Journal of the Midwest Association for Information Systems

Volume 2016 | Issue 2 Article 2

Date: 07-31-2016

Enterprise IT Asset Disposition: An Overview and Tutorial

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Abstract

Enterprise IT Asset Disposition (ITAD) addresses the recovery and recycling of an enterprise's IT assets that are near or at the end of their lifecycle. The aim of ITAD is to maximize the value of investment over the IT asset's entire lifecycle while guaranteeing data security and protecting against environmental liability. Regulatory requirements mandate specific disposal methods for computing assets, and enterprises face significant risks if they fail to comply. Despite the critical importance of ITAD, many enterprises lack a clear understanding of ITAD and its regulations and struggle with the management of ITAD processes. One solution to this challenge is the ITAD service provided by third-parties that can deliver effective and proper disposition services, and more importantly help enterprises maximize the potential value recovered from IT assets. This tutorial defines ITAD processes, presents its key elements and the third-party practice of ITAD services in the United States, and discusses the most important ITAD regulatory compliance and accreditations related to corporate environmental sustainability. We also discuss the role of IT and information systems in ITAD processes and recommend a research agenda.

Keywords: Green IT; enterprise sustainability; IT asset disposition; recycling; e-waste; environmental regulations; IT governance; IT audit; corporate social responsibility; reverse logistics

1. Introduction

Management of IT assets throughout the lifecycle has been recognized as one major contributing factor to the economic sustainability of enterprises while also widely recognized as a challenge to organizations (Chen, Watson, Boudreau, & Karahanna, 2009). Among the cradle-to-grave breadth of green IT dimensions, the management of end-of-life IT assets is one important stage of the green IT initiatives adopted by enterprises globally (Molla, Cooper, & Pittayachawan, 2009; Vykoukal, Wolf, & Beck, 2009). This critical stage of green IT is called enterprise IT asset disposition (ITAD), which addresses the recovery (including refurbishment, reuse, and resale) and recycling of an enterprise's IT assets that are near or at the end of their lifecycles. Green IT in general refers to environmentally friendly information technology (Huang 2009; Molla & Abareshi, 2012). In the case of ITAD, its aim is to maximize the IT asset value recovered while minimizing the risks associated with retiring active data-bearing equipment and complying with environmental protocols. Typical enterprise IT assets recovered and/or recycled cover a large selection of electronic products and devices such as computers, servers, printers, and their parts and accessories.

Challenges of end-of-life IT asset recycling mainly come from two aspects. First, there is rapid growth of the enormous amount of retired corporate IT equipment generated each year needing appropriate end-of-life management. According to the most recent findings by the U.S. Environmental Protection Agency (USEPA) (USEPA, 2010), Americans need to recycle 47.4 million computers and 141 million mobile devices (such as phones and tablets) annually. Although these numbers have included end consumers, enterprises, too, retire a staggering amount of IT equipment each year. For instance, IBM attends to 38,000 pieces of used equipment each week and replaces 100,000 employee desktop computers annually (Kopytoff, 2013). Taking this to a global perspective, not only does the Information Communication Technology (ICT) industry account for an estimated 2% of global carbon dioxide (CO2) emissions, the large volume of ICT waste potentially includes many hazardous materials, such as lead, cadmium, and mercury, that are toxic to our environment (Prasad, 2012). It is unfortunate for the world to witness the deterioration of our environment while realizing such e-waste generation is largely avoidable through responsible recycling.

Second, many organizations are in desperate need of knowledge and guidance on the proper processes of ITAD. Corporate and government organizations, a major source of retired IT equipment, bear the primary responsibility to address ITAD properly. However, researchers have discovered that those in executive leadership positions often lack this mindset, and the current consumption, production, and recycling processes in many businesses are unsustainable (Eboli & Mancini, 2012). Scholarly studies on corporate sustainability through green IT initiatives have identified and examined some important topics such as the adoption of green IT initiatives (Chen, et al., 2009; Molla & Abareshi, 2012; Pitt, Parent, Junglas, Chan, & Spyropoulou, 2011; Watson, Boudreau, & Chen, 2010; Watson, Boudreau, Chen, & Sepúlveda, 2011), product design (Kwak, Hong, & Cho, 2009; Pitt et al., 2011; Zhang, Liu, & Li, 2011), and extended producer responsibility (Zoetman, Krikke, & Venselaar, 2010). In recent years, the topic of ITAD has gained a considerable amount of recognition and many enterprises have identified ITAD as an important element in their green initiatives. However, many organizations lack the resources and legal expertise to manage the technology lifecycle and disposition all by themselves and thus have turned to certified, third-party service providers who can manage and provide a viable yet cost-effective solution.

Despite the importance of ITAD, this concept has been an extremely understudied and underrepresented phenomenon in the domains of Green IT and corporate environmental management. The purpose of this tutorial is to present the general practice of ITAD services provided to enterprises by certified third party IT disposition service companies in the United States. More specifically, our article introduces the concept of enterprise ITAD and describes the ITAD processes through which enterprises can achieve data security and privacy protection, accomplish environmental responsibility and compliance, and maximize the recovery of the residual value of IT assets, thereby delineating a green solution of effective ITAD and its value proposition to enterprises. Given that one of the authors of this discussion is an executive at an ITAD service company and serves in best practice standards development organizations for the industry, we provide an insider's perspective on this growing industry.

