and TMT to interact in the decision making of IS strategic issues?	1	2	3	4	5	6	7
12	Expect the CIO to have a free and open exchange of ideas with TMT members on IS strategic issues?	1	2	3	4	5	6	7

(Formalization)

#	For each question, select the answer that best represents the decision-making process about IS strategic issues in your organization. To what extent does your organization...	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor	Somewhat Agree	Agree	Strongly Agree
13	Follow written rules and procedures when the CIO and TMT address IS strategic issues?	1	2	3	4	5	6	7
14	Have rule oriented decision-making procedures when CIO and TMT address IS strategic issues?	1	2	3	4	5	6	7
15	Require formal committees or task groups when CIO and TMT deal with IS strategic issues?	1	2	3	4	5	6	7

(Institutional Forces)

#	For each statement, select the answer that best represents your organization	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor	Somewhat Agree	Agree	Strongly Agree
16	It is important for our organization to comply with government's intellectual property regulations	1	2	3	4	5	6	7
17	My organization is aware of severe penalties for noncompliance with government regulations on intellectual property rights	1	2	3	4	5	6	7
18	My organization knows that the government requires our firm to acquire software licenses legally	1	2	3	4	5	6	7
19	My organization is concerned to meet contractual obligations stipulated in software licenses	1	2	3	4	5	6	7

Assume that your organization is facing the situation that is described below. Please answer the questions that follow based on what your organization would do (not you personally).

Scenario

After a year of slow growth, the outlook of your organization is positive, and crucial business strategies rely on the execution of IT initiatives. Resources for IT, however, continue to be limited.

CNN Money mentioned that a good SAM strategy is one that aligns current and future business demands of software. The CFO has acknowledged the need to control software costs because they are among the top IT expenses. Gartner, a leading IT research firm, reported that organizations are more efficient in managing strategic software when chief executives sponsor SAM programs.

An IT consultant said that organizations frequently face vendor audits and involuntary license violations resulting in compensation payments to software vendors. Recently, your main competitor settled a software license violation case by paying $450,000 to Oracle. External auditors affirmed that inaccurate information about software assets exposes your organization to greater security and liability risks. Some managers have expressed a concern that a negative SAM audit will adversely affect your organization's reputation with key stakeholders.

Recently, the procurement personnel found that bulk discounts are possible on purchase of volume licenses if accurate information on use of software assets is available. The CFO thinks that your firm can reduce software costs by 25% during the first year by adopting a comprehensive SAM program. Likewise, your external auditor suggested that effective software support and maintenance can yield yearly savings of about 10%.

Your internal auditors have cautioned that the organization's SAM execution has been inadequate. They found 11% excess use of Microsoft Word licenses. A recent article in a top IT publication suggests that running software on local, virtualized, and cloud environments has increased the complexity of SAM. The IT technicians have heard rumors about a department using a cloud based analytics tool even though it is not reported in your software inventory.

A software vendor mentioned that specialized SAM software can generate accurate audits of software assets. The helpdesk technicians agree and think that tracking and executing software requests can be done more effectively if they had access to a similar tool in your organization

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A situation is said to be strategic when it could alter the position of the organization, affect the whole organization, and impact the purposes or goals of the organization.

#	To what extent would your organization consider the situation described in the scenario to be...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
20	Strategic for organization's Information Systems (IS)?	1	2	3	4	5	6	7
21	Strategic for the organization?	1	2	3	4	5	6	7

Positive Gain (Opportunity).

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
22	Perceive the benefits that may come from the situation?	1	2	3	4	5	6	7
23	Evaluate the situation as likely negative?	1	2	3	4	5	6	7
24	Evaluate the situation as a potential gain?	1	2	3	4	5	6	7
25	Perceive the situation as a potential loss?	1	2	3	4	5	6	7
26	Assess the situation as something positive?	1	2	3	4	5	6	7
27	Feel the future will be better because of the situation?	1	2	3	4	5	6	7
28	See the situation as having positive implications for the future?	1	2	3	4	5	6	7
29	Feel that there is a high a probability of losing a great deal?	1	2	3	4	5	6	7
30	See the situation as having negative implications for the future?	1	2	3	4	5	6	7
31	Feel that there is a high probability of gaining a great deal?	1	2	3	4	5	6	7

Controllability (Opportunity).

