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WHAT'S IN YOUR PAPER? ORGANIZATIONAL FIBER CONSUMPTION AND THE PURCHASING DECISIONS THAT DRIVE IT

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ABSTRACT

Institutions of higher education (HEI) today often pursue sustainability in a holistic manner, integrating sustainability into their day to day operations as well as their long-term strategic plans. One challenge that HEIs have faced as attention to sustainability has grown is how to best assess the performance of sustainability initiatives. From an operational perspective, measuring the impact of sustainability practices is necessary for assessing the efficacy of those practices and for identifying opportunities for improvement. Sustainability metrics are also an effective tool for communicating organizational values to interested stakeholders.

One area in which sustainability metrics are not yet well-developed is procurement. Institutional purchasing is crucial to the overall sustainability performance of HEIs. Despite this, the metrics used to evaluate and report sustainability performance of procurement outcomes often focus on the overall reduction of purchased materials and the acquisition of products carrying third-party environmental certifications. While such metrics are useful for encouraging better purchasing decisions, they have limited utility for assessing the environmental impact of those decisions.

For many universities, paper products are a core area of minor procurement expenditures. Paper, or rather the fiber it is composed of, is a worthwhile area to focus sustainability efforts due to the environmental burdens associated with its production. Even responsibly sourced paper products can have sizeable impacts on environmental indicators. Those impacts can also differ significantly between products that are effectively identical in form and function. As such, reliance on third-party certifications (e.g., FSC, SFI) is an inadequate method for improving sustainability performance in this procurement area. In order to effectively manage sustainability of paper consumption, universities must analyze their own fiber consumption patterns.

This research consisted of two related but distinct projects, each investigating different aspects of organizational fiber consumption. The first part of the research is a descriptive study offering a critical evaluation of sustainability metrics related to fiber consumption and corporate attempts at quantifying environmental impacts in the form of footprint-type measures. The second part of the research was rooted in behavioral science

and investigated human factors that influence fiber consumption in organizations. The study sought to explain the roles of behavioral attitudes and social norms in employee purchasing decisions. Specifically, Penn State employees who purchased select paper products in the prior year were surveyed to measure environmental concern, attitudes and norms toward green purchasing, task discretion, and green purchasing intention. Secondary purchasing data was obtained from the Department of Purchasing Services and linked to survey responses to measure behavioral outcomes.

In the areas of sustainability reporting and corporate social responsibility (CSR) practices, the concept of a forest footprint metric has not yet been addressed in the scientific literature. As such, this study offers the first critical examination of these metrics and presents recommendations for advancing the concept. Within the sustainable supply chain management and procurement fields of study, relatively little research has been published on the impact of minor procurement on the sustainability performance of organizations. Likewise, very little research has been dedicated to the purchasing decisions of staff level employees, with the bulk instead focused on senior level organizational buyers and supply managers. This research highlights the roles of administrative support employees and minor procurement decisions in sustainable supply chain management strategies of large organizations.

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These achievements are not mine. They belong to my family.
This dissertation, the degree; it is all dedicated to my girls (all four of them).

No person deserves more recognition for this work than my wife, Ashley. She has truly been the driving force behind this degree. It simply would not have been possible without her. As my partner and the mother of my children, she is nothing short of amazing. I am also forever grateful to my daughters: Adelyn, Anna, and Naomi. They may not fully appreciate it yet, but they have each been forced to make sacrifices so that I could pursue this goal. And while I cannot honestly say they made the process any easier, I can absolutely say they are what made it worthwhile. Ashley, Adelyn, Anna, and Naomi: I owe everything to you and am forever in your debt. Thank you for your unending support. I love you more than you will ever know.

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INTRODUCTION

Sustainability has become a paramount issue for many organizations, even entire industries, as stakeholders become increasingly ardent in the expectation that they take genuine steps to minimize the environmental and social impacts of their operations. Concerns about sustainability and the related expectations of stakeholders are no longer limited to large corporations and publicly traded companies. Organizations of all types now consider sustainability to be strategically, if not inherently, important to their long-term success. One context in which this has become overwhelmingly apparent is higher education in the United States.