The article is structured in five parts. We begin with a review of the literature surrounding corporate sustainability, paying special attention to green IT and the initiatives, development, and management of IT assets in enterprises. We then describe in detail the proper practice of IT asset disposition performed by certified third party recycling companies. At each step of the ITAD processes, we will explain how, if possible, the value of residual IT assets can be recovered.

We then discuss some of the key ITAD regulatory compliance issues in the U.S., such as legal responsibilities and requirements of which enterprises should be aware and how such responsibilities can be shared with ITAD solution providers. We then comment on the role of IT and information systems (IS) in typical ITAD processes and recommend a possible research agenda before providing concluding remarks.

2. Corporate Sustainability Through IT Initiatives

Social and environmental considerations are two important dimensions for today's globally connected organizations, in addition to their focus on the traditional financial bottom line. Economic, social, and environmental benefits are referred to as the three-dimensions of corporate sustainable value by Hart and Milstein (2003). This so-called "triple bottom line" (Elkington, 1994) requires a balanced consideration of people (i.e., social and safety), profits (i.e., economics), and environmental (i.e., waste and pollution) issues in strategic endeavors and is imperative for the long-term sustainable future of our planet. Corporate sustainability, also commonly known as corporate social responsibly due to its focus on more than just the environment, is a fast growing consideration for organizations as the public is demanding greater attention to how we can minimize our current usage of resources so future generations may survive and prosper. Key resources such as clean air, food, water, land, and energy are all in finite supply, and corporations can have a significant impact on saving or sustaining these scarce resources because they have the capital to make appropriate investments and the strategic and operational capabilities to successfully implement sustainability initiatives.

Corporate sustainability has received much attention in recent business and management studies. The term corporate sustainability originates from the concept of sustainability in integrating environmental integrity and social equity with corporate and economic prosperity (Linnenluecke & Griffiths, 2010) through sustainability development, a term defined as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, chapter 2). Corporate sustainability is therefore concerned with, in addition to achieving economical and financial objectives, reducing or minimizing the ecological impact and improving social and human welfare (Linnenluecke & Griffiths, 2010; Sharma, 2003). Scholars agree that corporate sustainability is a multifaceted concept that concerns the impact on the natural and ecological environment (Chen et al., 2009; Elliot, 2011; Kwak et al., 2009), corporate social responsibility (Babin & Nicholson, 2009; Watson et al., 2011), political influences (Jenkin, McShane, & Webster, 2011), and internal organizational culture and change (Bengtsson & Ågerfalk, 2011; Linnenluecke & Griffiths, 2010). Some scholars suggest that corporate sustainability is not a destination but rather a journey or a business approach that creates long-term stakeholder value by embracing opportunities and managing risks deriving from economic, environmental, and social developments (Marrone, Schmidt, Kossahl, & Kolbe, 2011).

In parallel with the increasing effort made by corporations to achieve sustainability, academics have focused on a series of factors and aspects to examine green IT and share their findings in a growing number of publications on this topic. For a comprehensive review of these publications in a broad scope, please refer to Elliot (2011) and Jenkin, Webster, and McShane (2011). Most researchers start by providing foundational technical solutions, i.e. green IT initiatives and their adoptions in corporations. For instance, Molla, Pittayachawan, Corbitt, and Deng (2012) showed empirical evidence that eco-efficiency and eco-effectiveness motivation factors can strongly influence the adoption of green IT. Additionally, to achieve corporate sustainability through green IT initiatives, most enterprises have made great efforts to control the consumption of resources (such as energy, electronic equipment, etc.) throughout business operations and to minimize the negative outcome (and/or maximize the potential positive outcome) of such consumption. First, when engaging green IT initiatives, many have proposed better use of IT and the creation and use of information systems to monitor and control the consumption of resources. This goes hand-in-hand with the call for the "reduction in computer related energy consumption" proposed by Watson, Boudreau, and Chen (2010, p. 32) and the power consumption and greenhouse emission proposed by Babin and Nicholson (2009). For instance, shipping giant UPS uses proprietary firmware installed in its trucks to gather information and monitor energy use, to improve safety, reduce mileage, lower emissions, and cut maintenance costs (Watson, Boudreau, Li, & Levis, 2010). Similarly, Pitt et al. (2011) looked at the rise of smartphone apps and suggested the potential to enhance sustainable business strategies and provide a decision-making process to guide managers in identifying and selecting smartphone apps for sustainable issues. Another interesting study in this strand of research was conducted by DesAutels and Berthon (2011). Renaming PC to the "polluting computer," the authors explored the monetary consequences of complying with sustainability standards. Contrary to their initial belief, they found that "notebooks produced to high sustainability standards do not differ significantly in price from those produced to de facto norms" (DesAutels & Berthon, 2011, p. 118), which portrays the complex nature of the pricing strategies of sustainable computers.

One important aspect of green IT initiatives in achieving corporate sustainability largely relates to recycling and asset value recovery. On a surface level, the goal is to minimize the negative impact (environmental and social) of the outcome of corporate consumption by recycling corporate e-waste properly. On a value level, efforts can be made to recover value out of end-of-life IT assets to obtain cost savings or even generate revenue. Unfortunately, existing literature pursuing this direction is quite scarce. For example, in one study, Kwak et al. (2009), proposed a design approach to support the end-of-life decision-making process using a novel concept of eco-architecture analysis where a product is represented as an assembly of end-of-life modules.

