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Internal Auditors' Experiences and Opinions Regarding Green IT: Assessing the Gap in Normative and Positive Perspectives

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ABSTRACT: Organizations' sustainability and environmental compliance activities are escalating. Information technology (IT) is an essential environmental compliance component under the rubric of green IT, which can include the designing, manufacturing, implementing, and disposing of IT components and the supporting electrical and cooling infrastructure. Green IT has numerous compliance, governance, and control issues, and management needs assurance that green IT metrics reported to management, regulators, and other stakeholders are accurate, complete, and timely. Boards, executives, the Institute of Internal Auditors (IIA), and the Committee of Sponsoring Organizations of the Treadway Commission (COSO) view internal auditors as control experts. This paper summarizes a survey of internal auditors as to what internal auditors should be doing in this domain and what they are actually doing. The results indicate that even though internal auditors believe that they should be more involved in green IT activities, their current involvement is limited to the traditional role as assurance provider, not as facilitators or consultants. The results also suggest that internal auditors' current involvement in green IT activities varies depending on the types of environmental sustainability strategies practiced by their organizations, whereas their perceived roles in green IT activities did not.

Keywords: internal auditor; green IT; sustainability; corporate social responsibility.

Data Availability: *Data used in this study are available from the authors on request.*

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I. INTRODUCTION

Whether the activities are labeled Corporate Social Responsibility (CSR), economic sustainability, sustainable business practices, or environmental compliance (or simply, *going green*), such activities continue to grow in importance because of expanding regulations and economic considerations.[1] Likewise, the potential risks associated with these activities also grow in significance (Deloitte 2011; PwC 2008; Brockett and Rezaee 2012). An obvious risk is *compliance risk* of not being in full compliance with applicable statutory and regulatory requirements, as well as internal (voluntary) sustainability and environmental policies.[2] Another compliance-related risk is *scope risk* in which organizations are unaware of all regulations in all jurisdictions that apply to them. Listing all the environment regulations that could apply to an organization is beyond the scope of this paper, but essentially every country and other government jurisdictions in which an organization operates probably have some applicable environmental regulations. Some of these regulations are industry specific and organization-size specific, such as the U.S. Environmental Protection Agency (EPA) Clean Air Act and the Energy Policy and Conservation Act (EPCA). For instance, EPCA allows the U.S. Department of Energy (DOE) to set compulsory performance standards for computers and a labeling program for servers to reduce electricity use if the computer industry does not meet prescribed standards. Some countries (e.g., Australia) and states (e.g., California) set carbon emissions limits, impose a carbon tax, and may have markets to buy and sell emission credits. This means that organizations must be able to calculate their complete carbon emissions (their carbon footprint). Furthermore, because these carbon footprint laws typically require organizations to reduce their carbon footprint in subsequent years, organizations are on a constant search for ways to achieve that required reduction. At a local level, many municipalities have recycling and waste disposal regulations.[3]

Boards and executives want to comply with the applicable regulations, but information asymmetry creates *agency risk* such as the board and top executives' (the principals') reliance on lower-level managers (the agents) to accurately report compliance information that will be aggregated into reports to regulatory agencies. It is in the agents' self-interest to not report negative data. Although less tangible, *reputation risk* is also a serious concern. If an organization gains a negative reputation for being a polluter, an uncaring, over-consumer of limited resources, or displaying any indications of being a bad "neighbor," that can have a detrimental impact on future sales and profits. At a practical operational level, there is also the *economic risk* of not selecting the most cost-effective approaches to compliance. Finally, there can even be an *opportunity risk* that there are sustainability activities the organization is unaware of that can have a positive impact on profits (e.g., being unaware of a less-expensive alternative approach).

According to the Committee of Sponsoring Organizations of the Treadway Commission (COSO), one way to mitigate risks and "to minimize surprises along the way" (COSO 1992, 3) is to implement appropriate internal controls, which COSO divides into three categories: (1)

[1] We recognize, depending on the specific definitions used, that these are overlapping, but not necessarily interchangeable terms; however, those differences are not critical to this paper. The term *compliance* refers to both compliance with applicable laws and regulations, and compliance with internal objectives, policies, and procedures.

[2] Although an organization can have a variety of internal, voluntary sustainability and environmental policies, the primary emphasis of this paper is compliance with statutory laws and regulations. Depending on economic conditions, organizations can increase or decrease their voluntary activities; however, cutting back on statutory compliance can result in civil and even criminal penalties and negative publicity.

[3] In addition to various government regulators, there are also a variety of non-government organizations that influence current and future sustainability reporting, including Sustainability Accounting Standards Board (SASB), Global Reporting Initiative (GRI), International Integrated Reporting Committee (IIRC), and Climate Disclosure Standards Board (CDSB).

effectiveness and efficiency of operations, (2) reliability of financial reporting, and (3) compliance with applicable laws and regulations. CSR compliance most closely relates to the third category, but management also wants the controls to be efficient (e.g., optimum cost/benefit relationship). The costs to design, implement, and monitor the control, as well as, non-compliance penalties, relate to the second category.

The design, implementation, and monitoring of controls introduce *control risks* in terms of whether a specific control is appropriately designed, properly implemented, and effectively complied with. Compliance data must be collected, aggregated, and reported in a timely, complete, and accurate manner. A failure in any of these tasks can subject an organization to fines and penalties as well as negative publicity. Accordingly, the board and top executives want a high level of confidence that these tasks are being performed correctly (Ballou, Heitger, and Landes 2006). Since management views internal auditors as the organization's control experts and as objective assurance providers (Gray 2008), one would logically conclude that internal auditors *should* have an active role in reducing the aforementioned risks. In their 1992 *Internal Control—Integrated Framework*, COSO specifically states, "Internal auditors play an important role in evaluating the effectiveness of control systems, and contribute to ongoing effectiveness. Because of organizational position and authority in an entity, an internal audit function often plays a significant monitoring role" (COSO 1992, 7). In their 2013 updated framework, COSO made frequent comments regarding the critical roles of internal auditors regarding internal control, including:

> Internal auditors provide the third line of defense in assessing and reporting on internal control and recommending corrective actions or enhancements for management consideration and implementation; their position and compensation are separate and distinct of the business areas they review. (COSO 2013, 124)

When saying "third line of defense," COSO does not mean the internal audit is the third most important component of control; instead, they are saying internal audit is the critical position of being the last line of defense in preventing or detecting control failures.

Reflecting the potential environmental compliance activities for internal auditors, the Institute of Internal Auditors (IIA) published the CSR practice guide, *Evaluating Corporate Social Responsibility/Sustainable Development* (IIA 2010), which describes three broad roles as auditors, facilitators, and consultants that internal auditors *could* do to support environmental compliance activities.[4] For instance, as an auditor, an internal auditor may evaluate management's assertions regarding organization's CSR activities and determine whether the organization has adequate controls to achieve its CSR goals. As a facilitator, the auditor may also facilitate management's CSR control self-assessments in identifying risks, quantifying those risks, and designing appropriate controls. Finally, the auditor may consult on designing and implementing an organization's CSR activities and CSR controls as a consultant.

The discussion thus far (as well as the IIA's CSR practice guide) takes a normative (what ought to be) view of the role of internal auditors in environmental compliance activities using terms like *could* and *should*. Our study, on the other hand, explores the positive (what is) view in terms of what internal auditors are actually doing in this domain to gain insights into any gaps that may exist between the normative and positive views. Any substantial gaps would indicate that organizations

[4] The potential population of roles for internal auditors is a rather fluid concept. The IIA's International Standards for the Professional Practice of Internal Auditing (Standard) provides the requirements applicable to assurance or consulting roles. The aforementioned CSR practice guide includes facilitating in addition to assurance and consulting. Other publications of the IIA (e.g., the IA Journal) mention other roles such as evaluating and monitoring. For our paper, we are generally referring to the three roles in the CSR practice guide.

and their internal audit departments are missing a potentially significant opportunity to efficiently and effectively control their environmental compliance and associated risks.

Our study specifically focuses on internal auditors' roles regarding the environmental compliance aspects of information technology (hereafter referred to as *green IT*). Research indicates that enterprise leaders are becoming increasingly aware of the importance of *green IT* (Molla, Pittayachawan, Corbitt, and Deng 2009) and that a green IT strategy is becoming a part of an organization's overall environmental compliance strategy (Murugesan 2008). Consequently, environmental compliance strategy has become a new dimension in IT evaluation (Piotrowicz and Cuthbertson 2009), and defines a new role for internal auditors (Ridley, D'Silva, and Szombathelyi 2011). Although COSO (1992, 2013) considers internal audit a critical component of the internal control environment, and management views internal auditors as their organizations' control experts, we did not find any academic articles that explored the roles of internal auditors in sustainability, in general, or green IT specifically, other than professional articles and the one aforementioned academic article (Ridley et al. 2011). Furthermore, Ridley et al. (2011) was not rigorous research; "theoretical in nature, the paper makes reference to a few 'real-world' illustrations" (Ridley et al. 2011, 475). As such, our paper is the first paper to explore empirically the real and potential relationships between organizations' green IT activities and their internal auditors' roles in those activities. Our research objective and primary contribution to literature is to identify and quantify the various components of the gaps between: (1) what internal auditors *could* do in the green IT domain, (2) what practicing internal auditors believe they *should* do in the green IT domain, and (3) what they are currently doing in that domain.

Green IT has many elements (e.g., power consumption and recycling), and the extent of any gaps could be dependent on the specific element being explored. Because the organization's tone at the top can permeate throughout the organization, we also explore whether these gaps varied by the organization's overall sustainability objectives and activities. That is, we explore whether organizations with more expansive (advanced) sustainability activities also have broader internal auditor involvement in those activities. Our findings provide benchmarks for future researchers to focus on to determine why any identified gaps exist and how to close those gaps. Specifically, to address our research objective, we conducted a survey to examine organizations' green IT activities, what internal auditors *should* be doing in this domain, and what internal auditors are actually doing in this domain. We used the aforementioned IIA CSR practice guide (IIA 2010) publication as our baseline as to what internal auditors could be doing in this domain.

While the IIA (2010) actively promotes internal auditors providing assurance, facilitating, and consulting services, only a minority of survey participants believe they *should* provide services outside of traditional assurance services in the green IT domain. Furthermore, only a small minority of participants and their internal audit departments are actually involved in green IT activities, even though a majority of them believe internal audit should be involved in assurance-related green IT activities. The findings about what internal auditors *should* do did not vary depending on the organizations' sustainability strategy or based on the auditor's current involvement in green IT. However, the internal auditor's actual green IT activities did vary depending on the organizations' sustainability strategy. In terms of specific elements of an organization's green IT activities, internal auditors were more heavily involved in procedures associated with purchasing IT equipment and with complying with green IT laws and regulations at organizations with more advanced sustainability strategies. In summary, organizations appear to be underutilizing a potentially valuable resource in their sustainability and environmental compliance activities, at least in the green IT domain. Because of the ever-increasing importance of sustainability and environmental compliance, future research needs to explore how to reduce these gaps.