Sustainability in Higher Education

While colleges and universities have long made efforts at being more sustainable, those actions were often limited in scope and in direct response to local student activism. Institutions of higher education (HEI) today though often pursue sustainability in a much more holistic manner, integrating sustainability into their day to day operations as well as their long-term strategic plans. Take, for instance, the prevalence today of administrative positions dedicated to sustainability. Titles such as sustainability coordinator, director of sustainability, and even chief sustainability officer are now commonplace among American universities but were largely nonexistent just a decade ago. Likewise, consider the rapid growth of participation in the Sustainability Tracking, Assessment and Rating System (STARS) since its introduction in 2010. This framework, developed by the Association for Advancement of Sustainability in Higher Education (AASHE), is now used by over 450 HEIs for reporting a wide variety of sustainability performance measures.

The rise in prominence of sustainability at universities since the early 2000's can likely be at least partly attributed to millennials becoming the dominant demographic group among college students during the same period. Generally defined as those born in the early 1980's though the mid-1990's, millennials have been shown to be more

environmentally conscious when making purchasing decisions than preceding generations. As students, this demographic cohort has been a highly influential stakeholder group in higher education for nearly two decades and so has likely played a significant role in making sustainability a priority.

Universities that have adopted sustainability practices may have done so in response to, or in anticipation of, pressures from students and other stakeholder groups. Annual university ranking systems based on environmental sustainability, such as The Princeton Review's "Green Colleges" and the Sierra Club's "Cool Schools" rankings, may also encourage HEIs to pursue sustainability in an effort to distinguish themselves from competitors or to imitate the actions of more successful peers. Of course, universities may also be more likely to orient toward sustainability because it naturally aligns with their core values or fundamental purpose as educational institutions. Whatever the source of motivation, HEIs are undoubtedly investing substantial resources into sustainability actions.

Sustainability Metrics

One challenge that HEIs have faced as attention to sustainability has grown is how to best assess the performance of sustainability initiatives. From an operational perspective, measuring the impact of sustainability practices is necessary for assessing the efficacy and value of those practices, for gauging progress toward sustainability goals, and for identifying opportunities for improvement. Sustainability metrics can also serve an important function beyond internal university operations, which is to effectively communicate organizational values to, and engage with, interested stakeholders.

Some of the most commonly used metrics for assessing sustainability performance among HEIs include landfill diversion rates of solid waste, energy consumption and the share from renewable sources, water consumption, and GHG emissions. One area in which quantitative measures are less well-developed is procurement. Institutional purchasing is crucial to the overall sustainability performance of HEIs. Purchasing decisions can broadly impact university operations and are also within the scope of institutional control. For instance, by limiting the types of plastic materials that enter a campus environment, purchasing decisions can reduce the likelihood of campus users

improperly disposing of materials, increase efficiency of waste collection processes, and ultimately decrease the amount of university-generated waste that is landfilled. Furthermore, HEIs, particularly large ones, can extend their influence up the supply chain by using purchasing decisions to reward the sustainable operations of suppliers.

Despite the profound impact that the procurement function can have on the sustainability of university operations, the metrics used to evaluate and report sustainability performance of procurement outcomes often focus on the overall reduction of purchased materials and the acquisition of products carrying third-party environmental certifications. For example, the AASHE STARS program measures sustainability of cleaning product purchasing as the proportion of total product expenditures carrying the Green Seal, UL ECOLOGO, or Safer Choice certifications. Likewise, sustainability of electronics purchasing is measured as the proportion of total product expenditures registered with the EPEAT program. Measures for paper products, too, emphasize purchasing of products carrying third-party certifications (e.g., FSC, SFI, PEFC).

While such metrics are useful for encouraging better purchasing decisions, they have limited utility for assessing the environmental impact of those decisions. Simply consuming relatively fewer resources than in the past is not a particularly effective method for measuring an organization's sustainability performance. Without quantitative measures comparing inputs to outputs or environmental losses to environmental gains, it is difficult to determine whether a practice has been made sustainable or simply less unstainable.