In summary, the broad nature of green IT relates to many facets of organizations' operations and contributes to the many streams of research in this area. We agree with our peers and their work in that IT professionals (scholars and practitioners) should develop "a new level of mindfulness" (Berthon & Donnellan, 2011, p. 5) to understand Green IT as system designers and users and more importantly, to make changes to our environment and pass on a prosperous lifestyle to future generations. Enterprise ITAD is one critical means of solution to corporate sustainability through green IT initiatives. In contrast to its great importance in modern enterprises, although there is an increasing amount of research appearing in the Green IT domain, enterprise ITAD has not been well documented in the existing literature. In fact, little has been presented to our research community about ITAD services that are available to enterprises and how such services can be provided and managed as a viable, yet cost-effective solution.

3. Enterprise Asset IT Disposition

3.1 Definition of Enterprise ITAD

Disposition refers to the action of disposing or getting-rid-of, and many organizations still consider IT asset disposition equivalent to and hardly anything more than electronic waste management (i.e., getting rid of old computers). Fortunately, the urgent need of improved corporate operational performance, combined with the increasing demand for corporate social responsibilities and environmental compliance have lead to the matured and refined meaning of ITAD that is accepted and adopted by most enterprises today. The concept of ITAD has now been reborn to not only address old IT equipment recycling, but also concerns data security, environmental accountability, and cost-saving imperatives to the enterprise throughout the IT asset life cycle. For instance, a report by Forrester Research (2009) depicts ITAD as the "processes to redeploy, remarket, donate, recycle, or dispose of IT assets in compliance with data security, environmental, and industry regulations." Following this process point of view, Forrester Research also recommends that companies understand the key regulations of ITAD, construct a comprehensive strategy, and adopt key evaluation criteria for ITAD services.

The definition provided by Forrester Research (2009) emphasizes that enterprise IT asset disposition addresses the recovery (including refurbishment, reuse, and resale) and recycling of an enterprise's IT asset that is near or at its end of lifecycle. Extending from this definition, we believe that the primary objectives of ITAD are to 1) maximize the value of IT asset investment over its entire lifecycle and the value recovered at the end, and 2) minimize the risks associated with retiring active data-bearing equipment and complying with environmental protocols. The two primary aims, in fact, reflect the risks and challenges facing enterprises when considering the retirement of their IT equipment. These risks and challenges include both internal (such as data security) and external (such as regulatory) risks. For instance, data resident on the retiring equipment could expose proprietary corporate information as well as private consumer data regulated by federal and state laws. Asset tags and other identifiable labels on the equipment could negatively impact the company's brand if discarded improperly. Recycling, transportation, and disposal of IT equipment require a company's compliance to a variety of state, federal, and even international environmental regulations, and the residual life and value of many assets could be lost if not effectively recovered through the secondary equipment market.

3.2 Process of Enterprise ITAD

ITAD solution providers shield organizations from the business, legal, and environmental risks associated with IT asset retirement and recycling. The comprehensive and tightly controlled asset disposition processes cover everything from logistics and data security to the de-manufacturing and recycling of materials. The goal is to manage the ITAD processes in a smooth, easy, and efficient manner to provide data security, minimum environmental impact, maximum value recovery, and full compliance for enterprises. More specifically, ITAD

solution providers manage the retiring enterprise IT equipment through a series of steps including triage, data sanitization, repair, testing, and quality check with the goal of the asset eventually being remarketed or resold. Based on evaluations on technical specifications or level of wear or damage, end-of-life electronic equipment will be destroyed and its remains recycled following environmental protocol and recycling regulations. Figure 1 illustrates the generic ITAD process, each of its steps, and its relationship with IT asset value recovery and recycling.

3.2.1 Receipt and Triage

Equipment is received at the ITAD processor's loading dock via common carrier trucks, parcel carriers, or the ITAD processor's own trucks. Arriving products include a wide range of electronics such as computers, monitors, printers, and their accessories, which often come in shrink-wrapped pallets. Each pallet is assigned a unique lot number by the recycling tracking system, indicating the origin of the content. The items inside this pallet are unpacked and quickly inspected to remove unacceptable or hazardous materials that may be mixed in. The tracking system then generates a bar code, printed on a sticker or an RFID tag and attached to each piece of the unloaded equipment to uniquely identify and track the originator and movement of the equipment. Such tracking capability could also provide data on the performance of the ITAD processes such as servicing time and even be benchmarked for marketing purposes. In some cases the tracking capability is included as a service level requirement in enterprise ITAD contracts.

Once a unit has been tagged and loaded in the internal tracking system, it is sorted by type. A trained inspector will examine each unit to determine if it meets minimum criteria for repair and resale on the secondary market. Such inspection criteria include technical, functional, and cosmetic dimensions. Examples of technical criteria are the processor speed, RAM, and equipment age. Functional criteria may include the presence of media drives and power supplies. Cosmetically, the equipment may be graded for different end markets (e.g., retail versus charities). If the product passes the triage step, it is routed for data drive erasure and further inspection. If the unit fails triage due to one or more of the criteria, it is routed for destruction and end-of-life recycling.

3.2.2 Data Driven Erasure and Inspection

By their nature, organizations' computers are used for managing important enterprise data such as financial transactions, contracts, client information and records, account numbers, and insurance data. Computers may also hold corporate trade secrets and other confidential corporate information that necessitate special security. As required by federal and state laws and regulations, corporations need to take extra precautions for the data. Therefore, when retiring old computers and electronics, organizations face the challenge of removing the data remaining on their hard drives completely and efficiently.