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
32	Have a choice about whether or not to address the situation?	1	2	3	4	5	6	7
33	Feel it has the capability to address the situation?	1	2	3	4	5	6	7
34	Feel that it can manage the situation instead of the situation managing the organization?	1	2	3	4	5	6	7
35	Feel that how the situation is resolved is a matter of chance?	1	2	3	4	5	6	7
36	Be constrained in how it could interpret the situation?	1	2	3	4	5	6	7

Reactive Controls (Inventory and Audit).

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
37	Formally document changes to status or location of software and related assets?	1	2	3	4	5	6	7
38	Define assets and information required to ensure integrity and control of software inventory?	1	2	3	4	5	6	7
39	Store physical copies of software assets?	1	2	3	4	5	6	7
40	Record information on characteristics of software and related assets?	1	2	3	4	5	6	7

Reactive (Verification and Compliance)

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
41	Formally verify and reconcile documentation on software licenses, inventory, or location?	1	2	3	4	5	6	7
42	Regularly verify compliance with security requirements for software assets (i.e. access controls to master copies, installation/usage rights controls)?	1	2	3	4	5	6	7
43	Regularly conduct internal verification of organizational conformance with SAM (i.e. policies, procedures)?	1	2	3	4	5	6	7

44	Regularly verify compliance with software licensing terms (i.e. actual use vs. permitted use)?	1	2	3	4	5	6	7

Proactive (Control Environment)

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
45	Expect top management or equivalent body to define a corporate statement scoping SAM?	1	2	3	4	5	6	7
46	Assign and communicate employees' roles and responsibilities in the SAM system?	1	2	3	4	5	6	7
47	Train personnel on SAM responsibilities?	1	2	3	4	5	6	7
48	Expects that SAM policies and procedures defined by management are followed closely by employees?	1	2	3	4	5	6	7

Proactive (Planning & Implementation)

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
49	Define plans for implementing SAM?	1	2	3	4	5	6	7
50	Expect top management to review reports measuring SAM implementation progress against plan?	1	2	3	4	5	6	7
51	Conduct periodic reviews assessing if SAM plans and objectives are being achieved?	1	2	3	4	5	6	7
52	Modify SAM planning and implementation when identifying improvements?	1	2	3	4	5	6	7

Proactive (Lifecycle Process Interfaces)

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
53	Execute processes to record all changes impacting software and related assets lifecycle?	1	2	3	4	5	6	7
54	Consistently control the retirement of software or related assets in accordance to software lifecycle?	1	2	3	4	5	6	7
55	Execute processes ensuring managed and controlled acquisition of software and related assets?	1	2	3	4	5	6	7
56	Document and classify incidents affecting software or related assets through their lifecycle?	1	2	3	4	5	6	7
57	Execute formal SAM processes controlling software releases through its lifecycle?	1	2	3	4	5	6	7
58	Execute problem management to identify and solve issues with software assets through their lifecycle?	1	2	3	4	5	6	7
59	Execute formal control of deployment and redeployment of software through their lifecycle?	1	2	3	4	5	6	7
60	Execute software development processes so that architecture, configuration, and licensing are under SAM control before live deployment?	1	2	3	4	5	6	7

Proactive (Operation Management and Interfaces)

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
61	Engage in managing service level of software assets by defining agreements with relevant entities?	1	2	3	4	5	6	7
62	Manage information security of all SAM processes? (i.e. physical/logical /procedural)	1	2	3	4	5	6	7
63	Generate financial reports about software assets? (i.e. budgeting, financial, taxes, cost)	1	2	3	4	5	6	7
64	Actively manage relationships and contracts with entities providing software and related assets?	1	2	3	4	5	6	7

General Information

1. What is your gender?

- ☐ Male
- ☐ Female

2. How old are you?

- ☐ 25 and under
- ☐ 26-30
- ☐ 31-35
- ☐ 36-40
- ☐ 41-45
- ☐ 46-50
- ☐ 51–55
- ☐ 56–60
- ☐ 60 & Above

3. About how many years do you have in your organization?

- ☐ 1-3
- ☐ 4-6
- ☐ 7-10
- ☐ 11-Above

4. What education level have you completed?

- ☐ Graduate
- ☐ Bachelors
- ☐ Associates
- ☐ Some college
- ☐ High school and below
- ☐ Other (Please specify) ___________________

5. What is your job position?

- ☐ CIO
- ☐ CTO
- ☐ IT Director
- ☐ IT Manager
- ☐ IS Manager
- ☐ Other (Please specify) ___________________

6. About how many people are in your organization's top management team? ___________

7. In your organization, who determines Information Technology strategy?
(Select the option that most closely resembles your organization)