Life cycle assessment (LCA) is often the ideal method for determining environmental merit of alternative scenarios, but it is best applied to highly defined contexts and is not well-suited for guiding general procurement strategies. Instead, university leaders and procurement professionals in higher education might benefit most from development of sustainability metrics like carbon or water footprints. The carbon footprint has become a standard measure of environmental sustainability not just because it addresses the primary driver of climate change but because it also allows organizations to measure their own carbon emissions and therefore manage them through reduction, sequestration, or offsetting practices. A key benefit of the carbon footprint metric is that it allows organizations to analyze the gap between the current impact of their operations (i.e.,

carbon emissions) and a point where the net impact of their operations equals zero. Unlike procurement metrics that seek to maximize expenditures on products carrying third-party environmental certifications, sustainability metrics that assess environmental impact (i.e., footprints) can provide organizations a roadmap of sorts on which they can develop strategies for actually becoming more sustainable.

Understanding Fiber Consumption

One significant area of university expenditures that would lend itself well to such a metric is paper products. Paper, or rather the fiber it is composed of, is a worthwhile area to focus sustainability efforts because of the environmental burdens associated with its production. The Union of Concerned Scientists has identified wood products, including wood pulp, as one of the "big four" agricultural commodities driving global deforestation. This is especially true in places like Indonesia, where from 2000-2010 deforestation for the purpose of establishing pulpwood plantations exceeded that of palm oil plantations (USC, 2016). Deforestation, along with issues related to forest degradation, habitat loss, exploitation of indigenous land, and the potential for human rights abuses should be motivation enough for sustainability professionals to prioritize fiber consumption as a key area of sustainability performance. Even responsibly sourced paper products, however, can still have sizeable impacts on environmental indicators, due to the energy, chemical, and water intensive processes involved in converting trees into paper. Paper products that are effectively identical in form and function can differ significantly in terms of environmental impacts, due to differences in the sourcing and processing of raw materials. As such, it is important that sustainability and procurement professionals understand both where their paper products come from and how they are manufactured.

Reducing paper consumption has long been a focus of organizational sustainability efforts. Despite this, many organizations struggle to decrease overall paper consumption. This is particularly true in record-intensive industries such as health care, government, and higher education. Organizations that have employed common paper reduction strategies, such as removing personal printers, setting duplex printing as default, digitizing records, and utilizing print management services have experienced varying

levels of success. For instance, a paper reduction initiative at Penn State Berks in 2015 resulted in a 44% reduction in paper consumption among students but only a 10% reduction among faculty and staff (PSU, 2016). A recent AASHE publication, in which the paper reduction efforts of five institutions were highlighted, reported reductions in paper use ranging 18-32% (Van Leuvan et al., 2019). Although these are positive outcomes, they suggest that limits exist in the effectiveness of sustainability efforts that focus solely on reducing paper use. The implication then is that beyond paper reduction practices, HEIs and other organizations must also manage the impact of their unavoidable paper consumption.

Justification

The sustainability of how organizations operate is a growing concern in practically all industries. This is especially true in higher education, where institutions face pressure from myriad stakeholders both internal and external to the organization. In response to stakeholder pressures regarding sustainability, many institutions of higher education (HEIs) in North America now engage in some form of sustainability reporting to communicate to stakeholders the actions being taken to reduce environmental impacts of university operations and the progress being made.

Despite the commitment demonstrated by these HEIs to measuring, reporting, and improving sustainability performance, most have yet to critically evaluate environmental impacts within their supply chains. Among large corporations with consumer-facing brands (e.g., Gap, H&M, Target, Starbucks, Apple, etc.), however, environmentally preferred purchasing policies and supplier disclosures are becoming increasingly prevalent. Universities could also benefit from engaging in these practices, through reduced exposure to supply chain risk and reputational gains among stakeholders. More importantly, understanding supply chains in key areas of institutional procurement would allow procurement professionals to make purchasing decisions based on sustainability considerations beyond simply the presence of third-party certifications.

Paper products is one such area that should be critically evaluated by most HEIs due to the sheer volume in which they are consumed by universities and the substantial differences in environmental impact that can exist among effectively identical products.