Within the ITAD processor's operation, the goals of the data sanitization stage are to clean the hard drives and any other equipment that may contain corporate data to maintain confidentiality and to protect the proprietary information of the client. Standards of U.S. Department of Defense (DoD) and National Institute of Standards and Technology (NIST, 2006) are used in the wiping software for data sanitization, requiring a minimum of three overwrite passes to guarantee the elimination of all confidential information. Computer applications for data sanitization can perform the erasure on one drive at a time, or wipe multiple hard discs simultaneously. The software application monitors the progress of each of the three sanitization processes and the progress of the total cleaning process, which can take up to several hours depending on the capacity of the hard drive. Cellphones and tablets are erased through a similar process to ensure all data and applications are removed, and the devices are reset to factory specifications. In addition to data hard drives, equipment is also inspected for other media that may contain data (e.g., discs left in the CDROM drives, USB flash memory drives, paper left in printers, etc.). Labels and tags attached to the equipment for inventory purposes are also identified. These items are removed and destroyed to ensure complete confidentiality and security of information from the originating organization.

3.2.3 Testing, Repairs, and Quality Check

After drive erasure and inspection, the items then undergo thorough testing to determine if technical repairs are needed. The item is connected with the corresponding testing equipment, usually a computer or testing device, to assess the functional capabilities of that item. Minor repairs may be required, such as replacing the media drive, adding RAM, and general cleaning. In some cases major repair is needed, and the item is sent to a lab area where

certified technicians complete such repairs. Following the repair step, a quality control check is made by trained employees who test each item of the many different types of computers to determine if it passes the quality check. At this quality checking point, if the refurbished item passes the examination, it then can be considered ready for resale or reuse. Otherwise, the item will be sent to the end-of-life recycling area to be disassembled and materials separated for downstream recycling.

3.2.4 Pack Finished Goods

Once refurbished products are cleaned to restore the original look as much as possible (cosmetic clean-up), they are then repackaged with new wrapping material. These products are also updated in the internal tracking system, and marked as ready for resale. Before any item leaves the facility, it is rescanned by the tracking system. From the final scan, an inventory control report is generated; this is another measure to maintain security of the assets and also to provide tracking of final disposition back to the originating organization. Since each retiring unit is monitored and tracked in the system, clients (the originating organization) can access real-time information about the movement of their equipment along the disposition process. This reporting is crucial for the organization as a basis for establishing compliance with legal requirements, i.e., an audit trail. The aggregation of this report data can also be used by the companies to measure and report on corporate sustainability and social responsibility initiatives.

3.2.5 Value Recovery

The value of enterprise IT assets (those finished goods) can be recovered through a variety of channels. The majority of the finished equipment is sold for reuse through various global distribution channels, including web sites, auction sites, direct retail, local and regional value-added resellers, and overseas brokers. Part of the resale revenue is given back to the client, the originating enterprise (also referred to as vendor credit), more than often resulting in a considerable amount of income for that enterprise. Some other finished goods may be donated as charitable items to not-for-profit organizations and agencies, with donation credit going back to the originating enterprise. Other refurbished IT equipment can be returned to enterprises for internal employee purchase with prices much lower than market prices or even internal redeployment. Many companies find the prices for internal purchase so affordable that they provide such options as employee benefits. Whether it is sold on the secondary markets, donated, purchased by internal employees of the enterprise, or redeployed back to the enterprise, the originating company (client) receives financial income or credit for the value. Effectively, the transaction may be done on a consignment basis, with the ITAD solution provider retaining a small portion of the proceeds. This recovered value of retiring IT assets can provide an unexpected revenue stream to the originating enterprise, which in some cases can fund the entire disposition program, covering the costs of transportation and processing fees.

3.2.6 End-of-Life Recycling

Through the process of ITAD, equipment can fail the examination and testing at various stages. Failed items are then routed to the recycling process. The goal of the recycling process is to recover the raw materials used to manufacture the equipment, such as plastic, steel, aluminum, and copper. Recycling operations typically use manual labor and hand tools to perform initial disassembly and extraction of reusable components. In some cases this is enough to effectively separate the materials into near-pure streams for sale into the commodities markets with the ultimate goal to produce new products. In other cases, further mechanical methods are necessary to efficiently separate the large volume of materials. Recycling operations may house advanced high-capacity shredders, capable of rapidly destroying large volumes of electronics and automatically separating the various materials using specialized technologies such as screens, magnetic belts, shakers, and electronic separators. The entire recycling system features automatic monitoring to ensure efficiency and safety of the disassembly and separation.

Whether resulting from manual disassembly or mechanical shredding and separation, all the commodity materials are loaded into large containers, each weighing 500 to 1000 kilograms. These containers of material will eventually be sent to downstream recycling partners who will then further process or refine these materials and convert them into new products (such as processing shredded plastic pieces to be re-melted to make new plastic parts). Scrutiny in downstream recycling is especially important for those toxic and hazardous materials found in some IT equipment (for example, batteries, mercury-containing switches and lamps, lead-based solder, etc.). Therefore, the criteria used to qualify downstream recycling partners are very stringent and require on-site audits

and ongoing tracking of material flows to ensure regulatory compliance and transparency.