- ☐ C-Level executives
- ☐ Corporate IT Professionals
- ☐ Autonomous business units
- ☐ A combination involving C-level executives, Corporate IT professionals, business units
- ☐ IT corporate professionals and one business group
- ☐ Each business group

8. In your organization, who determines Information Technology strategy concerning software assets?

(select the option that most closely resembles your organization)

- ☐ C-Level executives
- ☐ Corporate IT Professionals
- ☐ Autonomous business units
- ☐ A combination involving C-level executives, Corporate IT professionals, business units
- ☐ IT corporate professionals and one business group
- ☐ Each business group

9. About how many employees does your organization have?

- ☐ Under 100
- ☐ 100 - 500
- ☐ 500 - 1000
- ☐ 1000 - 2500
- ☐ 2500 - 5000
- ☐ 5000 - 10000
- ☐ 10000 or above

10. Can you estimate your organization's revenue?

- ☐ $1 million or less
- ☐ 1$ million to below $50 million
- ☐ $50 million to below $100 million
- ☐ $100 million to below $500 million
- ☐ $500 million to below $1 billion
- ☐ $5 billion to below $10 billion
- ☐ $10 billion or more

11. What is the industry sector of your organization?

- ☐ Agriculture
- ☐ Banking/Finance/Insurance
- ☐ Consulting
- ☐ Education
- ☐ Food/Beverage/Consumer Packaged Goods
- ☐ Government
- ☐ Healthcare
- ☐ Hospitality
- ☐ Information Technology
- ☐ Manufacturing
- ☐ Media/Entertainment/Publishing
- ☐ Medical, Bio-Technology, Pharmacology
- ☐ Nonprofit
- ☐ Retail/Wholesale/Distribution
- ☐ Real Estate
- ☐ Telecommunications
- ☐ Other ____________________

Describe the CIO Position

12. Is the CIO a formal member of the top management team? (yes / no)
13. How many reporting levels are between the CIO and the CEO? (a. direct report, b. 1 level, c. 2 or more levels)

Table *A.8*

Item Progression from Pilot to Final Survey

Pilot_ID	Pilot_Item	Final_ID	Final_Item	Origin	Comment
Stra01	Try to be the first to offer innovative Information Systems (IS) solutions?	Stra01	Try to be the first to offer innovative Information Systems (IS) solutions?	Stra01	
Stra02	Is usually among the early adopters of new IS technologies?	Stra02	Is usually among the early adopters of new IS technologies?	Stra02	
Stra03	Always endeavor to develop new IS offerings?	Stra03	Always endeavor to develop new IS offerings?	Stra03	
Stra04	Respond rapidly to early external signs of IS opportunities?	Stra04	Respond rapidly to early external signs of IS opportunities?	Stra04	
Stra05	Have an IS portfolio which is always growing?	Stra05	Provide continuously an IS portfolio that meets evolving organizational needs?	Stra05	Reworded after pilot
Stra06	Enter in partnership with external IS partners?	Dropped	Dropped after pilot		
Part01	Encourage the CIO to participate with TMT in the analysis of IS strategic issues?	Part01	Encourage the CIO to participate with TMT in the analysis of IS strategic issues?	Part01	
Part02	Expect the CIO to provide advice to TMT before making decisions on IS strategic issues?	Part02	Expect the CIO to provide advice to TMT before making decisions on IS strategic issues?	Part02	
Part03	Expect the CIO to play an active role when TMT make decisions on IS strategic issues?	Part03	Expect the CIO to play an active role when TMT make decisions on IS strategic issues?	Part03	
Int01	Expect the CIO to interact with TMT members on an informal basis?	Int01	Expect the CIO to interact with TMT members on an informal basis?	Int01	
Int02	Expect the CIO and TMT to interact in the decision making of IS strategic issues?	Int02	Expect the CIO and TMT to interact in the decision making of IS strategic issues?	Int02	
Int03	Expect the CIO to have a free and open exchange of ideas with TMT members on IS strategic issues?	Int03	Have an open exchange of ideas between CIO and TMT when analyzing IS strategic issues strategic issues?	Int03	Reworded after pilot
Form01	Follow written rules and procedures when the CIO and TMT address IS strategic issues?	Form01	Follow written rules and procedures when the CIO and TMT address IS strategic issues?	Form01	