Furthermore, in contexts of HEIs with decentralized purchasing systems, it is crucial to understand the antecedents of purchasing decisions involving paper products in order to develop effective green purchasing strategies.

This research is, in part, a critical examination of methodologies that have been developed for analyzing fiber consumption and frameworks for reporting sustainability performance related to fiber consumption. To support development of purchasing processes necessary for obtaining the optimal fiber mix, this research also investigates purchasing behaviors and outcomes of University employees responsible for procuring paper products. This research makes valuable contributions in multiple fields of study. In the areas of sustainability reporting and corporate social responsibility (CSR) practices, the concept of a fiber footprint metric has not yet been addressed in the scientific literature. As such, this research is the first to critique forest footprint metrics and other measures of organizational fiber consumption. Similarly, the research also proposes the novel concept of a fiber profile as a framework for organizations to manage and report key measures of fiber consumption.

The methodologies for the second component of the study, such as the identified research population and application of secondary data sources, also present unique opportunities for theoretical contributions. Within the sustainable supply chain management and procurement fields of study, relatively little research has been published on the impact of minor procurement on the sustainability performance of organizations. Likewise, very little research has been dedicated to the purchasing decisions of staff level employees, with the bulk instead focused on senior level organizational buyers and supply managers. This research highlights the roles of administrative support employees and minor procurement decisions in the sustainable supply chain management strategies of large organizations. Finally, despite its wide use in studies of consumer behavior, the this research is among the first to apply the Theory of Planned Behavior to organizational purchasing decisions.

From a practical perspective, the information gained from this study can help guide development of University purchasing policies and practices. For example, understanding what factors influence employee decisions to purchase non-preferred products over preferred products could help University administrators identify solutions to more

effectively encourage purchasing of preferred products. Likewise, practitioners in other HEIs with similarly decentralized purchasing systems could benefit from knowing key factors associated with employee purchasing decisions. Finally, developing a practical method for analyzing organizational fiber consumption will allow procurement and sustainability professionals to make better informed purchasing decisions that support both the operational needs and sustainability goals of their organizations.

PART ONE

Methods for Assessing the Sustainability of Organizational Fiber Consumption

CHAPTER 1

Literature Review

Introduction

This chapter is intended to present the reader with a general representation of the current body of knowledge relating to part one of the study. The chapter is organized into five topical areas, each focused on a subject matter necessary for consideration in the realm of this research. The first will briefly review literature related to the study of supply chain management followed by a discussion of procurement practices in higher education with a focus on paper products. Next, pertinent information related to wood fiber presented, as well as an overview of the production processes for virgin and recovered fiber products. The final topical area addressed is environmental impacts associated with producing virgin and recycled fiber for manufacturing paper products.

Supply Chain Management

Today, organizations of all forms and sizes can be dependent on an international network of other organizations in order to successfully get their products or services to market. This is due to the increasingly global nature of both supply and demand. Consider, for example, a traditionally regional industry such as primary wood processing. A small sawmill in Pennsylvania may procure the majority of its logs from an area within a 100 mile radius of its location and sell the majority of the lumber it produces to customers within the broader mid-Atlantic region. The bandsaw blades it uses to cut logs into lumber, however, could be manufactured in the southeastern United States using steel imported from Asia. Disruptions in global trade, such as those caused by newly created tariffs on steel imports, have the potential to adversely impact the sawmill's operations through increased costs and/or delayed delivery of needed blades. That impact could also be experienced further downstream, for instance in the form of delayed lumber deliveries to a small furniture manufacturer and ultimately the delayed fulfillment of customer orders.

This example is an effective, albeit simple, illustration of how, despite its small size and seemingly regional operational boundaries, the sawmill is nonetheless part of an interconnected system of geographically dispersed organizations that are, to varying degrees, dependent on each other for their own success. Supply chain management encompasses many organizational practices intended to reduce the risk associated with those dependencies and create competitive advantage for all organizations within the network. In fact, a driving force behind the study of supply chain management is the recognition that each firm in a supply chain can influence, both negatively and positively, the performance of all other firms in the chain (Cooper et al., 1997). As is further discussed below, an organization's sustainability performance is particularly vulnerable to the actions of other firms within its supply chain, including those both upstream and downstream of its operations. As such, managing supply chains is a critical component in achieving organizational sustainability goals.