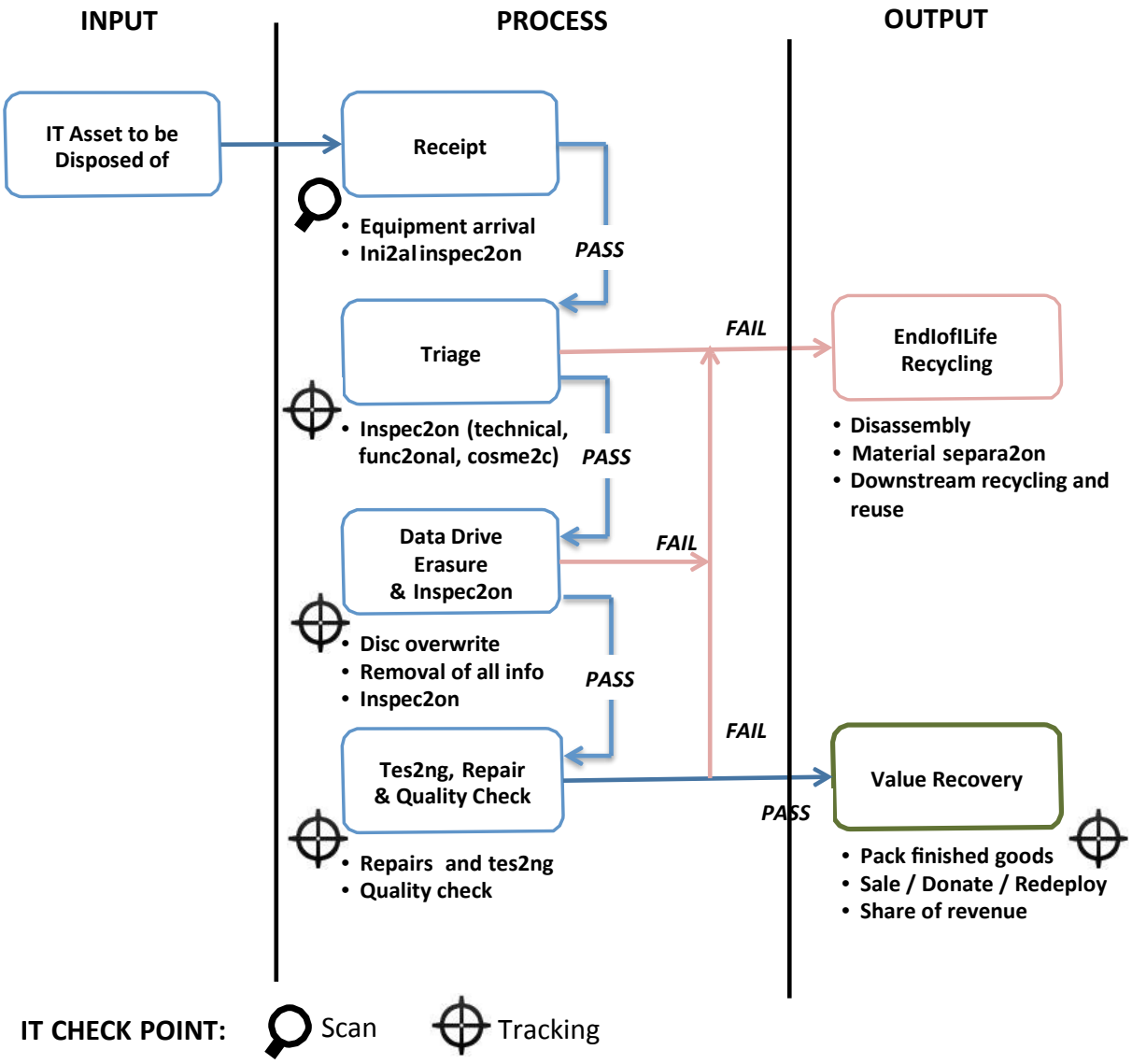

Figure 1. Representative IT Asset Disposition (ITAD) Process

4. ITAD Providers

The authors of this article include two researchers who have observed an ITAD operation and one author who works in the ITAD industry. Thus, the following discussion benefits from real-world, practical experiences. In an effort to achieve corporate sustainability through green IT initiatives, enterprises today, regardless of size and industry sectors such as corporate and not-for-profit, need to effectively address the disposition of their IT assets. U.S. government organizations and agencies are also required by the U.S. General Services Administration (GSA) to "lead by example … that all of its electronics are managed effectively in the disposal process and direct electronics to certified recyclers" (GSA, 2012, http://www.gsa.gov/portal/content/127503).

4.1 Choosing a Third Party ITAD Provider

Among many possibilities for disposing electronic equipment (D'Amico & White, 2012), one option for disposing end-of-the-lifecycle IT asset is recycle "do it yourself" (DIY), where companies get rid of the old equipment themselves. However, many companies are not aware of how to dispose retired IT equipment properly. For instance, any data storage needs to be wiped completely clean before a device can be resold, donated, or reused. Such service is often beyond the day-to-day practice of the business. Additionally, enterprises do not typically have the expertise in keeping workers safe when recycling potentially hazardous components in IT equipment; a certified solution provider would have that expertise built into their best practices.