The remainder of this paper is organized as follows. Section II provides a broad overview of green IT and prior studies. Section III describes research hypotheses. Section IV outlines the

research method. Section V summarizes the research results. Section VI presents conclusions and suggestions for further green IT research to reduce the gaps identified in our research.

II. BACKGROUND AND LITERATURE REVIEWS

This section is divided into three subsections. The first subsection provides an overview of green IT, and the second subsection introduces a green IT research framework. Finally, the third subsection offers a broad discussion of potential added value of internal auditors' involvement in sustainability and environmental compliance.

Green IT

The elements of green IT in Murugesan's (2008) definition illustrate the cradle-to-grave life-cycle perspective of green IT:

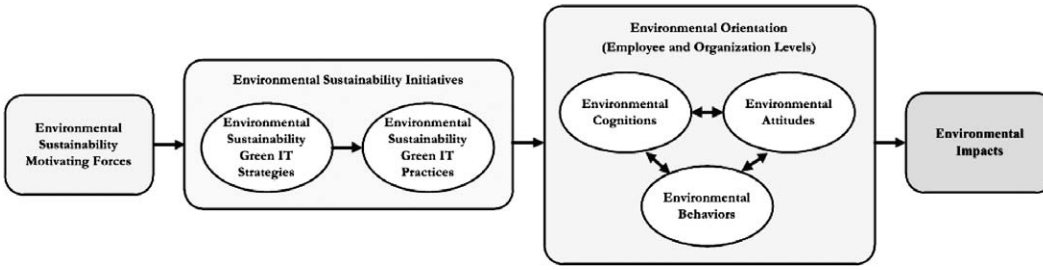
> [Green IT is] the study and practice of *designing*, *manufacturing*, *using*, and *disposing* [emphasis added] of computers, servers, and associated subsystems—such as monitors, printers, storage devices, and networking and communications systems—efficiently and effectively with minimal or no impact on the environment. Green IT also strives to achieve economic viability and improved system performance and use, while abiding by our social and ethical responsibilities. Thus, green IT includes the dimensions of environmental sustainability, the economics of energy efficiency, and the total cost of ownership, which includes the cost of disposal and recycling. (Murugesan 2008)

Green IT provides many opportunities to contribute to an organization's environmental compliance goals (Prattipati 2010). For example, according to a U.S. EPA study in 2006 (EPA 2007), servers and data centers in the U.S. alone consumed approximately 61 billion kilowatt-hours (kWh) (nearly the same as 5.8 million households) for a total electricity cost of about $4.5 billion. Electrical power consumption doubled from 2000 to 2006 and is expected to continue to grow at an ever-increasing rate. As such, even a small percentage improvement in these numbers could provide large dollar payoffs for organizations and could significantly contribute to satisfying environmental compliance goals.

At issue is how IT creates environmental problems that need their own remedy while functioning as a tool to mitigate environmental impacts originating elsewhere in the organization. That is, IT is recognized as a means to greatly enhance the efficient and effective use of resources within organizations. However, IT places a heavy burden on electrical grids, consumes depletable resources, and creates tons of waste (Murugesan 2008), which is why environmentally sustainable IT needs to take a cradle-to-grave life cycle perspective. These issues have become particularly acute due to the ever-increasing global sensitivity to resource depletion and other environmental issues (Plant 2010).

Organizations are increasingly obliged to have strategies and operations that consider environmental issues and the environmental impact of their activities (Henriques and Sadorsky 1999; Ramus and Steger 2000; Robertson 2008). Organizations also need to accomplish their environmental sustainability goals while controlling (even reducing) operating costs. To meet ever-increasing demands, many organizations are taking various steps to establish environmentally responsible practices even beyond legal requirements and are trying to move toward sustainable practices to minimize their environmental footprint. However, it has been observed that many organizations neglect the critical roles played by IT, particularly green IT, in environmental sustainability, even though green IT has been acknowledged as a critical element of an organization's efforts to reduce its environmental impact (T. Velte, A. Velte, and Elsenpeter 2008).

FIGURE 1
A Framework for Green IT/IS Research



* Adapted from Jenkin et al. (2011).

A body of literature from scholars and practitioners alike began over a decade ago to suggest initiatives to address the more elemental issues of IT environmental problems—primarily regarding the energy IT consumes—aimed mostly at IT managers (Harmon and Demirkan 2011). More recent literature addresses broader initiatives for organizational strategy and the role of IT in environmental sustainability. For example, Hedman and Henningsson (2011) suggest strategic realignment of organizations to leverage the potential of green IT. Such realignment can make more efficient and effective processes that reduce resource consumption in areas outside of IT (Elliot 2011).

Green IT Research Framework

Jenkin, Webster, and McShane (2011) developed a research framework to address how green IT relates to sustainability in an organization and to guide future research by identifying critical research gaps. Their framework is comprised of four components: (1) the motivating forces driving organizations' environmental initiatives, (2) green IT strategies and practices that organizations develop in response to these forces, (3) overall environmental orientation (i.e., environmental cognitions, attitudes, and behaviors at individual and organization levels), and (4) environmental impacts. Figure 1 illustrates the framework.

An organization's environmental strategies are influenced by various environmental motivating forces, including organizational, regulatory-market, socio-cultural, ecological, and technological forces (e.g., Bansal 2002; Bansal and Roth 2000). Organizational forces refer to internal factors such as internal stakeholders, leadership, structure, policies, and financial considerations. Regulatory-market forces reflect regulatory and market pressure that influences the degree to which the organization is willing to implement environmental initiatives. Socio-cultural forces represent the environmental values, beliefs, public pressure related to environment, and the organization's needs for social legitimacy. Ecological forces are related to the current level of resources, consumption rates, and the rate of depletion of natural resources, which affect the organization's environmental strategies. Finally, technological forces indicate technological capabilities or innovations (e.g., energy efficient chips) that facilitate the organization's environmental initiatives. The aforementioned motivating forces are combined in varying degrees to drive an organization's green IT strategies, which, in turn, are transformed into green IT practices to support its green IT strategies.

The success of green IT practices largely depends on the degree to which the organization and its employees have implemented and institutionalized its green IT strategies and practices (i.e.,

overall environmental orientation). Environmental orientation consists of three components: environmental cognitions, environmental attitudes, and environmental behaviors (Jenkin et al. 2011). At the employee level, environmental cognitions refer to an employee's expectations, values, and beliefs regarding environmental issues. Environmental attitudes reflect an employee's tendency to respond positively or negatively toward the environmental issues and initiatives. Environmental behaviors represent an employee's participation in green IT practices. At the organization level, environmental cognitions indicate shared environmental expectations, values, and beliefs within an organization. Environmental attitudes involve organizational climates or culture toward the environmental issues and initiatives. Environmental behaviors imply organizational routine relative to green IT activities.

Finally, the three components of environmental orientation are related and affect one another, which, in turn, impact the environment. The outcome of green IT activities or implementation is eventually assessed by the impact of these activities on the environment (e.g., corporate environment performance such as greenhouse gas emission and consumption of electricity).

Potential Value-Added Involvement of Internal Auditors

Environmental sustainability is an important organizational duty that offers not only opportunities but also poses risks for organizations (IIA 2010; Rake and Grayson 2009). A key component of environmental sustainability is to minimize environmental impact (Velte et al. 2008). Arguably, any organization failing to consider environmental sustainability may endanger the long-term sustainability of the organization. Conversely, implementing the wrong environmental sustainability initiatives or implementing them badly, or simply failing to properly assess the success and effectiveness of particular environmental sustainability initiatives carry their own risks. Without measuring the success of its green IT practices, an organization cannot show that it is compliant with regulations or may be incurring expense on ineffective initiatives, thus risking damage to the public image of the organization (Jain, Benbunan-Fich, and Mohan 2011; Rake and Grayson 2009).

Accounting professionals have been involved in the area of sustainability and environmental accounting to help organizations be profitable and environmentally responsible (Perrini and Tencati 2006). The Big 4 and other accounting and consulting firms actively promote green-IT-related services to organizations (e.g., green IT consulting, assessment, and assurance services). Given internal auditors are already heavily involved in operational and IT-related activities, many of the green IT services provided by these external firms overlap the potential roles of internal auditors. In fact, IT internal auditors probably have a broader understanding of the IT environment than other IT staff members who typically focus on just one IT area (Juergens 2010).

At first, it may appear that only a small population of internal auditors could be involved in green IT activities due to the technical aspects of green IT. While the specific metrics and key performance indicators (KPIs) associated with the green IT functions can vary, ultimately, green IT is synonymous with efficient IT. The objectives of green IT include lowering operating costs (e.g., for electricity, water, and waste), increasing return on investment (ROI), decreasing demand for natural resources, and reducing various forms of pollution (Dedrick 2010; Harmon and Demirkan 2011). As such, the most common measurements associated with green IT (e.g., kilowatts, gallons of water, tons of waste) are already familiar to auditors. In those cases where green IT KPIs are of a technical nature, the auditors can still use their skills monitoring the procedures that are used to collect, summarize, and report those KPIs. Given that internal auditors may have (or could acquire) the skill sets to provide the needed green IT assurances (as well as facilitating and consulting) services, the internal auditors should proactively identify value-added services that can help an organization accomplish its green IT objectives. At the same time, internal auditors must identify

and focus on those green IT activities that have the highest potential added value to their organizations because of limitations in resources and demands of other high-priority responsibilities (e.g., the Sarbanes-Oxley Act compliance).

Although research addressing general environment issues continues to grow, research on green IT is more recent and less developed. Many of the existing studies on green IT are conceptual and focus on organizational-level analysis (e.g., Elliot 2007; Elliot and Binney 2008; Huang 2009). Research on the role of internal auditors in green IT has also received limited attention. In particular, no study has examined what internal auditors are currently doing in the green IT domain and, more importantly, what they should be doing in this domain. *The International Standards for the Professional Practice of Internal Auditing* (IIA 2008) necessitates that internal audit activities evaluate and contribute to the improvement of risk management, control, and governance processes through consulting and value-added assurance activities. Considering COSO's (2013) strong statement about internal auditing being the "third line of defense in assessing and reporting on internal control and recommending corrective actions or enhancements," failing to recognize the full potential value-added role of internal auditors in sustainability and environmental activities can actually present risks to an organization, such as aforementioned compliance, economic, and control risks. Managing such risks requires the internal auditors' involvement in green IT activities and offers the potential for internal auditing to provide value-added activities to an organization (Gray 2011). To enhance our understanding of the current level of green-IT-related practices in organizations and the effect of such practices on internal auditors, this study investigates internal auditors' roles in their organization's green IT activities. In particular, we limit our focus to the employee level of analysis in the Jenkin et al. (2011) framework (see Figure 1).