Before exploring concepts related to supply chain management, it would be worthwhile to first define supply chain and supply chain management. Unlike the latter, the former has a well-established and widely accepted definition; a supply chain is "a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer" (Mentzer et al., 2001, p. 4). Figure 1.1 below illustrates different levels of complexity that supply chains can reach.

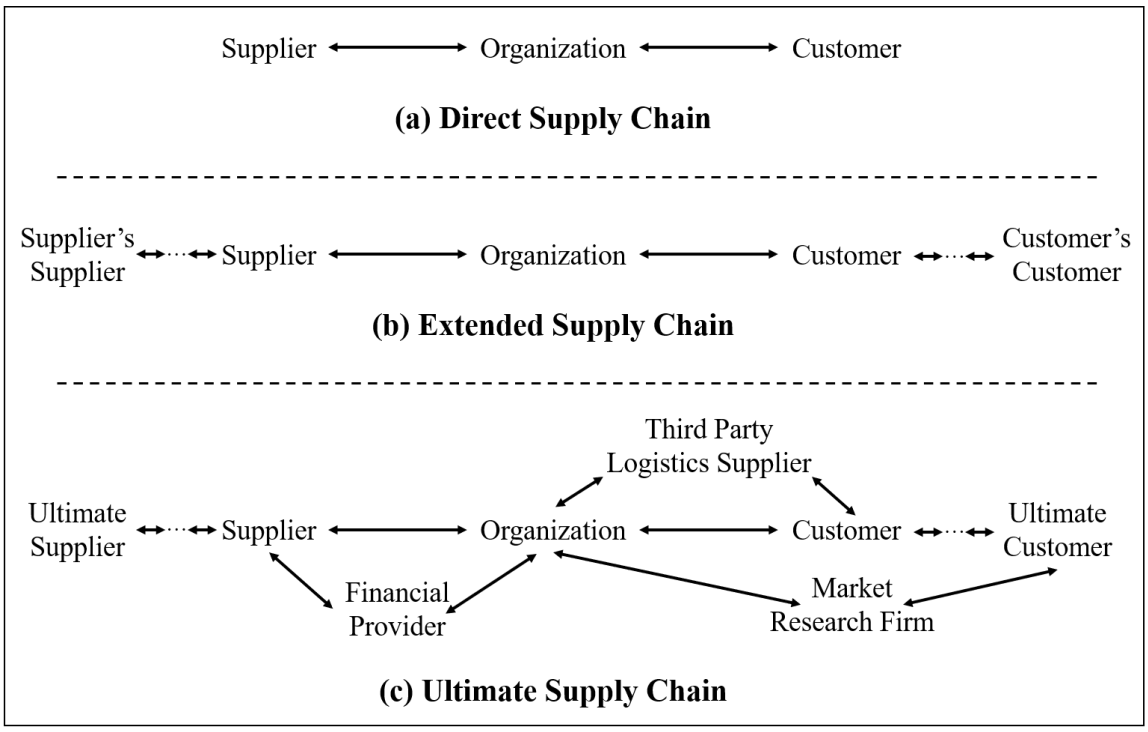

Figure 1.1 Types of channel relationships
Source: Mentzer et al., 2001, p. 4

As was alluded to, many definitions of supply chain management have been proposed in the literature, often differing based on the chosen perspective of supply chain management being a process, discipline, philosophy, governance structure, or function (Ellram & Cooper, 2014). Perhaps the most encompassing definition that is commonly cited was developed by Mentzer and colleagues (2001), who defined supply chain management as "the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole" (p. 18). A simpler definition also worth considering here defines supply chain management as "the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole" (Christopher, 2005, p. 5). Other key concepts and practices associated with supply chain management are introduced below.