Table *A.8*

Item Progression from Pilot to Final Survey

Pilot_ID	Pilot_Item	Final_ID	Final_Item	Origin	Comment
Form02	Have rule oriented decision-making procedures when CIO and TMT address IS strategic issues?	Form02	Have rule oriented decision-making procedures when CIO and TMT address IS strategic issues?	Form02	
Form03	Require formal committees or task groups when CIO and TMT deal with IS strategic issues?	Form03	Require formal committees or task groups when CIO and TMT deal with IS strategic issues?	Form03	
Inst01	It is important for our organization to comply with government's intellectual property regulations	Inst01	It is important for our organization to comply with government's intellectual property regulations	Inst01	
Inst02	My organization is aware of severe penalties for noncompliance with government regulations on intellectual property rights	Inst02	My organization is aware of severe penalties for noncompliance with government regulations on intellectual property rights	Inst02	
Inst03	My organization knows that the government requires our firm to acquire software licenses legally	Inst03	My organization knows that the government requires our firm to acquire software licenses legally	Inst03	
Inst04	My organization is concerned to meet contractual obligations stipulated in software licenses	Inst04	My organization is concerned to meet contractual obligations stipulated in software licenses	Inst04	
PoGa01	Perceive the benefits that may come from the situation?	Dropped	Dropped after pilot		
PoGa02	Evaluate the situation as likely negative?	Dropped	Dropped after pilot		
PoGa03	Evaluate the situation as a potential gain?	PoGa01	Evaluate the situation as a potential gain?	PoGa03	
PoGa04	Perceive the situation as a potential loss?	Dropped	Dropped after pilot		
PoGa05	Assess the situation as something positive?	PoGa02	Assess the situation as something positive?	PoGa05	
PoGa06	Feel the future will be better because of the situation?	PoGa03	Feel the future will be better because of the situation?	PoGa06	
PoGa07	See the situation as having positive implications for the future?	Dropped	Dropped after pilot		

Table *A.8*

Item Progression from Pilot to Final Survey

Pilot_ID	Pilot_Item	Final_ID	Final_Item	Origin	Comment
PoGa08	Feel that there is a high a probability of losing a great deal?	Dropped	Dropped after pilot		
PoGa09	See the situation as having negative implications for the future?	Dropped	Dropped after pilot		
PoGa10	Feel that there is a high probability of gaining a great deal?	PoGa04	Feel that there is a high probability of gaining a great deal?	PoGa10	
Contr01	Have a choice about whether or not to address the situation?	Contr01	Have a choice about whether or not to address the situation?		
Contr02	Feel it has the capability to address the situation?	Contr02	Feel it has the capability to address the situation?		
Contr03	Feel that it can manage the situation instead of the situation managing the organization?	Contr03	Feel that it can manage the situation instead of the situation managing the organization?		
Contr04	Feel that how the situation is resolved is a matter of chance?	Contr04	Possess the capability to manage it?		Changed after pilot. Avoided negatively worded item
Contr05	Be constrained in how it could interpret the situation?	Contr05	Perceive the situation as controllable?		Changed after pilot. Avoided negatively worded item
InCn01	Formally document changes to status or location of software and related assets?	OSAM01	Formally document changes to status or location of software and related assets?	InCn01	
InCn02	Define assets and information required to ensure integrity and control of software inventory?	OSAM02	Define assets and information required to ensure integrity and control of software inventory?	InCn02	
InCn03	Store physical copies of software assets?	**RSAM01**	Store physical copies of software assets?	InCn03	Loaded as RSAM in pilot
InCn04	Record information on characteristics of software and related assets?	**RSAM02**	Record information on characteristics of software and related assets?	InCn04	Loaded as RSAM in pilot
VerCo01	Formally verify and reconcile documentation on software licenses, inventory, or location?	**RSAM03**	Formally verify and reconcile documentation on software licenses, inventory, or location?	VerCo01	Loaded as RSAM in pilot
VerCo02	Regularly verify compliance with security requirements for software assets	OSAM03	Regularly verify compliance with security requirements for software assets (i.e. access controls to	VerCo02	