III. RESEARCH HYPOTHESES

This section discusses the development of our four research hypotheses. The first three hypotheses reflect our expectations regarding the internal auditors' green IT beliefs and activities as reflected by the organizational sustainability environment in which the auditors work. If the organization's tone at the top is very positive regarding sustainability and green activities, in general, then one would expect that internal auditors would also have a more positive attitude about these activities. The discussion regarding the fourth hypothesis recognizes that, independent of an organization's attitude about sustainability and green activities, individual internal auditors have personal attitudes about sustainability and green activities that are formed independent of their work environment (e.g., some people believe human activity contributes to global climate change and others do not). These personal attitudes, separate from their employer's green attitude, would be expected to contribute to an auditor's green IT beliefs about what internal auditors should do and their current activities.

Organizational Environmental Strategies and Internal Auditor's Beliefs and Activities

As conceptualized in Jenkin et al. (2011), organizations aiming to reduce negative environmental impacts develop appropriate strategies that acknowledge the importance of environmental issues and implement green IT practices corresponding to their environmental strategies. Their implementation then influences the environmental orientation of employees (i.e., employees' environmental attitudes, cognitions, and behaviors). According to Jenkin et al. (2011), an organization's green IT strategies can be classified into four types of environmental sustainability strategies: image-oriented strategy (Type 0), prevent/control strategy (Type 1), product stewardship strategy (Type 2), and sustainable development strategy (Type 3). Type 0 strategies are associated with portraying an image that indicates the organization's commitment to the environment through publicly announcing environmental policies, but not implementing these

policies. Type 1 strategies encompass the efficient use of natural resources and the proper disposal of waste or minimizing waste to reduce negative environmental impacts. Type 2 strategies are related to minimizing negative environmental impacts throughout a product's lifecycle (i.e., raw material utilization, product design, production, packaging and distribution, and disposal) by redesigning products or manufacturing processes. Finally, Type 3 strategies involve embedding the organization's environmental sustainability considerations into all of its activities to minimize the organization's global environmental impacts.

Ramus and Steger (2000) argue that employees tend to be more engaged in green IT activities when they perceive a strong signal from their organization regarding environmental policy. Therefore, it is expected that an organization's environmental sustainability strategies will influence their employees' cognitions, attitudes, and behaviors. Specifically with regard to internal auditors, organizations that adopt high-level environmental sustainability strategies (e.g., Type 3 strategy) may have a positive effect on internal auditors' perceived roles in green IT activities (i.e., cognitions and attitudes) and their current involvement in green IT activities (i.e., current roles and green IT elements). Green IT elements refer to some specific green IT activities such as purchasing and recycling computers. This discussion leads to the following hypotheses.

H1: Internal auditors' perceived roles in green IT activities that they should be involved in are greater if their organizations have a higher type of environmental sustainability strategies.

H2: Internal auditors' current roles in green IT activities are broader if their organizations have a higher type of environmental sustainability strategies.

H3: The specific green IT elements in which internal auditors are currently involved is greater if their organizations have a higher type of environmental sustainability strategy.

Auditor's Internal Beliefs and Current Green IT Activities

Jenkin et al. (2011) argued that the success of green IT implementation and the resulting environmental impact in an organization depend on the environmental orientation of the individual employees. That is, the alignment between the three components of environmental orientation (i.e., environmental cognitions, attitudes, and behaviors) leads to a higher level of environmental orientation, which, in turn, leads to an increase in the environmental activities.

According to the Theory of Planned Behavior (Ajzen 1991, 2002), individual behavior is guided by three types of beliefs (i.e., behavioral beliefs, normative beliefs, and control beliefs), and these beliefs are aggregated to create a behavioral intention through three determinants (i.e., attitude toward the behavior, subjective norm, and perceived behavioral control). Behavioral beliefs create a favorable or unfavorable attitude toward the behavior based on individuals' perceptions of the outcomes of performing that behavior. Normative beliefs produce a positive subjective norm if other individuals see performing the behavior as positive, and individuals are motivated to meet the expectation of the other individuals. Control beliefs lead to a positive perceived behavioral control if individuals hold strong beliefs about the existence of factors that will facilitate the behavior. The more favorable the attitude toward the behavior and subjective norm, and the stronger the perceived behavior control, the stronger the individuals' intention to perform the behavior. With a sufficient degree of actual control over the behavior, individuals have a tendency to perform the behavior.

Based on the Theory of Planned Behavior and Jenkin et al. (2011), we expect that internal auditors tend to align their involvement in green IT activities (i.e., behaviors) with their perceived roles in green IT activities (i.e., behavioral beliefs) to achieve their organizations' environmental sustainability goals or strategies. Therefore, this study introduces the following hypothesis.

H4: Internal auditors' current involvement in green IT activities is aligned with their perceptions as to what the roles for internal auditors should be.

IV. RESEARCH METHOD

To examine our hypotheses, we conducted a web-based survey. Email invitations to participate in the survey were sent to members of the North America IIA jurisdiction. Since there was no reliable way to pre-screen IIA members who were knowledgeable of green IT,[5] we asked the IIA to send the email to all members who classified themselves as internal auditors (as opposed to consultants, students, etc.) to solicit the members to complete the survey.

A total of 652 individuals started the survey (approximately a 2.6 percent response rate).[6] Among them, 144 did not complete the survey. We further excluded 95 responses that were not from the United States or Canada. These excluded 95 responses were distributed thinly over many other countries and, therefore, it would not have been possible to conduct a statistically valid between-country analysis.[7] We also excluded 18 responses where there was more than one participant from the same organization so that multiple responses from the same organizations would not distort statistic results.[8] In addition, 23 responses not from internal auditors were excluded (e.g., external public accountants and audit services contractors). Accordingly, our final sample consisted of 372 responses from the United States or Canada.

Survey Instrument

The questionnaire was designed to explore practicing internal auditors' personal perspectives on a variety of environmental practices within their organizations and their own department's involvement in green IT. Based on a variety of sources, 38 questions were developed.[9] The questions regarding technical aspects of green IT were based on sources such as EPA (2007), Lamb (2009), and Velte et al. (2008), as well as green IT publications from Big 4 accounting firms (e.g., Deloitte 2007; Ernst & Young 2010; KPMG 2008). The internal auditor and internal audit department demographic questions were based on prior IIA surveys such as Gray, Gold, Jones, and Miller (2010). The IIA's CSR practice guide (IIA 2010) was also the basis for some questions. We pilot-tested the initial survey instrument by sending emails to members of local IIA and Information Systems Audit and Control Association (ISACA) chapters asking them to complete the online questionnaire and to return comments or suggestions to the principal investigator. The questionnaire was then modified based on the comments received during the pilot test.

Control Variables: Industry Type and Organization Size

Several prior studies showed that industry is a significant determinant of an organization's environmental strategic decisions or its attitude toward environmental issues (e.g., Henriques and Sadorsky 1999; Sharma 2000). In addition, environmental accounting literature argues that organization size plays an important role in an organization's environmental disclosures (Roberts

[5] The IIA member database includes a wide variety of demographic variables, but none of those specifically relates to sustainability activities.

[6] The IIA Research Foundation indicated that the solicitation email went out to approximately 25,000 IIA members.

[7] We also conducted analyses by including these 95 responses and found they had no effect on the results.

[8] We identified responses from the same organization using respondents' emails, IP addresses, and the demographic information collected on the respondents' organization. We acknowledged that this approach might not completely eliminate the multiple responses from the same organizations.

[9] Several questions had sub-questions. As such, the survey generated 67 data elements.

1992; Spicer 1978). Accordingly, industry type and organization size were used as control variables for the statistical analysis. For industry type, we classified industry based on two-digit SIC code. For organization size, we used the organization's total revenues.

V. RESEARCH RESULTS

This section presents our research results. The first subsection summarizes the demographics of the survey respondents. The next subsection briefly summarizes green IT environment in our respondents' organizations. The last subsection addresses findings related to our four hypotheses.

Demographics

The demographic information of the 372 survey respondents is shown in Table 1. Nearly 87 percent of the respondents (322 organizations) were from the United States and approximately 13 percent of the respondents (50 organizations) were from Canada. The organizations represented in the survey cover a wide range of sizes in terms of total revenues. The total revenues of roughly 45 percent of the organizations were greater than $1 billion. A summary of the sample distribution based upon industry classification by major division in SIC code indicates that the organizations also represented a wide variety of industries. Public Administration (26.9 percent) has the greatest representation, followed by Service (26.1 percent), Finance (20.7 percent), Transportation (11.6 percent), Manufacturing (7.8 percent), Mining (3 percent), Retail Trade (1.9 percent), Construction (1.1 percent), and Wholesale Trade (1.1 percent).

A little more than half (57.5 percent) of the respondents selected accounting as their primary education. A total of 295 respondents (79.3 percent) were non-IT internal auditors (i.e., internal audit staff, internal audit manager, and internal audit director), and 45 respondents (12.1 percent) were IT auditors (i.e., IT audit staff, IT audit manager, and IT audit director).[10] The size of internal audit departments ranged from 1 to 808 non-IT auditors and from 0 to 150 IT auditors. On average, there were 29 non-IT auditors and 5 IT auditors per organization. The total years of work experience ranged from less than one year to 54 years, with an average of 19.1 years and a median of 18 years. The number of years of experience as an internal auditor ranged from less than one year to 32 years, with an average of 8.6 years.

Green IT and Organization: Green Motivating Forces, Strategy, and Activities

This subsection briefly describes the green IT environment in the respondents' organizations, which defines the boundary of what internal auditors could do for their organizations. In other words, internal auditors cannot be involved in green IT activities beyond what their organizations are currently doing or are planning to do.

Green Motivating Forces

Panel A of Table 2 shows the motivating forces that influence green IT initiatives in respondents' organizations. The motivating forces are listed in order based on the force's mean score. In general, the respondents indicated that all five forces are at least somewhat important (all overall $M > 2.26$). The most important green IT driver was reducing operational costs (organization force), followed by socially responsible thing to do (socio-cultural force), government regulations (regulatory-market force), and meet organization's overall green initiatives (organiza-

[10] The remainder were the board, Chief Audit Executives (CAEs) or equivalent that we could not classify as non-IT or IT auditors.

TABLE 1

Demographics

Panel A: Demographics

Country	USA	322	(86.6%)	Industry	Mining	11	(3%)
	Canada	50	(13.4%)		Construction	4	(1.1%)
Revenue	< $50M	58	(15.6%)		Manufacturing	29	(7.8%)
	$50M–$100M	25	(6.7%)		Transportation	43	(11.6%)
	$100M–$500M	74	(19.9%)		Wholesale trade	4	(1.1%)
	$500M–$1B	47	(12.6%)		Retail trade	7	(1.9%)
	$1B–$5B	81	(21.8%)		Finance	77	(20.7%)
	$5B–$10B	33	(8.9%)		Services	97	(26.1%)
	> $10B	54	(14.5%)		Public administration	100	(26.9%)
What is your primary educational or training background?	Accounting	214	(57.5%)	What was your primary job/position before becoming an internal auditor?	Internal audit staff	179	(48.1%)
	IT/IS	27	(7.3%)		Internal audit manager	79	(21.2%)
	Joint Accounting and IT/IS	23	(6.2%)		Internal audit director	37	(9.9%)
	Other business area	59	(15.9%)		IT audit staff	26	(7%)
	Engineering	14	(3.8%)		IT audit manager	15	(4%)
	Non-business	4	(1.1%)		IT audit director	4	(1.1%)
	Other	31	(8.3%)		Chief audit executive	32	(8.6%)

(continued on next page)

TABLE 1 (continued)

Panel B: Characteristics

	n[a]	M[b]	MD[c]	SE[d]	Min[e]	Max[f]
Total number of internal auditors	372	29.33	7	74.38	1	808
Total number of internal IT auditors	372	4.59	1	12.62	0	150
Work experience	372	19.08	18	10.83	0	54
Work experience as an internal auditor	372	8.55	6	7.31	0	32

[a] Number of respondents.
[b] Mean.
[c] Median.
[d] Standard deviation.
[e] Minimum.
[f] Maximum.