One other option is vendor take-back, where the manufacturers collect the old IT equipment at the end of its service cycle, often with a fee for recycling. The convenience of the service can also couple with other benefits such as retaining some of the value by reusing, reselling, and remarketing refurbished equipment. The downside of this option is that one particular vendor may only take the equipment manufactured from that vendor. As a result, the client needs to work with multiple vendors to dispose various brands and types of aging equipment. There is also concern about bias, as manufacturers are motivated to recycle equipment and remove it from the secondary market rather than redeploying used equipment to maximize lifecycle and value return to the originating enterprise.

Choosing the option of using third-party ITAD service providers can successfully and effectively address the two major challenges faced by enterprises. First, the large amount of aging and obsolete IT assets produced by business operations is growing continuously and rapidly. In addition, to properly dispose the retiring IT equipment, enterprises including government organizations and agencies need to comply with complex regulations and especially data security regulations. The penalty of not following these requirements and policies properly could be severe. Some unfortunate cases include the Safeway supermarket chain that has been ordered to pay nearly $10 million for illegally dumping batteries, electronics and pharmaceuticals in California landfills (Ho, 2015) and AT&T's recent fine of $23.8 million for unlawfully disposing of hazardous waste and material (CA.gov, 2014).

The complex array of technical, economic, regulatory, and social challenges and uncertainties related to IT asset disposition make it impossible for many enterprises to handle ITAD internally. The entire ITAD process provided by the recycler is certified to protect enterprises from loss of data and liability exposure while complying with all U.S. EPA regulations to protect our environment. In this section, we first discuss two critical aspects of the adoption and management of enterprise ITAD services: the complex array of regulatory compliance and the accreditation and audit of ITAD services. Given the above combined morass of regulations, more and more companies are thus driven to develop rigorous disposal policies and adopt the best approaches for IT asset disposition.

In the U.S. market, there is a large number of third-party ITAD service providers who work with their clients to manage data security and risks, limit interruptions, improve efficiency, and maximize returns of the company's IT assets. The official website of e-Stewards.org lists 143 certified companies in the United States and sustainableelectronics.org lists 508 R2 (Responsible Recycling practices) certified facilities in the United States. Electronic recyclers may specialize in one or more of the process areas such as recycling and value recovery; however, all certified (either e-Stewards or R2) companies should use the representative processes and practices to a certain degree. The main services provided to enterprises include all types of IT asset and electronics recycling, refurbishing, and asset management. All must meet the requirements defined in R2 and e-Stewards standards, which are very similar to the generic activities previously described in section 3.2 of this paper.

4.2 ITAD Regulatory Compliance

Compliance with regulations is crucial to enterprise IT asset management and disposition services to ensure the proper handling of the proprietary and private data as well as the toxic components contained in retired IT assets. However, given the large number of state, federal, and international laws, policies, and regulations, a thorough

understanding of every applicable regulation is nearly impossible for a typical organization. Therefore, outsourcing this function to an ITAD processor is well justified for the received expertise as well as for legal indemnification. Nonetheless, while enterprises are able to leave the details to the ITAD processor, it is still important for enterprises to be aware of the most critical environmental protocols so the effort and expense of proper handling of retired assets can be justified and the compliance risks are well understood. Despite their wide coverage and challenging level of details for comprehension, the array of laws and regulations can fall into three basic categories: corporate governance, privacy, and environmental protection, with some cases where other legal issues may also apply (e.g., worker safety, export, copyright, and contract law).

Two major sub-categories of regulatory compliance requirements exist that directly concern ITAD practice today. The first deals with corporate governance and related privacy issues over personal data when considering asset disposal and the second deals with environmental issues. Both are essential for corporations to understand before considering ITAD. The Sarbanes-Oxley Act of 2002 (SOX) applies to corporate governance in the United States. This and the associated regulations administered by the Securities and Exchange Commission may apply to the financial records associated with appropriate bookkeeping for IT equipment as well as the proprietary intellectual property that may be stored on it. Fines associated with violation of SOX can range as high as $5,000,000, in addition to possible criminal penalties. Privacy laws have increased dramatically in importance in the past several years due to the rising rate of identity theft crimes. In addition to a variety of state laws, applicable federal laws include the Gramm-Leach-Bliley Act of 1999 (GLB) that applies to financial institutions, the Fair and Accurate Credit Transactions Act of 2003 (FACTA) that applies to businesses with credit card transactions, and notably the Health Insurance Portability and Accountability Act of 1996 (HIPAA) that protects personal health information. Enforcement of all of these laws has been active. GLB penalties may be as high as $100,000 per violation. FACTA's maximum fines are $2,500 per violation. With the changes to HIPAA signed by President Obama in 2009, fines can go as high as $1,500,000 per violation. When one considers the tens of thousands of social security numbers, credit cards, or health records that could be contained on a single hard drive, it is not hard to imagine tremendous penalties on irresponsible companies.

Environmental regulations may be the most complex and challenging for many companies, since they vary greatly depending on the type of material, what ultimately happens to the material (even if outside the control of the originating company), and the state, federal, and international laws that may apply at any given time. A patchwork of legislation enacted by half the states in the U.S. creates confusion and disparate requirements on companies with far-flung offices. Federal laws such as the Comprehensive Environmental Response, Compensation, and Liabilities Act of 1980 (CERCLA), the Superfund Recycling Equity Act of 1999 (SREA), and the Resource Conservation and Recovery Act of 1976 (RCRA) also apply and can impact a company many years after it disposed equipment and materials improperly. On a global scale, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal applies to international movements of materials (Basel Convention, 2013). Europe subjects companies to the Waste Electrical and Electronic Equipment Directive (WEEE). Canada applies the Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations. As a generator of used computers and electronics in each state and country in which it operates, an organization is required to comply with all relevant environmental regulations.