Table *A.8*

Item Progression from Pilot to Final Survey

Pilot_ID	Pilot_Item	Final_ID	Final_Item	Origin	Comment
	(i.e. access controls to master copies, installation/usage rights controls)?		master copies, installation/usage rights controls)?		
VerCo03	Regularly conduct internal verification of organizational conformance with SAM (i.e. policies, procedures)?	OSAM04	Regularly conduct internal verification of organizational conformance with SAM (i.e. policies, procedures)?	VerCo03	
VerCo04	Regularly verify compliance with software licensing terms (i.e. actual use vs. permitted use)?	**RSAM04**	Regularly verify compliance with software licensing terms (i.e. actual use vs. permitted use)?	VerCo04	Loaded as RSAM in pilot
CoEn01	Expect top management or equivalent body to define a corporate statement scoping SAM?	**PSAM01**	Expect top management or equivalent body to define a corporate statement scoping SAM?	CoEn01	Loaded as PSAM in pilot
CoEn02	Assign and communicate employees' roles and responsibilities in the SAM system?	**CEnv01**	Assign and communicate employees' roles and responsibilities in the SAM system?	CoEn02	**PSAM**
CoEn03	Train personnel on SAM responsibilities?	CEnv02	Train personnel on SAM responsibilities?	CoEn03	
CoEn04	Expects that SAM policies and procedures defined by management are followed closely by employees?	CEnv03	Expects that SAM policies and procedures defined by management are followed closely by employees?	CoEn04	
Palm01	Define plans for implementing SAM?	P_Imp01	Define plans for implementing SAM?	Palm01	
Palm02	Expect top management to review reports measuring SAM implementation progress against plan?	**PSAM02**	Expect top management to review reports measuring SAM implementation progress against plan?	Palm02	
Palm03	Conduct periodic reviews assessing if SAM plans and objectives are being achieved?	P_Imp02	Conduct periodic reviews assessing if SAM plans and objectives are being achieved?	Palm03	
Palm04	Modify SAM planning and implementation when identifying improvements?	**P_Imp03**	Modify SAM planning and implementation when identifying improvements?	Palm04	**PSAM**
Lyln01	Execute processes to record all changes impacting software and related assets lifecycle?	LCy01	Execute processes to record all changes impacting software and related assets lifecycle?	Lyln01	

Table *A.8*

Item Progression from Pilot to Final Survey

Pilot_ID	Pilot_Item	Final_ID	Final_Item	Origin	Comment
Lyln02	Consistently control the retirement of software or related assets in accordance to software lifecycle?	LCy02	Consistently control the retirement of software or related assets in accordance to software lifecycle?	Lyln02	
Lyln03	Execute processes ensuring managed and controlled acquisition of software and related assets?	LCy03	Execute processes ensuring managed and controlled acquisition of software and related assets?	Lyln03	
Lyln04	Document and classify incidents affecting software or related assets through their lifecycle?	LCy04	Document and classify incidents affecting software or related assets through their lifecycle?	Lyln04	
Lyln05	Execute formal SAM processes controlling software releases through its lifecycle?	**LCy05**	Execute formal SAM processes controlling software releases through its lifecycle?	Lyln05	**PSAM**
Lyln06	Execute problem management to identify and solve issues with software assets through their lifecycle?	**PSAM03**	Execute problem management to identify and solve issues with software assets through their lifecycle?	Lyln06	Loaded as PSAM in pilot
Lyln07	Execute formal control of deployment and redeployment of software through their lifecycle?	LCy06	Execute formal control of deployment and redeployment of software through their lifecycle?	Lyln07	
Lyln08	Execute software development processes so that architecture, configuration, and licensing are under SAM control before live deployment?	LCy07	Execute software development processes so that architecture, configuration, and licensing are under SAM control before live deployment?	Lyln08	
OMgt01	Engage in managing service level of software assets by defining agreements with relevant entities?	**PSAM04**	Engage in managing service level of software assets by defining agreements with relevant entities?	OMgt01	Loaded as PSAM in pilot
OMgt02	Manage information security of all SAM processes? (i.e. physical/logical /procedural)	**OMgt01**	Manage information security of all SAM processes? (i.e. physical/logical /procedural)	OMgt02	**PSAM**
OMgt03	Generate financial reports about software assets? (i.e. budgeting, financial, taxes, cost)	OMgt02	Generate financial reports about software assets? (i.e. budgeting, financial, taxes, cost)	OMgt03	
OMgt04	Actively manage relationships and contracts with entities providing software and related assets?	OMgt03	Actively manage relationships and contracts with entities providing software and related assets?	OMgt04	

Full Study Survey

Instructions

Please answer the questions of the accompanying survey based on what your organization would do (not you personally). There are no right or wrong answers.

Definitions of terms used in the survey are shown below.

Strategic Issues are situations that could alter the position of the organization, affect the whole organization, or impact the purposes or goals of the organization.

Software asset management (SAM) is the integration of people, processes, information, and infrastructure required for the lifecycle management, protection, and efficient utilization of software assets by an organization.

The top management team (TMT) is the group of the highest-level executives with a responsibility to interpret information and make decisions about the formulation, articulation, and execution of strategy and tactics implemented by an organization.