TABLE 2

Green IT Motivating Forces, Environmental Strategy, and Green IT Practices

Panel A: Green Motivating Forces

Motivating Forces	Not Important (1)	Somewhat Important (2)	Important (3)	Very Important (4)	M	SE	n
Reducing operational costs (e.g., energy use)	15 (4.5%)	47 (14.1%)	128 (38.4%)	143 (42.9%)	3.20	0.84	333
Socially responsible thing to do	24 (6.9%)	60 (17.3%)	137 (39.6%)	125 (36.1%)	3.05	0.90	346
Government regulations	33 (10.2%)	47 (14.5%)	109 (33.6%)	135 (41.7%)	3.07	0.98	324
Meet organization's overall green initiatives	37 (11.8%)	65 (20.8%)	136 (43.5%)	75 (24%)	2.80	0.94	313
Actions of competitors	83 (26.4%)	108 (34.4%)	82 (26.1%)	41 (13.1%)	2.26	0.99	314

Not sure:
Reducing operational costs (e.g., energy use): 39 responses (10.5 percent of 372 total responses);
Socially responsible thing to do: 26 responses (7 percent of 372 total responses);
Government regulations: 48 responses (12.9 percent of 372 total responses);
Meet organization's overall green initiatives: 59 responses (15.9 percent of 372 total responses); and
Actions of competitors: 58 responses (15.6 percent of 372 total responses).

Panel B: Environmental Strategies

No Formal Statement		Formal Statement							
(1)	(2)	(3)	(4)	(5)					
No statement 1[a]	*No statement 2*[b]	*Type 0*[c]	*Type 1*[d]	*Type 3*[e]	M	SE	n		
84 (25.5%)	118 (35.9%)	24 (7.3%)	55 (16.7%)	48 (14.6%)	2.59	1.40	329		

[a] *No statement 1*: No statements and no ecological impact in decisions.
[b] *No statement 2*: No statements but consider ecological impact in decisions.
[c] *Type 0*: Type 0 (Image-oriented) strategy—Not part of mission statement and not actively publicized.
[d] *Type 1*: Type 1 (Prevent/control) strategy—Not part of mission statement but actively publicized.
[e] *Type 3*: Type 3 (Sustainable development) strategy—Integral part of mission (or vision) statement.
Not sure: 43 responses (11.6 percent of 372 total responses).

Panel C: Measuring Carbon Footprint

Do Not Measure Carbon Footprint		Measure Carbon Footprint				
(1)	(2)	(3)	(4)			
No, and we have no plan to do so in the near future.	**No, but we plan to do the measurement in the near future.**	**Yes, but IT is not separately calculated.**	**Yes, and IT is listed as a separate calculation.**	**M**	**SE**	**n**
105 (51.7%)	23 (11.3%)	60 (29.6%)	15 (7.4%)	1.93	1.05	203

Not sure: 169 responses (45.4 percent of 372 total responses).

(continued on next page)

TABLE 2 (continued)

Panel D: Monitoring IT-Related Energy Spending

(1)		(2)		(3)				
No, and we have no plan to do so in the near future.		**No, but we plan to in the near future.**		**Yes**		**M**	**SE**	**n**
110	(59.1%)	15	(8.1%)	61	(32.8%)	1.74	0.92	186

Not sure: 186 responses (50 percent of 372 total responses).

tion force).[11] As compared with other drivers, the action of competitors was a relatively minor driver, with 26.4 percent of the respondents indicating that it was not important. These results suggest that an organization's green IT initiatives are not driven solely by regulatory compliance; instead initiatives are influenced by a mixture of motivating forces: organizational, regulatory-market, and socio-cultural forces.

Environmental Strategies

The environmental strategies of the respondents' organizations are summarized in Panel B of Table 2. Overall, 127 organizations (38.6 percent) had some form of formal green (social responsibility) statement. Among those 127 organizations, 24 organizations (7.3 percent) fell into Type 0 (image-oriented) strategy, 55 organizations (16.7 percent) in Type 1 (prevent/control) strategy, and 48 organizations (14.6 percent) in Type 3 (sustainable development) strategy.[12] In contrast, 202 respondents (61.4 percent) stated that their organizations did not have a formal written statement covering environmental sustainability strategies. Among those organizations, 118 organizations (35.9 percent) considered ecological impact in their decisions even though they did not have a formal written statement. The fact that more than half of organizations did not have any formal written statement suggests that many organizations did not yet emphasize the importance of environmental issues or efforts in their business strategies and activities.

Measuring Carbon Footprint and IT Energy Usage

Overall, 75 organizations (37.0 percent) measured their carbon footprint. Among them, 15 organizations (7.4 percent) did a separate calculation for IT whereas 60 organizations (29.6 percent) did not (see Panel C of Table 2). On the other hand, more than half of the respondents (63.1 percent) stated that their organization did not measure their carbon footprints. Among them, 105 organizations (51.7 percent) had no plan to measure it in the future, and 23 organizations (11.3 percent) had planned to measure it in the future. In addition, Panel D of Table 2 shows that roughly one-third (32.8 percent) of the respondents affirmed that their organization monitors IT energy spending, but, many organizations did not monitor IT energy spending (67.2 percent). Among 125 organizations that did not monitor IT energy spending, 15 organizations (8.1 percent) plan to monitor it in the future. Although many respondents knew what their organization was doing in terms of green IT practices, it is noteworthy that a considerable number of respondents were not

[11] The terms in the parentheses are the various environmental motivating forces (e.g., Bansal 2002; Bansal and Roth 2000) discussed in Section II.

[12] Four types of environmental sustainability strategies are from Jenkin et al. (2011) and discussed in Section II.

sure about what their organizations were doing: calculating carbon footprint (169 respondents, 45.4 percent) and monitoring IT-related energy spending (186 respondents, 50 percent).

Specific Green IT EPA Scenarios

The EPA provides three energy-efficiency scenarios that can be a guide to classifying an organization's environmental strategy: improved operation scenario, best practice scenario, and state of the art scenario (EPA 2007).[13] The improved operation scenario includes energy-efficiency improvements beyond current trends that are essentially operational in nature and require little or no capital investment. The best practice scenario represents the efficiency gains that can be obtained through the more widespread adoption of the practices and technologies used in the most energy-efficient facilities in operation today. The state-of-the-art scenario identifies the maximum energy-efficiency savings that could be achieved using available technologies.

Table 3 summarizes green IT activities that organizations adopt to reduce environmental impacts relative to the EPA energy-efficiency scenarios. More than half of organizations employed green IT activities that fell into both the improved operation and best practices scenarios. Although items in Table 3 could be anywhere on the Type 0 to Type 3 strategy dimension depending on how deeply an organization is involved in those items, these items could probably be considered as activities that are related to at least Type 1 (prevent/control) strategy (Jenkin et al. 2011). As would be expected, several popular practices were related to simple activities (e.g., automatically switching to sleep mode and turning off equipment at night) that could be adopted simply by operating the existing IT equipment more efficiently without extra cost. In addition, two popular practices related to recycling or disposing of IT equipment, which potentially reflect regulatory restrictions on disposing of electronic equipment in landfills. Less than half of organizations employed state-of-the-art green IT practices. Such practices could be considered as Type 3 (sustainable development) strategy-related activities (Jenkin et al. 2011) and tend to be complex and require substantial capital investment and strong commitments from corporate management. The results of green IT activities employed by organizations suggest that many organizations adopt green IT activities that reduce the impact on the environment, however, many of them have not adopted the most efficient technologies and best management practices available today to gain maximum possible environmental efficiency.

Green IT and Internal Auditor

While the prior subsection focused on organizational-level environmental and green IT activities, this subsection summarizes internal auditors' personal perceptions (i.e., environmental cognitions and attitudes) about what auditor should do and their actual participation (i.e., environmental behaviors) regarding green IT practices.

Green IT Activities that Internal Auditors Should Be Involved in (Environmental Cognitions and Attitudes)

Panel A of Table 4 shows a summary of responses regarding green IT activities that internal auditors should be involved in. In addition to including an overall response, the table also includes the responses for different levels of their organization's environmental strategies, so as to explore whether auditors from more progressive green IT organizations hold broader opinions about auditor involvement in green IT. The discussion below focuses on the overall responses. These different

[13] Although the EPA report focuses on servers and data centers, their observations and recommendations can be applied to other IT uses.

TABLE 3

Green IT Activities

Energy-Efficiency Scenario	Activities	Yes		n
Improved operation	Configure desktops to automatically enter sleep mode when inactive	252	(84.0%)	300
	Use recycling service to dispose of obsolete IT equipment	219	(85.5%)	256
	Educate users to turn off IT equipment at night	223	(70.6%)	316
Best practice	Participated in product take-back/recycling programs from vendors	156	(78.8%)	198
	Use virtualization software to reduce the number of servers	139	(71.3%)	195
	Install more efficient data center power supplies	116	(57.4%)	202
State-of-the-art	Modified data center cooling infrastructure to improve efficiency	94	(49.0%)	192
	Use cloud computing to reduce the number of servers	87	(49.7%)	175
	Build a new data center that is energy efficient	54	(25.8%)	209
	Moved a data center to another city/state to reduce energy costs and/or environmental impact	46	(19.1%)	241

Not sure:
Configure desktops to automatically enter sleep mode when inactive: 72 responses (19.4 percent of 372 total responses);
Use recycling service to dispose of obsolete IT equipment: 116 responses (31.2 percent of 372 total responses);
Educate users to turn off IT equipment at night: 56 responses (15.1 percent of 372 total responses);
Participated in product take-back/recycling programs from vendors: 174 responses (46.8 percent of 372 total responses);
Use virtualization software to reduce the number of servers: 177 responses (47.6 percent of 372 total responses);
Install more efficient data center power supplies: 170 responses (45.7 percent of 372 total responses);
Modified data center cooling infrastructure to improve efficiency: 180 responses (48.4 percent of 372 total responses);
Use cloud computing to reduce the number of servers: 197 responses (53 percent of 372 total responses);
Build a new data center that is energy efficient: 163 responses (43.8 percent of 372 total responses); and
Moved a data center to another city/state: 131 responses (35.2 percent of 372 total responses).

responses related to environment strategies will be directly explored in the hypotheses testing discussion later in this section.