While governments are responsible for creating laws and regulations, practicing recycling activities should be a collective effort of all organizations (Visvanathan & Kashyap, 2012). The combination of international, federal, and state laws regarding governance, privacy, and the environment creates a tremendous burden of compliance with regulations that the organization may not even be aware of. Furthermore, compliance may be just scratching the surface compared with the brand damage a company may experience when its violations are highlighted by the press. Such risk increases the importance of working with an expert to ensure compliance and to protect the enterprise.

4.3 ITAD Service Accreditation and Certified Solution Providers

For enterprises, deploying and managing ITAD can never succeed without the assurance of the quality of ITAD services. However, the burden of compliance with these regulations and having expertise to properly mitigate the risks are beyond the capability of most companies. Therefore, specialized and certified third-party solution providers have formed to manage these processes at scale for enterprises. The USEPA, the U.S. General

Services Administration (USGSA), state governments, and many enterprises recognize that to be credible the certification must be performed by independent qualified 3rd party certifying bodies accredited by an internationally recognized accrediting body (USEPA, 2015). Currently, the EPA recognizes two certification standards: the Responsible Recycling Practices (R2/RIOS™), and the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment® (e-Stewards). The R2 standard was developed by a variety of stakeholders across the ITAD industry (e.g., U.S. states, manufacturers, e-recyclers, trade associations, public interest advocacy groups) via a process facilitated by the EPA. The e-Stewards Standard is implemented primarily in the U.S. and requires conformance with the 1992 Basel Convention as well as an Environmental, Health, and Safety Management System (EHSMS).

Both of the major standards have submitted and qualified their certification criteria through the ANSI National Accreditation Board (ANAB), and all third party certifying bodies and their auditors must go through rigorous training and testing to be approved for issuing certificates to solution providers. Afterwards, a governing body, Sustainable Electronics Recycling International (SERI, 2015) will oversee the ongoing maintenance of the standard. E-Stewards accreditation represents a strong alternative to R2. The USEPA and USGSA (as well as many states, manufacturers, and enterprises) have recognized both R2 and e-Stewards certification programs as meeting the requirements for federal electronics recycling.

Any enterprise with computing equipment to dispose of can outsource the company's ITAD practices to a chosen ITAD vendor with certification. In this case, the vendor has been independently audited or reviewed on an annual basis to follow appropriate sustainability practices. However, because an audit of EHSMS and recycling practices alone does not guarantee business practices or conformance to the enterprise's needs, companies should perform their own due diligence in addition to requiring certification to either of these standards. When choosing the ITAD service provider, the client should know the best ways to protect the company by knowing their own liability and the type of service and coverage provided by the third-party (D'Amico & White, 2012). In addition, an ITAD vendor should be willing to be transparent about their internal processes for adherence to standards and about how it further documents that its downstream partners are certified, audited and adhere to industry standards. An ITAD vendor should also have adequate insurance to cover risks and liabilities. It is critical for both the client and the service provider to establish an approach for performance measurement so that each step of ITAD can be monitored and evaluated.

Looking from within the enterprise, IT assurance professionals will be affected by sustainability initiatives and issues such as IT asset disposal (ISACA, 2011). Internal IT auditors will want to ascertain whether their own enterprise is properly disposing IT assets in order to meet the public's expectations and compliance requirements (e.g., data protection required by HIPAA and SOX). Auditors will also want to assure that their ITAD vendors are certified and determine which independent certifying company has been used. Since these certification companies could conceivably become de-certified over time, this will be a continuous endeavor (e.g., annually). Assurance professionals working at ITAD vendors may also want to become educated about the detailed practices that their companies have instituted to create an EHSMS in order to assess these practices for effectiveness before the certifying party arrives to do an audit – this could reduce the time and cost of the independent examination. It also may reveal redundancies and/or inefficiencies in their ITAD governance and reporting practices.

5. Discussion: A Research Agenda

Green IT in general refers to environmentally friendly information technology (Huang 2009; Molla & Abareshi, 2012). The focus of Green IT research typically addresses the concepts and consequences of the dual roles of IT; i.e., IT could cause environmental problems such as in the case of e-waste, but more importantly, IT can help promote and sustain environmental and corporate sustainability (Lee, Park, & Trimi, 2013) and in fact protect our environment (Huang, 2009). Scholars believe that information technologies "represent the potential source of solutions to environmental problems" (Elliot, 2011, p. 200). Relating to our IS research community, we believe that more meaningful and important research is needed to further examine and understand IT asset management in enterprises with the purpose of improving the use of resources and our practices of policies and regulations. Wang, Brooks, and Sarker (2015 a, b) calls upon the need for research in the areas of attributes and structures of green IS initiatives, processes for implementation and adoption, the impacts on organizations and environments, and analysis on different levels of individuals, organizations, and society. Similarly, Molla,

Cooper, and Pittayachawan (2009) also urges the research community to develop and apply models that includes practice, policy, technology, and governance. Enterprise IT asset management can contribute significantly to the call for such needed research. We strongly encourage scholars and practitioners to work collaboratively on producing such research studies because of the complexity of the operations and policies of IT asset management. We propose that research studies in this area should consider two important elements - process and policy.