(IS Strategic Orientation)[23]

#	For each question, select the answer that best represents the decision-making process about IS strategic issues in your organization. To what extent does your organization …	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
1	Try to be the first to offer innovative Information Systems (IS) solutions?	1	2	3	4	5	6	7
2	Is usually among the early adopters of new IS technologies?	1	2	3	4	5	6	7
3	Always endeavor to develop new IS offerings?	1	2	3	4	5	6	7
4	Respond rapidly to early external signs of IS opportunities?	1	2	3	4	5	6	7
5	Provide continuously an IS portfolio that meets evolving organizational needs?	1	2	3	4	5	6	7

(Participation)

#	For each question, select the answer that best represents the decision-making process about IS strategic issues in your organization. To what extent does your organization...	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor	Somewhat Agree	Agree	Strongly Agree
6	Encourage the CIO to participate with TMT in the analysis of IS strategic issues?	1	2	3	4	5	6	7
7	Expect the CIO to provide advice to TMT before making decisions on IS strategic issues?	1	2	3	4	5	6	7

[23] Paper and online versions administered to respondents do not show the question number nor the underlying construct it researches. That information is only available in this version for illustration purposes

8	Expect the CIO to play an active role when TMT make decisions on IS strategic issues?	1	2	3	4	5	6	7

(CIO-TMT Interaction)

#	For each question, select the answer that best represents the decision-making process about IS strategic issues in your organization. To what extent does your organization...	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor	Somewhat Agree	Agree	Strongly Agree
9	Expect the CIO to interact with TMT members on an informal basis?	1	2	3	4	5	6	7
10	Expect the CIO and TMT to interact in the decision making of IS strategic issues?	1	2	3	4	5	6	7
11	Have an open exchange of ideas between CIO and TMT when analyzing IS strategic issues?	1	2	3	4	5	6	7

(Formalization)

#	For each question, select the answer that best represents the decision-making process about IS strategic issues in your organization. To what extent does your organization...	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor	Somewhat Agree	Agree	Strongly Agree
12	Follow written rules and procedures when the CIO and TMT address IS strategic issues?	1	2	3	4	5	6	7
13	Have rule oriented decision-making procedures when CIO and TMT address IS strategic issues?	1	2	3	4	5	6	7
14	Require formal committees or task groups when CIO and TMT deal with IS strategic issues?	1	2	3	4	5	6	7

(Institutional Forces)

#	For each statement, select the answer that best represents your organization	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor	Somewhat Agree	Agree	Strongly Agree
15	It is important for our organization to comply with government's intellectual property regulations	1	2	3	4	5	6	7
16	My organization is aware of severe penalties for noncompliance with government regulations on intellectual property rights	1	2	3	4	5	6	7
17	My organization knows that the government requires our firm to acquire software licenses legally	1	2	3	4	5	6	7
18	My organization is concerned to meet contractual obligations stipulated in software licenses	1	2	3	4	5	6	7

Assume that your organization is facing the situation that is described below. Please answer the questions that follow based on what your organization would do (not you personally).

Scenario

After a year of slow growth, the outlook of your organization is positive, and crucial business strategies rely on the execution of IT initiatives. Resources for IT, however, continue to be limited.

CNN Money mentioned that a good SAM strategy is one that aligns current and future business demands of software. The CFO has acknowledged the need to control software costs because they are among the top IT expenses. Gartner, a leading IT research firm, reported that organizations are more efficient in managing strategic software when chief executives sponsor SAM programs.

An IT consultant said that organizations frequently face vendor audits and involuntary license violations resulting in compensation payments to software vendors. Recently, your main competitor settled a software license violation case by paying $450,000 to Oracle. External auditors affirmed that inaccurate information about software assets exposes your organization to greater security and liability risks. Some managers have expressed a concern that a negative SAM audit will adversely affect your organization's reputation with key stakeholders.

Recently, the procurement personnel found that bulk discounts are possible on purchase of volume licenses if accurate information on use of software assets is available. The CFO thinks that your firm can reduce software costs by 25% during the first year by adopting a comprehensive SAM program. Likewise, your external auditor suggested that effective software support and maintenance can yield yearly savings of about 10%.

Your internal auditors have cautioned that the organization's SAM execution has been inadequate. They found 11% excess use of Microsoft Word licenses. A recent article in a top IT publication suggests that running software on local, virtualized, and cloud environments has increased the complexity of SAM. The IT technicians have heard rumors about a department using a cloud based analytics tool even though it is not reported in your software inventory.
A software vendor mentioned that specialized SAM software can generate accurate audits of software assets. The helpdesk technicians agree and think that tracking and executing software requests can be done more effectively if they had access to a similar tool in your organization.