Most respondents indicated that internal auditors probably or definitely should be involved in providing assurance (83 and 186 respondents, respectively; together 269 respondents, 85.4 percent) and monitoring controls (90 and 154 respondents, respectively; together 244 respondents, 77.5 percent). This is not surprising because providing assurance and monitoring controls are traditional services provided by internal auditors as promulgated by the IIA (2008) and emphasized by COSO (1992, 2013). On the other hand, only 54 respondents (17.4 percent) stated that auditors probably (42 respondents, 13.5 percent) or definitely (12 respondents, 3.9 percent) should design or develop specifications for green IT activities. Designing and developing specifications could definitely challenge objectivity standards (i.e., investigating and evaluating own works).[14] That challenge does not mean that internal auditors can never be involved in designing and developing specifications. The IIA recognized this concern in their CSR practice guide (IIA 2010). The key

[14] In general, internal auditors are responsible for investigating and evaluating an organization's activities. If the auditors design or develop specifications for green IT activities, this will potentially put the auditors in the position investigating and evaluating their own works, which could threaten their objectivity.

TABLE 4

Green IT Activities that Internal Auditors Should Be Involved In

Panel A: Summary

Green IT Activities	Environmental Strategy[a]	Definitely Not (1)	Probably Not (2)	Maybe or Maybe Not (3)	Probably Should (4)	Definitely Should (5)	M	SE	n
Provide assurance that the green IT monitoring controls are being used properly by others	*No statement 1*	3 (3.8%)	0 (0%)	6 (7.5%)	19 (23.8%)	52 (65%)	4.46	0.93	80
	No statement 2	2 (1.8%)	5 (4.4%)	8 (7%)	32 (28.1%)	67 (58.8%)	4.38	0.93	114
	Type 0	0 (0%)	1 (4.5%)	6 (27.3%)	6 (27.3%)	9 (40.9%)	4.05	0.95	22
	Type 1	1 (1.9%)	2 (3.8%)	5 (9.4%)	13 (24.5%)	32 (60.4%)	4.38	0.95	53
	Type 3	0 (0%)	1 (2.2%)	6 (13%)	13 (28.3%)	26 (56.5%)	4.39	0.80	46
	Overall	6 (1.9%)	9 (2.9%)	31 (9.8%)	83 (26.3%)	186 (59%)	4.38	0.91	315
Monitor controls to determine whether green IT specifications are being complied with	*No statement 1*	4 (5%)	5 (6.3%)	11 (13.8%)	17 (21.3%)	43 (53.8%)	4.13	1.17	80
	No statement 2	6 (5.3%)	8 (7%)	8 (7%)	38 (33.3%)	54 (47.4%)	4.11	1.14	114
	Type 0	0 (0%)	2 (9.1%)	5 (22.7%)	6 (27.3%)	9 (40.9%)	4.00	1.02	22
	Type 1	2 (3.8%)	3 (5.7%)	7 (13.2%)	16 (30.2%)	25 (47.2%)	4.11	1.09	53
	Type 3	1 (2.2%)	5 (10.9%)	4 (8.7%)	13 (28.3%)	23 (50%)	4.13	1.11	46
	Overall	13 (4.1%)	23 (7.3%)	35 (11.1%)	90 (28.6%)	154 (48.9%)	4.11	1.12	315
Design/develop specifications for green IT activities	*No statement 1*	29 (36.7%)	19 (24.1%)	19 (24.1%)	6 (7.6%)	6 (7.6%)	2.25	1.25	79
	No statement 2	37 (32.7%)	34 (30.1%)	21 (18.6%)	18 (15.9%)	3 (2.7%)	2.26	1.16	113
	Type 0	5 (22.7%)	4 (18.2%)	9 (40.9%)	2 (9.1%)	2 (9.1%)	2.64	1.22	22
	Type 1	17 (32.1%)	15 (28.3%)	10 (18.9%)	10 (18.9%)	1 (1.9%)	2.30	1.17	53
	Type 3	14 (31.8%)	14 (31.8%)	10 (22.7%)	6 (13.6%)	0 (0%)	2.18	1.04	44
	Overall	102 (32.8%)	86 (27.7%)	69 (22.2%)	42 (13.5%)	12 (3.9%)	2.28	1.17	311
Design/develop controls to monitor green IT activities to ensure compliance with green IT specifications	*No statement 1*	26 (32.9%)	10 (12.7%)	21 (26.6%)	14 (17.7%)	8 (10.1%)	2.59	1.37	79
	No statement 2	29 (25.2%)	28 (24.3%)	17 (14.8%)	24 (20.9%)	17 (14.8%)	2.76	1.42	115
	Type 0	3 (13.6%)	2 (9.1%)	9 (40.9%)	5 (22.7%)	3 (13.6%)	3.14	1.21	22
	Type 1	15 (28.3%)	7 (13.2%)	8 (15.1%)	18 (34%)	5 (9.4%)	2.83	1.41	53
	Type 3	12 (26.1%)	8 (17.4%)	11 (23.9%)	8 (17.4%)	7 (15.2%)	2.78	1.41	46
	Overall	85 (27%)	55 (17.5%)	66 (21%)	69 (21.9%)	40 (12.7%)	2.76	1.39	315

(continued on next page)

TABLE 4 (continued)

[a] No formal statement:
No statement 1: No statements and no ecological impact in decisions; and
No statement 2: No statements but consider ecological impact in decisions.
Formal statement:
Type 0: Type 0 (Image-oriented) strategy—Not part of mission statement and not actively publicized;
Type 1: Type 1 (Prevent/control) strategy—Not part of mission statement but actively publicized; and
Type 3: Type 3 (Sustainable development) strategy—Integral part of mission (or vision) statement.

Panel B: Analysis of Covariance Results

(a) Provide assurance that the green IT monitoring controls are being used properly by others

Source	df	MS	F	p	η^2
Firm size	1	0.053	0.065	0.799	0.001
Industry	20	1.198	1.473	0.089	0.093
Strategy	4	0.741	0.911	0.458	0.012
Error	289	0.813			

(b) Monitor controls to determine whether green IT specifications are being complied with

Source	df	MS	F	p	η^2
Firm size	1	0.025	0.020	0.889	0.001
Industry	20	1.014	0.784	0.732	0.051
Strategy	4	0.142	0.110	0.979	0.002
Error	289	1.293			

(c) Design/develop specifications for green IT activities

Source	df	MS	F	p	η^2
Firm size	1	0.028	0.020	0.887	0.001
Industry	20	1.051	0.752	0.770	0.050
Strategy	4	0.848	0.607	0.658	0.008
Error	285	1.397			

(d) Design/develop controls to monitor green IT activities to ensure compliance with green IT specifications

Source	df	MS	F	p	η^2
Firm size	1	0.075	0.039	0.844	0.001
Industry	20	2.022	1.044	0.410	0.067
Strategy	4	1.464	0.756	0.555	0.010
Error	289	1.937			

consideration is to not put the individual auditors in the position of auditing their own designing and developing activities, which would threaten their objectivity. For larger internal audit departments, in particular, they could establish a separate team for involvement in designing and developing activities. Only a little over a third (109 respondents, 34.6 percent) indicated that internal auditors probably (69 respondents, 21.9 percent) or definitely (40 respondents, 12.7 percent) should design or develop controls to monitor green IT activities. The low number is interesting because one major potential role played by internal auditors, in general, is to help design or develop effective and efficient controls. The involvement of internal auditors is critical in all phases (feasibility through post-implementation review) of any new IT implementation. To maximize the effectiveness of new IT implementation, it is essential that internal auditors participate in the design and development stages of the project and provide advice on appropriate internal controls. The exact set of controls will vary greatly by industry, degree of applicable regulations, and an organization's overall philosophy (i.e., tone at the top) regarding sustainability, in general, and green IT specifically. With that said, the board and top executives are going to want effective controls in place to ensure that green IT policies and procedures are distributed to all employees, that those policies and procedures are being properly complied with, and any compliance data (particularly for external reporting) are collected on a timely and accurate basis. In large organizations in particular, agency risks can be high, and, as such, the board and top executives want a high level of confidence in the upward flow of data to them from the various business units.

Testing H1 (Perceived Roles)

An analysis of covariance (ANCOVA) was conducted to assess, after controlling for organization size and industry, whether internal auditors' perceived roles in green IT activities vary depending on the types of organizational environmental sustainability strategies.[15] The ANCOVA results in Panel B of Table 4 are not statistically significant. Therefore, H1 is not supported. That is, contrary to our expectations that more progressive organization would have more progressive internal auditors, internal auditors' perceived roles in terms of green IT activities that they should be involved in did not vary depending on the types of organizational environmental sustainability strategies implemented in their organizations.

Current Involvement of Green IT Activities (Environmental Behaviors)

Contrasting the prior discussion as to what auditors should do in green IT, Panel A of Table 5 reveals that the actual participation of internal auditors in green IT activities is limited. Interestingly, only a few respondents and their departments were involved in providing assurance (3 percent for the individual and 4.4 percent for the department) and monitoring controls (2.8 percent for the individual and 5.6 percent for the department), even though they deemed that internal auditors should be involved in such activities. Slightly fewer of the respondents (2.2 percent for the individual and 4.3 percent for the department) participated in designing or developing specifications and designing or developing controls (2.8 percent for the individual and 3.6 percent for the department) for green IT activities at the individual or department level. These results suggest that internal auditors currently have minimal involvement in green IT activities.

[15] We conducted an analysis of covariance (ANCOVA) because it is used to determine whether there are any significant differences between groups (i.e., the types of organizational environmental sustainability strategies) when we know that extraneous variables (i.e., size and industry) may have an impact on the outcome variable (i.e., internal auditors' perceived roles in green IT activities).