First, research should introduce best practices and methods to manage the process of enterprise IT asset life cycle as well as the interactivities among the components of such processes. In the case where third party service providers are involved, managing the interactions, i.e., the process and performance between an enterprise and an ITAD service provider, is recognized as strategically important and fundamentally beneficial to both parties. To help understand this dynamic interaction, we conceptualize the structure of enterprise ITAD process in a process view (Selection, Governance, Evaluation) and disseminate the nature (What, Why, How) of each process at the same time (Table 1). As highlighted by other scholars the importance of management perspective in green IS (Gladwin, 1993), this process-nature structure promotes a managerial focus by looking at the interplay of the IT, people, and business processes. Following the selection to governance to evaluation process, research questions can be framed on the actions for each stage, the motivations for different stakeholders, as well as the procedures to follow on different levels for different stages. Studies can also take place to evaluate the process and its impact on both the enterprise and the service provider. Of particular interest would be case studies to address these questions.

Second, research should greatly influence the practices in polices and more importantly, policy-making in the area of enterprise IT asset management. Recently the IS community has witnessed an increasing amount of discussions on policy-shaping and policymaking guided by IT research and practice and especially in the area of e-government (Bouwman, Houtum, Janssen, & Versteeg, 2011; Gajendra, Xi, & Wang, 2012) and ICT research (Raghupathi & Wu, 2011). Such effort is especially important for scholars doing research on green IS (Wang et al., 2015 a, b; Molla et al., 2009). There is a great level of differences in green IT policies among different countries, regions, and cultures. In the U.S. alone, practices need to be carried out in compliance with local, state, federal, and international policies and regulations. Policymakers play a key role in the effort of influencing the adoption of green IS initiatives (Wang et al., 2015a). Research findings should provide insights on how regulations are conceptualized and developed in different political, social, economic, and technical environments. In addition, studies can examine the impacts of policymaking on IT product development and design, adoption of the green IS policies, and the influence of the adoption on individuals, organizations, and regions or society. More importantly, IS scholars can contribute by modeling policies and by developing innovative socio-technical theories and approaches. Multi-disciplinary research should be highly encouraged to help policymakers develop, govern, regulate, and evaluate policies to help enterprises manage the life cycle of IT assets.

6. Conclusion

Sustainability is rapidly becoming a strategic priority for businesses around the globe. Our IST research community recognizes the importance of this and calls for action to address sustainability issues through an information systems strategy that considers human rational and social behavior (Watson, Corbett, Boudreau, & Webster, 2012). Advocating the importance of ITAD, our article introduces the practice of using external services that aim to maximize the value of the IT asset investment of enterprises over the entire lifecycle while guaranteeing data security and protecting against environment liability. The ITAD processes, typified by the steps described, demonstrate a representative best practice of the efficient and cost-effective disposal services provided to enterprises by ITAD providers.

	Selection à	**Governance** à	**Evaluation** à
WHAT: action to be taken	Enterprise selects the ITAD vendor and negotiates contract.	Enterprise collaborates with ITAD vendor and monitors the process.	Enterprise evaluates: – Process: efficiency – Outcome: costs and benefits
WHY: motivation for action	– To optimize value gained from retiring IT asset – To minimize costs and risks associated with retiring IT asset – To obtain knowledge and expertise in ITAD operations – To be protected from legal and environmental liabilities	– To monitor ITAD process – To collaborate with and support ITAD activities – To manage the collaborative relationship – To ensure compliance with applicable laws and regulations	– To document information of the resources used – To make continuous improvement on ITAD process – To provide data for use in Corporate Social Responsibility and Sustainability reporting
HOW: procedure to be follow	Select vendor using criteria including the following aspects: – Range of services – Quality of services – Regulatory compliance – Financial health – Pricing and contract terms – Risks – Value recovery capability – Sustainability	Manage and monitor ITAD process including: – Asset identification – Asset pick-up/shipment – Inspection, triage, data sanitization, refurbish, recycling, etc. – Value recovery – Third party assurance	Evaluate ITAD process using measurements on: – Activity level – Action level – Agency level

Table 1. Process View for Enterprise ITAD Research

IT professionals should also be aware of other initiatives, such as designing green computers and systems from the beginning of the lifecycle to fundamentally ease the pressure of recycling IT assets afterwards. One notable study is by Huang (2009), who proposed a Sustainable Systems Development Lifecycle (SSDLC) where "disposal needs become a formal stage of the development lifecycle … formally included in the budgeting process of system development, and serves as a reminder at every other stage in the cycle" (p. 119). Another popular initiative, BYOD (Bring Your Own Device) also has significant impact on ITAD practices. More enterprises are now creating policies to encourage BYOD at the work place, which reduces hardware costs and waste, a key benefit welcomed by many enterprises (O'Donnell, 2014). However, adoption of formal BYOD procedures among enterprises has been hindered due to the complex requirements for security of data on personally owned devices and the related needs for secure recycling of the same.

Pioneering companies and organizations have recognized the imperative of IT asset lifecycle management and have implemented a systematic approach for the ongoing disposition of end-of-lifecycle IT equipment. A well-managed IT asset disposition program can empower corporate sustainability as an investment rather than as a cost and will create opportunities for an enterprise to become more competitive.

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