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19 Have you read this scenario before?

Yes ○ No ○

A situation is said to be strategic when it could alter the position of the organization, affect the whole organization, and impact the purposes or goals of the organization.

#	To what extent would your organization consider the situation described in the scenario to be...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
20	Strategic for organization's Information Systems (IS)?	1	2	3	4	5	6	7
21	Strategic for the organization?	1	2	3	4	5	6	7

Positive Gain (Opportunity).

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
22	Evaluate the situation as a potential gain?	1	2	3	4	5	6	7
23	Assess the situation as something positive?	1	2	3	4	5	6	7
24	Feel the future will be better because of the situation?	1	2	3	4	5	6	7
25	Feel that there is a high probability of gaining a great deal?	1	2	3	4	5	6	7

Controllability (Opportunity).

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
26	Have a choice about whether or not to address the situation?	1	2	3	4	5	6	7
27	Feel it has the capability to address the situation?	1	2	3	4	5	6	7
28	Feel that it can manage the situation instead of the situation managing the organization?	1	2	3	4	5	6	7
29	Possess the capability to manage it?	1	2	3	4	5	6	7
30	Perceive the situation as controllable?	1	2	3	4	5	6	7

Reactive SAM (Inventory and Audit + Verification and Compliance).

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
31	Store physical copies of software assets?	1	2	3	4	5	6	7
32	Record information on characteristics of software and related assets?	1	2	3	4	5	6	7
33	Formally verify and reconcile documentation on software licenses, inventory, or location?	1	2	3	4	5	6	7
34	Regularly verify compliance with software licensing terms (i.e. actual use vs. permitted use)?	1	2	3	4	5	6	7

Proactive SAM (Control Environment + Planning & Implementation + Lifecycle + Operations Management)

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
35	Expect top management or equivalent body to define a corporate statement scoping SAM?	1	2	3	4	5	6	7

36	Expect top management to review reports measuring SAM implementation progress against plan?	1	2	3	4	5	6	7
37	Execute problem management to identify and solve issues with software assets through their lifecycle?	1	2	3	4	5	6	7
38	Engage in managing service level of software assets by defining agreements with relevant entities?	1	2	3	4	5	6	7

Control Environment

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
39	Assign and communicate employees' roles and responsibilities in the SAM system?	1	2	3	4	5	6	7
40	Train personnel on SAM responsibilities?	1	2	3	4	5	6	7
41	Expects that SAM policies and procedures defined by management are followed closely by employees?	1	2	3	4	5	6	7

Planning & Implementation

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
42	Define plans for implementing SAM?	1	2	3	4	5	6	7
43	Conduct periodic reviews assessing if SAM plans and objectives are being achieved?	1	2	3	4	5	6	7
44	Modify SAM planning and implementation when identifying improvements?	1	2	3	4	5	6	7

Lifecycle Process Interfaces

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
45	Execute processes to record all changes impacting software and related assets lifecycle?	1	2	3	4	5	6	7
46	Consistently control the retirement of software or related assets in accordance to software lifecycle?	1	2	3	4	5	6	7
47	Execute processes ensuring managed and controlled acquisition of software and related assets?	1	2	3	4	5	6	7
48	Document and classify incidents affecting software or related assets through their lifecycle?	1	2	3	4	5	6	7
49	Execute formal SAM processes controlling software releases through their lifecycle?	1	2	3	4	5	6	7
50	Execute formal control of deployment and redeployment of software through their lifecycle?	1	2	3	4	5	6	7
51	Execute software development processes so that architecture, configuration, and licensing are under SAM control before live deployment?	1	2	3	4	5	6	7

Operation Management and Interfaces

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
52	Manage information security of all SAM processes? (i.e. physical/logical /procedural)	1	2	3	4	5	6	7
53	Generate financial reports about software assets? (i.e. budgeting, financial, taxes, cost)	1	2	3	4	5	6	7
54	Actively manage relationships and contracts with entities providing software and related assets?	1	2	3	4	5	6	7

Other Reactive SAM

#	When faced with a situation described in the scenario, to what extent would your organization...	Not at all	very small extent	small extent	moderate extent	fairly great extent	great extent	very great extent
55	Formally document changes to status or location of software and related assets?	1	2	3	4	5	6	7
56	Define assets and information required to ensure integrity and control of software inventory?	1	2	3	4	5	6	7
57	Regularly verify compliance with security requirements for software assets? (i.e. access controls to master copies, installation/usage rights controls)	1	2	3	4	5	6	7
58	Regularly conduct internal verification of organizational conformance with SAM? (i.e. policies, procedures)	1	2	3	4	5	6	7