TABLE 5

Internal Auditor's Current Involvement of Green IT Activities

Panel A: Summary

Green IT Activities	Environmental Strategy	Could Not Do This With Current Dept. Skills (1)		My Dept. Could Help, But Not Do It Alone (2)		My Dept. Has Not Done This, But They Have The Skills To Do This (3)		I Have Not, But My Dept. Has Done This (4)		I Have Personally Done This (5)		M	SE	n
Provide assurance that the green IT monitoring controls are being used properly by others	*No statement 1*	15	(20.5%)	23	(31.5%)	33	(45.2%)	0	(0%)	2	(2.7%)	2.33	0.90	73
	No statement 2	14	(14.7%)	32	(33.7%)	47	(49.5%)	1	(1.1%)	1	(1.1%)	2.40	0.79	95
	Type 0	0	(0%)	8	(47.1%)	6	(35.3%)	3	(17.6%)	0	(0%)	2.71	0.77	17
	Type 1	8	(18.2%)	9	(20.5%)	24	(54.5%)	2	(4.5%)	1	(2.3%)	2.52	0.93	44
	Type 3	3	(7.1%)	7	(16.7%)	22	(52.4%)	6	(14.3%)	4	(9.5%)	3.02	1.00	42
	Overall	40	(14.8%)	79	(29.2%)	132	(48.7%)	12	(4.4%)	8	(3%)	2.52	0.90	271
Monitor controls to determine whether green IT specifications are being complied with	*No statement 1*	15	(20%)	24	(32%)	34	(45.3%)	0	(0%)	2	(2.7%)	2.33	0.89	75
	No statement 2	11	(11%)	34	(34%)	52	(52%)	2	(2%)	1	(1%)	2.48	0.76	100
	Type 0	0	(0%)	6	(31.6%)	9	(47.4%)	4	(21.1%)	0	(0%)	2.89	0.74	19
	Type 1	6	(12.5%)	13	(27.1%)	25	(52.1%)	2	(4.2%)	2	(4.2%)	2.60	0.92	48
	Type 3	4	(9.1%)	8	(18.2%)	21	(47.7%)	8	(18.2%)	3	(6.8%)	2.95	1.01	44
	Overall	36	(12.6%)	85	(29.7%)	141	(49.3%)	16	(5.6%)	8	(2.8%)	2.56	0.88	286
Design/develop specifications for green IT activities	*No statement 1*	41	(54.7%)	21	(28%)	11	(14.7%)	0	(0%)	2	(2.7%)	1.68	0.92	75
	No statement 2	35	(35.7%)	38	(38.8%)	20	(20.4%)	4	(4.1%)	1	(1%)	1.96	0.91	98
	Type 0	6	(33.3%)	6	(33.3%)	4	(22.2%)	2	(11.1%)	0	(0%)	2.11	1.02	18
	Type 1	14	(31.8%)	20	(45.5%)	9	(20.5%)	1	(2.3%)	0	(0%)	1.93	0.79	44
	Type 3	10	(23.8%)	15	(35.7%)	9	(21.4%)	5	(11.9%)	3	(7.1%)	2.43	1.19	42
	Overall	106	(38.3%)	100	(36.1%)	53	(19.1%)	12	(4.3%)	6	(2.2%)	1.96	0.97	277

(continued on next page)

TABLE 5 (continued)

Green IT Activities	Environmental Strategy	Could Not Do This With Current Dept. Skills (1)		My Dept. Could Help, But Not Do It Alone (2)		My Dept. Has Not Done This, But They Have The Skills To Do This (3)		I Have Not, But My Dept. Has Done This (4)		I Have Personally Done This (5)		M	SE	n
Design/develop controls to monitor green IT activities to ensure compliance with green IT specifications	*No statement 1*	27	(36%)	25	(33.3%)	21	(28%)	0	(0%)	2	(2.7%)	2.00	0.94	75
	No statement 2	17	(17.7%)	41	(42.7%)	34	(35.4%)	3	(3.1%)	1	(1%)	2.27	0.83	96
	Type 0	5	(25%)	5	(25%)	7	(35%)	2	(10%)	1	(5%)	2.45	1.15	20
	Type 1	11	(23.4%)	14	(29.8%)	20	(42.6%)	0	(0%)	2	(4.3%)	2.32	0.98	47
	Type 3	6	(14%)	17	(39.5%)	13	(30.2%)	5	(11.6%)	2	(4.7%)	2.53	1.03	43
	Overall	66	(23.5%)	102	(36.3%)	95	(33.8%)	10	(3.6%)	8	(2.8%)	2.26	0.95	281

Panel B: Analysis of Covariance Results

(a) Provide assurance that the green IT monitoring controls are being used properly by others

Source	df	MS	F	p	η^2
Firm size	1	0.621	0.874	0.351	0.004
Industry	20	1.488	2.095	0.005	0.146
Strategy	4	2.260	3.183	0.014	0.049
Error	245	0.710			

(b) Monitor controls to determine whether green IT specifications are being complied with

Source	df	MS	F	p	η^2
Firm size	1	0.453	0.628	0.429	0.002
Industry	20	1.043	1.445	0.102	0.100
Strategy	4	1.932	2.678	0.032	0.040
Error	260	0.722			

(c) Design/develop specifications for green IT activities

Source	df	MS	F	p	η^2
Firm size	1	0.176	0.202	0.653	0.001
Industry	20	1.321	1.517	0.076	0.108
Strategy	4	2.661	3.056	0.017	0.046
Error	251	0.871			

(d) Design/develop controls to monitor green IT activities to ensure compliance with green IT specifications

Source	df	MS	F	p	η^2
Firm size	1	0.729	0.835	0.362	0.003
Industry	20	1.090	1.249	0.215	0.089
Strategy	4	1.395	1.599	0.175	0.024
Error	255	0.873			

Testing H2 (Actual Roles)

An ANCOVA was conducted to assess, after controlling for organization size and industry, whether internal auditors' current involvement in green IT activities varies depending on the types of environmental sustainability strategies. The ANCOVA results in Panel B of Table 5 indicate that, after controlling for organization size and industry, there are significant differences in internal auditors' current involvement on three green IT activities across the various types of organizational environmental sustainability strategies: providing assurance ($F_{(4,\ 245)} = 3.183$, $p = 0.014$, $\eta^2 = 0.049$), monitoring control ($F_{(4,\ 260)} = 2.678$, $p = 0.032$, $\eta^2 = 0.04$), and designing or developing specifications ($F_{(4,\ 251)} = 3.056$, $p = 0.017$, $\eta^2 = 0.046$). Etas (η) were about 0.22, 0.2, and 0.22. According to Cohen (1988), they can be considered as small effect sizes.[16]

Furthermore, pairwise comparisons results with respect to providing assurance (not provided in tabular form) indicate significant differences between *No statement 1* and *Type 3* groups ($p = 0.001$), between *No statement 2* and *Type 3* groups ($p = 0.002$), and between *Type 1* and *Type 3* groups ($p = 0.014$). This suggests that internal auditors in *Type 3* (sustainable development) strategy organizations ($M = 3.009$, $SE = 0.153$) are currently more involved in providing assurance than those auditors in organizations with *No statement 1* ($M = 2.401$, $SE = 0.112$), *No statement 2* ($M = 2.456$, $SE = 0.106$), and *Type 1* organizations ($M = 2.547$, $SE = 0.147$). With respect to monitoring controls, there are significant differences between *No statement 1* and *Type 0* groups ($p = 0.035$), between *No statement 1* and *Type 3* groups ($p = 0.004$), and between *No statement 2* and *Type 3* groups ($p = 0.019$). Therefore, in comparison with those in organizations with *No statement 1* ($M = 2.397$, $SE = 0.112$) and *No statement 2* ($M = 2.515$, $SE = 0.105$), internal auditors in *Type 3* organizations ($M = 2.925$, $SE = 0.151$) tend to be more involved in monitoring controls to determine whether green IT specifications are being complied with. Also, internal auditors in *Type 0* (image-oriented) organizations ($M = 2.88$, $SE = 0.208$) are more likely involved in monitoring controls than those in *No statement 1* group. Finally, significant differences are found between *No statement 1* and *Type 3* groups ($p = 0.001$) and between *No statement 2* and *Type 3* groups ($p = 0.012$) in terms of designing or developing specifications. A marginally significant difference is also observed between *Type 1* and *Type 3* groups ($p = 0.056$). Thus, in general, internal auditors in *Type 3* organizations ($M = 2.397$, $SE = 0.169$) are currently more involved in designing or developing specifications than in organizations with *No statement 1* ($M = 1.683$, $SE = 0.123$), *No statement 2* ($M = 1.891$, $SE = 0.116$), and *Type 1* organizations ($M = 1.979$, $SE = 0.16$).

In sum, the ANCOVA results support H2 for all activities except for designing or developing controls. This suggests that in general, internal auditors' current involvement in green IT activities varies depending on the types of organizational environmental sustainability strategies, and their involvement is generally greater if their organizations have the higher type of environmental sustainability strategies.

Current Involvement in Elements of Green IT Activities (Environmental Behaviors)

Panel A of Table 6 shows specific elements of green IT activities where respondents are involved. A relatively small number of the respondents engaged in purchasing IT equipment (9.5 percent for the individual and 10.9 percent for the department), developing disposal and recycling policy and procedures (6 percent for the individual and 5.3 percent for the department), complying with green IT regulations (5.4 percent for the individual and 5.8 percent for the department), and

[16] Cohen (1988) provided guidelines for interpreting the size of the "effect" for common effect size measures such as γ, η, and φ. According to Cohen, $\eta > 0.10$ is a small effect, $\eta > 0.24$ is a medium effect, and $\eta > 0.37$ is a large effect in social science research.

TABLE 6

Internal Auditor's Current Involvement in Green IT Elements

Panel A: Summary

Green IT Areas	Environmental Strategy	Could Not Do This With Current Dept. Skills (1)		My Dept. Could Help, But Not Do It Alone (2)		My Dept. Has Not Done This, But They Have The Skills To Do This (3)		I Have Not, But My Dept. Has Done This (4)		I Have Personally Done This (5)		M	SE	n
Purchasing computers and related equipment	*No statement 1*	23	(32.9%)	21	(30%)	15	(21.4%)	5	(7.1%)	6	(8.6%)	2.29	1.24	70
	No statement 2	29	(29.3%)	36	(36.4%)	17	(17.2%)	9	(9.1%)	8	(8.1%)	2.30	1.22	99
	Type 0	5	(23.8%)	4	(19%)	5	(23.8%)	5	(23.8%)	2	(9.5%)	2.76	1.34	21
	Type 1	14	(31.1%)	13	(28.9%)	12	(26.7%)	4	(8.9%)	2	(4.4%)	2.27	1.14	45
	Type 3	5	(12.8%)	12	(30.8%)	7	(17.9%)	7	(17.9%)	8	(20.5%)	3.03	1.37	39
	Overall	76	(27.7%)	86	(31.4%)	56	(20.4%)	30	(10.9%)	26	(9.5%)	2.43	1.26	274
Developing equipment disposal and recycling policy and procedures	*No statement 1*	21	(28.4%)	27	(36.5%)	20	(27%)	1	(1.4%)	5	(6.8%)	2.22	1.09	74
	No statement 2	22	(22.2%)	47	(47.5%)	21	(21.2%)	5	(5.1%)	4	(4%)	2.21	0.98	99
	Type 0	8	(40%)	2	(10%)	6	(30%)	4	(20%)	0	(0%)	2.30	1.22	20
	Type 1	8	(16.7%)	21	(43.8%)	14	(29.2%)	1	(2.1%)	4	(8.3%)	2.42	1.07	48
	Type 3	9	(22.5%)	14	(35%)	9	(22.5%)	4	(10%)	4	(10%)	2.50	1.24	40
	Overall	68	(24.2%)	111	(39.5%)	70	(24.9%)	15	(5.3%)	17	(6%)	2.30	1.08	281
Complying with green IT laws and regulations from government agencies	*No statement 1*	18	(25.7%)	25	(35.7%)	23	(32.9%)	1	(1.4%)	3	(4.3%)	2.23	1.00	70
	No statement 2	16	(15.8%)	49	(48.5%)	28	(27.7%)	4	(4%)	4	(4%)	2.32	0.93	101
	Type 0	5	(27.8%)	4	(22.2%)	7	(38.9%)	2	(11.1%)	0	(0%)	2.33	1.03	18
	Type 1	5	(10.6%)	19	(40.4%)	16	(34%)	3	(6.4%)	4	(8.5%)	2.62	1.05	47
	Type 3	4	(10%)	13	(32.5%)	13	(32.5%)	6	(15%)	4	(10%)	2.83	1.13	40
	Overall	48	(17.4%)	110	(39.9%)	87	(31.5%)	16	(5.8%)	15	(5.4%)	2.42	1.02	276

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TABLE 6 (continued)

Green IT Areas	Environmental Strategy	Could Not Do This With Current Dept. Skills (1)		My Dept. Could Help, But Not Do It Alone (2)		My Dept. Has Not Done This, But They Have The Skills To Do This (3)		I Have Not, But My Dept. Has Done This (4)		I Have Personally Done This (5)		M	SE	n
Designing data center energy and cooling infrastructure	*No statement 1*	56	(76.7%)	11	(15.1%)	2	(2.7%)	3	(4.1%)	1	(1.4%)	1.38	0.84	73
	No statement 2	61	(62.9%)	25	(25.8%)	8	(8.2%)	2	(2.1%)	1	(1%)	1.53	0.82	97
	Type 0	10	(62.5%)	3	(18.8%)	2	(12.5%)	1	(6.3%)	0	(0%)	1.63	0.96	16
	Type 1	29	(61.7%)	10	(21.3%)	7	(14.9%)	1	(2.1%)	0	(0 %)	1.57	0.83	47
	Type 3	23	(60.5%)	7	(18.4%)	3	(7.9%)	2	(5.3%)	3	(7.9%)	1.82	1.27	38
	Overall	179	(66.1%)	56	(20.7%)	22	(8.1%)	9	(3.3%)	5	(1.8%)	1.54	0.91	271

Panel B: Analysis of Covariance Results

(a) Purchasing computers and related equipment

Source	df	MS	F	p	η^2
Firm size	1	1.223	0.874	0.351	0.004
Industry	20	3.380	2.416	0.001	0.163
Strategy	4	3.663	2.618	0.036	0.041
Error	248	1.399			

(b) Developing equipment disposal and recycling policy and procedures

Source	df	MS	F	p	η^2
Firm size	1	0.329	0.280	0.597	0.001
Industry	20	1.188	1.014	0.445	0.074
Strategy	4	1.097	0.937	0.443	0.014
Error	255	1.172			

(c) Complying with green IT laws and regulations from government agencies

Source	df	MS	F	p	η^2
Firm size	1	0.453	0.486	0.486	0.002
Industry	19	2.025	2.173	0.004	0.141
Strategy	4	2.059	2.210	0.068	0.034
Error	251	0.932			

(d) Designing data center energy and cooling infrastructure

Source	df	MS	F	p	η^2
Firm size	1	0.182	0.224	0.636	0.001
Industry	20	1.055	1.297	0.181	0.096
Strategy	4	0.725	0.892	0.469	0.014
Error	245	0.813			

designing data center energy and cooling infrastructure (1.8 percent for the individual and 3.3 percent for the department) at the individual or department level.

Testing H3 (Actual IT Elements)

An ANCOVA was also conducted to assess, after controlling for organization size and industry, whether the scope of internal auditors' current involvement in various green IT elements differs depending on the types of organizational environmental sustainability strategies. Panel B of Table 6 indicates a significant difference in internal auditors' current involvement on purchasing computers and related equipment ($F_{(4,\ 248)} = 2.618$, $p = 0.036$, $\eta^2 = 0.041$). The Eta is 0.2, which, according to Cohen (1988), is a small effect. Also, a marginally significant difference is observed with respect to complying with green IT laws and regulations from government agencies ($F_{(4,\ 251)} = 2.21$, $p = 0.068$, $\eta^2 = 0.034$), which, according to Cohen (1988), can be considered as a small effect size ($\eta = 0.18$). However, there is no significant difference in the other two elements of green IT elements.

Furthermore, pairwise comparison results with purchasing computers and related equipment (not provided in tabular form) indicate significant differences between *No statement 1* and *Type 3* groups ($p = 0.008$), between *No statement 2* and *Type 3* groups ($p = 0.01$), and between *Type 1* and *Type 3* groups ($p = 0.005$). This suggests that, as compared with those in organizations with *No statement 1* ($M = 2.362$, $SE = 0.168$), *No statement 2* ($M = 2.417$, $SE = 0.15$), and *Type 1* (prevent/control) strategy organizations ($M = 2.3$, $SE = 0.206$), internal auditors in *Type 3* (sustainable development) strategy organizations ($M = 3.051$, $SE = 0.22$) are currently more involved in purchasing computers and related equipment. In terms of complying with green IT laws and regulations from government agencies, significant differences are also found between *No statement 1* and *Type 1* groups ($p = 0.049$), between *No statement 1* and *Type 3* groups ($p = 0.019$), between *No statement 2* and *Type 1* groups ($p = 0.048$), and between *No statement 2* and *Type 3* groups ($p = 0.019$). These results suggest that internal auditors in organizations with *No statement 1* ($M = 2.279$, $SE = 0.134$) and *No statement 2* ($M = 2.307$, $SE = 0.113$) are generally less involved in activities ensuring compliance with green IT laws and regulations than those in *Type 1* ($M = 2.67$, $SE = 0.158$) and *Type 3* organizations ($M = 2.777$, $SE = 0.173$).

Overall, the ANCOVA results partially support H3. That is, internal auditors' current involvement in various green IT elements differs depending on the types of environmental sustainability strategies for some green IT elements, and their involvement is generally greater if their organizations have the higher type of environmental sustainability strategies.

Alignment of Internal Auditors' Perceived Roles and Actual Roles in Green IT Activities

Paired samples t-tests were conducted to examine whether internal auditors' current involvement in green IT activities is aligned with their perceived roles to what roles auditors should pursue in green IT activities (i.e., H4). In other words, auditors who have strong views about the broad roles of internal auditors in green IT are also more involved in their organization's green IT activities. Table 7 shows the paired samples t-test results.

Testing H4 (Perceived and Actual Role Alignment)

The results in the overall table indicate that all results are statistically significant (all $p < 0.001$). According to Cohen (1988),[17] the differences in the first two activities are much larger than

[17] According to Cohen (1988), $d > 0.20$ is a small or smaller-than-typical effect, $d > 0.50$ is a medium or typical effect, $d > 0.80$ is a large or larger-than-typical effect, and $d > 1.00$ is a much-larger-than-typical effect in social science research.

TABLE 7

Internal Auditors' Perceived Role in Green IT Activities and Current Involvement

Green IT Activities	M	SE	t	df	p	d
(a) Overall						
Provide assurance			27.723	294	0.001	1.61
Perceived role	4.44	0.87				
Current involvement	2.52	0.92				
Monitor controls			20.977	309	0.001	1.19
Perceived role	4.12	1.14				
Current involvement	2.56	0.90				
Design/develop specifications			4.738	293	0.001	0.28
Perceived role	2.31	1.16				
Current involvement	1.96	0.97				
Design/develop controls			5.938	304	0.001	0.34
Perceived role	2.80	1.38				
Current involvement	2.27	0.96				
(b) No Statement 1						
Provide assurance			16.457	72	0.001	1.93
Perceived role	4.47	0.94				
Current involvement	2.33	0.90				
Monitor controls			12.345	74	0.001	1.43
Perceived role	4.13	1.19				
Current involvement	2.33	0.89				
Design/develop specifications			3.488	73	0.001	0.41
Perceived role	2.24	1.23				
Current involvement	1.69	0.92				
Design/develop controls			3.441	73	0.001	0.40
Perceived role	2.59	1.37				
Current involvement	2.01	0.94				
(c) No Statement 2						
Provide assurance			15.535	94	0.001	1.59
Perceived role	4.40	0.92				
Current involvement	2.40	0.79				
Monitor controls			11.242	99	0.001	1.12
Perceived role	4.04	1.19				
Current involvement	2.48	0.76				
Design/develop specifications			3.052	95	0.003	0.31
Perceived role	2.29	1.16				
Current involvement	1.95	0.91				
Design/develop controls			3.200	95	0.002	0.33
Perceived role	2.78	1.42				
Current involvement	2.27	0.83				
(d) Type 0						
Provide assurance			5.907	16	0.001	1.43
Perceived role	4.24	0.83				
Current involvement	2.71	0.77				
Monitor controls			3.877	18	0.001	0.89
Perceived role	4.00	1.05				
Current involvement	2.89	0.74				
Design/develop specifications			1.304	17	0.210	0.31
Perceived role	2.44	1.15				
Current involvement	2.11	1.02				
Design/develop controls			2.042	19	0.055	0.46
Perceived role	3.05	1.19				
Current involvement	2.45	1.15				

(continued on next page)

TABLE 7 (continued)

Green IT Activities	M	SE	t	df	p	d	Green IT Activities	M	SE	t	df	p	d
(e) Type 1							(f) Type 3						
Provide assurance			13.119	43	0.001	1.98	Provide assurance			7.646	40	0.001	1.19
Perceived role	4.55	0.76					Perceived role	4.44	0.81				
Current involvement	2.52	0.93					Current involvement	3.00	1.00				
Monitor controls			8.893	47	0.001	1.28	Monitor controls			6.089	42	0.001	0.93
Perceived role	4.13	1.12					Perceived role	4.12	1.14				
Current involvement	2.60	0.92					Current involvement	2.93	1.01				
Design/develop specifications			1.800	43	0.079	0.27	Design/develop specifications			−0.723	38	0.474	−0.12
Perceived role	2.27	1.17					Perceived role	2.23	1.01				
Current involvement	1.93	0.79					Current involvement	2.38	1.21				
Design/develop controls			2.009	46	0.050	0.29	Design/develop controls			1.402	41	0.168	0.22
Perceived role	2.83	1.42					Perceived role	2.83	1.41				
Current involvement	2.32	0.98					Current involvement	2.50	1.02				

typical ($d = 1.61$ and $d = 1.19$) whereas the differences in the last two activities, although statistically significant, are small ($d = 0.28$ and $d = 0.34$). Therefore, H4 is not supported, suggesting that internal auditors' current involvement in green IT activities is not aligned with their perceived potential roles in green IT activities. In other words, although internal auditors believe that they should be involved in green IT activities, their current involvement of all four activities was limited.