General Information

59. What is your gender?

- ☐ Male
- ☐ Female

60. How old are you?

18 ⟶ 100

61. About how many years do you have in your organization?

0 ⟶ 60

62. What education level have you completed?

- ☐ Graduate
- ☐ Bachelors
- ☐ Associates
- ☐ Some college
- ☐ High school and below
- ☐ Other (Please specify) ___________________

63. What is your job position?

- ☐ CIO
- ☐ CTO
- ☐ IT Director
- ☐ IT Manager
- ☐ IS Manager
- ☐ Other (Please specify) ___________________

64. About how many people are in your organization's top management team?

0 ⟶ 15

65. **Does your organization employ software as a service (SaaS)?**

Yes ○ No ○

66. **About what percentage of your software is SaaS based?**

0% → 100%

67. **In your organization, who determines Information Technology strategy?**

(Select the option that most closely resembles your organization)

- ☐ C-Level executives
- ☐ Corporate IT Professionals
- ☐ Autonomous business units
- ☐ A combination involving C-level executives, Corporate IT professionals, business units
- ☐ IT corporate professionals and one business group
- ☐ Each business group

68. **In your organization, who determines Information Technology strategy concerning software assets?**

(select the option that most closely resembles your organization)

- ☐ C-Level executives
- ☐ Corporate IT Professionals
- ☐ Autonomous business units
- ☐ A combination involving C-level executives, Corporate IT professionals, business units
- ☐ IT corporate professionals and one business group
- ☐ Each business group

69. **About how many employees does your organization have?**

- ☐ Under 100
- ☐ 100 - 500
- ☐ 500 - 1000
- ☐ 1000 - 2500
- ☐ 2500 - 5000
- ☐ 5000 - 10000
- ☐ 10000 or above

70. **Can you estimate your organization's revenue?**

- ☐ $1 million or less
- ☐ 1$ million to below $50 million
- ☐ $50 million to below $100 million
- ☐ $100 million to below $500 million
- ☐ $500 million to below $1 billion
- ☐ $1 billion to below $5 billion
- ☐ $5 billion to below $10 billion
- ☐ $10 billion or more

71. **What is the industry sector of your organization?**

- ☐ Agriculture
- ☐ Banking/Finance/Insurance
- ☐ Consulting
- ☐ Education
- ☐ Food/Beverage/Consumer Packaged Goods
- ☐ Government
- ☐ Healthcare
- ☐ Hospitality
- ☐ Information Technology
- ☐ Manufacturing
- ☐ Media/Entertainment/Publishing
- ☐ Medical, Bio-Technology, Pharmacology
- ☐ Nonprofit
- ☐ Retail/Wholesale/Distribution
- ☐ Real Estate
- ☐ Telecommunications
- ☐ Other _____________________

72. **What is your organization's home state?**

Describe the CIO Position

73. Is the CIO a formal member of the top management team? (yes / no)
74. How many reporting levels are between the CIO and the CEO? (a. direct report, b. 1 level, c. 2 or more levels)

BIOGRAPHICAL SKETCH

Juan A. Chavarria earned his Doctor of Philosophy in Business Administration, with a major in Information Systems, from The University of Texas Rio Grande Valley (UTRGV) in 2017. He also earned a Bachelor of Technology from the University of North Florida in 1993 and a Master of Business Administration from Morehead State University in 2004.

Dr. Chavarria worked as research assistant and assistant instructor in the University of Texas Rio Grande Valley. Further, in 2016, he was awarded the 2016 outstanding Information Systems Ph.D. student in the Robert C. Vackar college of business and entrepreneurship.

Dr. Chavarria's research interests include software piracy, software asset management, business intelligence and analytics, and IS use in organizations. Dr. Chavarria's research has been published in journals such as the Communications of the Association for Information Systems and he has presented at conferences such as Southwest DSI, and Midwest DSI. Moreover, he was invited to participate in AMCIS 2015 doctoral consortium.

Prior to joining UTRGV's Ph.D. program, Dr. Chavarria worked for more than 20 years in IT and operations management positions with organizations such as PriceSmart (PSMT) and Caracol Knits / Fruit of the Loom strategic alliance in Honduras. Dr. Chavarria can be reached at chavarria.juan@gmail.com.