In addition, we performed separate paired samples t-tests for each type of environmental sustainability strategy (see Table 7). The results of *No statement 1* and *No statement 2* groups suggest that for all internal auditors' roles in green IT activities, there is a gap between internal auditors' current involvement and their perceived potential roles in *No statement 1* and *No statement 2* groups (all four roles $p < 0.01$). With respect to *Type 0* group, internal auditors' current involvement in green IT activities is not aligned with their perceived potential roles for three activities: providing assurance ($p = 0.001$), monitoring controls ($p = 0.001$), and designing or developing controls (marginal, $p = 0.055$). Regarding *Type 1* group, internal auditors' current involvement in green IT activities is not aligned with their perceived potential roles for all activities: providing assurance ($p = 0.001$), monitoring controls ($p = 0.001$), designing or developing specifications (marginal, $p = 0.079$), and designing or developing controls (marginal, $p = 0.05$). However, the results of *Type 3* group indicate that internal auditors' current involvement in green IT activities is not aligned with their perceived potential roles only for two roles: providing assurance and monitoring controls (both roles $p = 0.001$).

VI. CONCLUSIONS AND FUTURE RESEARCH

The primary motivation of this study was to be the first to explore internal auditors' perceptions and actual roles regarding green IT activities. We were interested in the scope of those activities in terms of roles (e.g., auditor, consultant, and facilitator) and green IT elements (e.g., purchasing, implementation, recycling). We explored whether those perceptions and actual activities were different in light of the types of environmental sustainability strategies implemented in their organizations (Type 0 to Type 3) and whether there was alignment between the auditor's perceived roles and actual roles. The following summarizes our primary conclusions from our survey concerning the perceptions and actual activities of internal auditors regarding green IT:

1. **What roles should auditors take?** Most respondents indicated that internal auditors should be involved in providing assurance (85.4 percent) and monitoring controls (77.5 percent); with only 34.6 percent indicating that internal auditors should design or develop controls to monitor green IT activities and only 17.4 percent indicating that auditors should actually help designing or developing specifications for green IT activities. The perceived roles did not vary depending on the types of environmental sustainability strategies implemented in their organizations.
2. **What roles do auditors actually perform?** Participation of internal auditors in green IT activities is limited with only a few respondents and their departments being involved in providing assurance (7.4 percent) and monitoring controls (8.4 percent). Less than 7 percent participated in the design or development of specifications and controls for green IT activities at the individual or department level. Internal auditors' current involvement in these three green IT activities (i.e., providing assurance, monitoring control, and designing or developing specifications) did vary by the types of environmental sustainability strategies implemented in their organizations, but their current involvement in designing or developing controls did not vary.
3. **What green IT elements are auditors involved with?** No one element dominated internal auditor's green IT involvement. A relatively small numbers of the respondents engaged in

activities related to purchasing IT equipment (20.4 percent), developing disposal and recycling policy and procedures (11.4 percent), complying with green IT regulations (11.2 percent), and designing data center energy and cooling infrastructure (5.2 percent) at the individual or department level. Only one green IT element related to purchasing computers and related equipment and complying with green IT laws and regulations vary by the types of environmental sustainability strategies implemented in their organizations. Involvement in other elements did not vary.

4. **Alignment of perceived and actual roles?** Internal auditors' current involvement in green IT is not aligned with their perceived potential roles in green IT. In other words, there was significant difference in perceived roles and actual roles; however, it appeared that internal auditors' actual roles did not differ between those who perceived a broad role in green IT and those who perceived a narrow role.

In summary, item #1 indicates there is a significant gap between green activities being promoted by the IIA (e.g., as discussed in IIA [2008]) and the roles that participants believe internal auditors should be involved in. The participant's perceived roles are much narrower and conservative than those promoted by the IIA. Items #2, #3, and #4 indicate another gap between what auditors perceive their roles should be (could be) and what their actual roles are. In general, the results indicate that internal auditors believe that they should be more involved in green IT, but limited to the traditional role as assurance provider, not as facilitators and consultants. Whether limited to assurance or not, these two gaps indicate there are opportunities for internal auditors to proactively expand their value-added green IT services. These two gaps present a variety of future research opportunities discussed in the following section.

Future Research

The survey respondents are a self-selected sample limited to the North American jurisdiction of the IIA and are mostly non-IT internal auditors, therefore, caution must be exercised in generalizing the survey results. With that caveat stated, we suggest some areas for future research.

Based on the two extensive gaps we identified, it appears, in contrast to IIA and COSO recommendations, that organizations are unwisely underutilizing a potentially valuable resource in their sustainability and environmental compliance activities, at least in the green IT domain. Because of the ever-increasing importance of sustainability and environmental compliance, future research needs to explore why these two gaps exist and how to reduce these gaps. Since 2002, at public companies, complying with SOX has been both a benefit and challenge to internal auditors in the United States. It has increased the stature of internal auditors and enhanced their image as their organizations' control experts, but it has also made major demands on internal audit departments' resources (Gray 2008). That may explain one reason for the low green IT involvement. However, with SOX activities becoming more routine and less demanding, other inhibitors should also be identified if internal auditors plan to expand their green IT activities.

It should also be noted that green IT activities cannot be addressed in isolation. Green IT objectives can conflict with other IT objectives, and require management to carefully evaluate these conflicting objectives. For example, meeting green IT objectives may suggest dismantling some of the redundancy built into the systems that contributes to an organization's SOX compliance, since the redundancy increases power consumption (Juergens 2010). In addition, because of limitations in resources and demands of other high-priority responsibilities, internal auditors also have conflicts and must be able to identify and focus on those green IT activities that have the highest value-added potential for their organizations (Juergens 2010). Understanding the various trade-offs in terms of controls and security objectives and green IT objectives is an important future research topic.

There are a variety of potential reasons why the first gap between the IIA and auditor perceptions exists: (1) the IIA message may not be getting out to its members; (2) the IIA's message is not getting to those that internal audit department report to such as the board and the CFO; (3) internal auditors are not generally proactive in expanding their portfolio of services; or (4) it may be that internal auditors wrongly believe the necessary skills to be involved in green IT are outside their skill set. Future research should explore these potential reasons behind this gap to identify the most pertinent reasons—and how those reasons could be addressed. Focus groups and additional surveys of internal auditors would be two ways to collect those reasons and rationales. Laboratory behavioral experiments where auditors are given a variety of green IT scenarios could also help pinpoint reasons and rationales.

The second gap is disconcerting, particularly in organizations that have a high level of green strategies (i.e., Type 2 and 3), because those organizations are apparently underutilizing a valuable resource in their green activities. Like the first gap, there are a variety of possible reasons why the second gap exists. For example, the boards to whom the audit department reports want their auditors to be conservative and to take narrow roles (i.e., financial auditing and SOX activities) in their activities. Although the IIA and COSO promote the critical roles of internal auditors as control experts, boards and management may not even consider a role for internal auditors in green IT because the board views green IT as primarily a technical issue, not as control, cost, and benefits issues. Internal auditors are generally not proactive in identifying new opportunities for themselves—they wait to be asked to do something (Gray et al. 2010). While green IT and green activities in general are important, auditors have to allocate their limited resources to higher priority projects (e.g., SOX), which may consume all of those resources.

To help identify the primary reasons for the gap between perception and actual activities, we recommend a triangular approach to future research. That is, future research needs to include internal auditors, IT people, and boards and CFOs. We include both the board and CFO because, even though the IIA and SOX recommend that an internal audit department should report to the board, Chief Audit Executives (CAEs) usually indicate that their department has a "solid-line" reporting responsibility to the board and "dotted-line" responsibility to the CFO (or CEO or other similar position). CFOs have a greater influence on the day-to-day activities of the internal audit department than the board. We are not recommending that one future research project has to include all three sides of the triangle, but that different projects could address one or two sides in separate projects. As recommended above, focus groups and surveys could be used to glean an understanding of the views of IT representative, boards, and CFOs regarding the roles of internal auditors in green IT activities. Laboratory behavioral experiments could be conducted where IT representative, boards, and CFOs subjects are given a variety of green IT scenarios that involve internal auditors. These experiments could also help pinpoint reasons and rationales for the low level of participation by internal auditors.

For the IT representative, boards, and CFOs sides of the triangle, we suggest working with the appropriate professional organizations (e.g., Society for Information Management[18] for IT subjects and Financial Executives International[19] for CFO subjects) to identify and encourage subjects to participate in future research projects.

We also suggest repeating our study outside the United States. Participants in our study were from North America. The European Union (EU) and specific countries such as France as well as countries outside the EU, such as Australia, have stricter sustainability rules and regulations. As

[18] Available at: http://www.simnet.org/
[19] Available at: http://www.financialexecutives.org

such, it would be interesting to see if internal auditors' perceptions and actual activities are broader in scope and more frequent in these other countries.

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APPENDIX A

Summary of Survey Questions

Environmental Sustainability Motivating Forces

How important are the following drivers in your organization for adopting green IT initiatives?

- Reducing operational costs (e.g., energy use)
- Socially responsible thing to do
- Government regulations
- Meet organization's overall green initiatives
- Actions of competitors.

Environmental Sustainability green IT Strategies

Does your organization have a general green (social responsibility) statement?

Environmental Sustainability green IT Practices

Does your organization measure its carbon footprint (or other general measures of environmental impact)?

Does your organization monitor IT-related energy spending?

Which of the following activities are parts of your organization's green IT activities? (check all that apply)

- Configure desktops to automatically enter sleep mode when inactive
- Use recycling service to dispose of obsolete IT equipment
- Educate users to turn off IT equipment at night
- Participated in product take-back/recycling programs from vendors
- Use virtualization software to reduce the number of servers
- Install more efficient data center power supplies
- Modified data center cooling infrastructure to improve efficiency
- Use cloud computing to reduce the number of servers
- Build a new data center that is energy efficient
- Moved a data center to another city/state to reduce energy costs and/or environmental impact.

Environmental Attitudes (Tendency toward Internal Auditors' Role in green IT Activities)

Assuming a hypothetical internal audit department has the skills to perform each of the following activities, should they perform those activities in light of internal auditing standards—particularly, regarding independence and objectivity?

- Design/develop specifications for green IT activities.
- Design/develop controls to monitor green IT activities to ensure compliance with green IT specifications.
- Monitor controls to determine whether green IT specifications are being complied with.
- Provide assurance that the green IT monitoring controls are being used properly by others (outside of internal auditing).

Environmental Behaviors (Experience with green IT Activities and Related Audit Experience)

Based on your experiences, your department's experiences, and the combined skills of your internal audit department, select the most appropriate answer for each of the following broad green IT activities.

- Design/develop specifications for green IT activities.
- Design/develop controls to monitor green IT activities to ensure compliance with green IT specifications.
- Monitor controls to determine whether green IT specifications are being complied with.
- Provide assurance that the green IT monitoring controls are being used properly by others (outside of internal auditing).

(continued on next page)

APPENDIX A (continued)

Based on your experiences, your department's experiences, and the combined skills of your internal audit department, select the most appropriate answer for each AREA of green IT policies, procedures, and/or specifications.

- Purchasing computers and related equipment.
- Developing equipment disposal and recycling policy and procedures.
- Complying with green IT laws and regulations from government agencies.
- Designing data center energy and cooling infrastructure.