The concept most commonly associated with supply chain management is probably logistics management. These terms are even often used interchangeably, though logistics

management actually describes a function of supply chain management. According to the Council of Supply Chain Management Professionals (CSCMP), logistics management is defined as "that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements," and may include activities such as transportation management, supply/demand planning, inventory management, materials handling, warehousing, and order fulfillment (2013). Put simply, logistics management is focused on the inward and outward flow of materials and information in an organization.

As with logistics management, many business activities are associated with supply chain management, such as supplier selection, purchasing, outsourcing, production scheduling, lean manufacturing, customer service, etc. More broadly speaking, a number of business practices have been identified in the literature as core dimensions of supply chain management. The exact dimensions identified as supply chain management practices differ depending on the study, but a great deal of overlap can be seen. For instance, information sharing among supply chain members is a commonly identified dimension of supply chain management in the literature (Li et al., 2005; Mentzer et al., 2001; Tan et al., 2002), as is the quality of information being shared (Holmberg, 2000; Li et al., 2005; Tan et al., 2002). Openly sharing and regularly exchanging up-to-date information such as production schedules, inventory levels, sales forecasts, and timelines for new product introductions can allow supply chain members to anticipate changes in supply and/or demand and reduce uncertainties.

Another frequently cited dimension of supply chain management is the establishment of long-term relationships among supply chain members (Li et al., 2005; Min & Mentzer, 2004). Such relationships, often referred to as strategic supplier partnerships, allow strategically aligned organizations to leverage the operational capabilities of each for the mutual benefit of the whole. When organizations are involved in the planning activities of each, such as when designing new products or entering new markets, suppliers can help solve problems and lend expertise to mitigate the risk of bad decisions.

The final commonly identified dimension of supply chain management to be considered here is a focus on customer relations (Li et al., 2005; Mentzer et al., 2001; Tan

et al., 2002). Building long-term, committed relationships with customers can be a source of competitive advantage, the benefits of which can extend to other supply chain members. Customer loyalty can provide a bulwark to market fluctuations and other environmental uncertainties, providing some level of stability throughout the supply chain. Strong customer relationships can also enable firms to create greater customer value by offering individualized product and service solutions based on customers' unique needs.

Whereas strategic supplier partnerships are orientated toward the upstream side of the supply chain, a customer service focus is orientated downstream. It is worth emphasizing here that customers in a supply chain are not limited to final consumers. In fact, the customers in a supply chain are predominately represented by supply chain member firms, since every supplier is also generally a customer of other firms (see Figures 1B and 1C above). This helps to explain why practices such as information sharing, collaborative planning, and building customer relations must occur between firms at each step of a supply chain in order for the supply chain itself to become a source of competitive advantage for its members.

Sustainable Supply Chain Management (SSCM)

Within the Supply Chain Management (SCM) field, Sustainable Supply Chain Management (SSCM) has become a dominant domain over the past decade (Rajeev et al., 2017) and is now one of the most dynamic research areas in the broader SCM field (Martins & Pato, 2019). The development of this stream of research is often attributed to the general increase in sustainability concerns following the 1987 issuing of the "Report of the World Commission on Environment and Development: Our Common Future" by the United Nations. That report, often referred to as the Brundtland Report, offered a definition for sustainable development that has since become a standard definition for sustainability in many fields: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). It was not long after that the business concept of the triple bottom line (TBL) emerged, which advocated for companies to measure performance in areas of social responsibility and environmental impact, in addition to traditional financial measures of performance (Elkington, 1998). Combining these ideas, Slawinski and Bansai defined

business sustainability as “the ability of firms to respond to short-term financial, social, and environmental demands, without compromising their long-term financial, social and environmental performance” (2010, p. 1).

The development of supply chain management as an academic discipline largely coincided with the growing awareness of issues related to sustainable development. As the idea of sustainability became prominent in business, it was only natural that the concept be extended to supply chain management since many of the business practices associated with SCM were already intended to increase efficiencies, reduce waste, and mitigate risks among global networks of firms. One definition of sustainable supply chain management that emphasizes the role of sustainability in business practices is, “the set of supply chain management policies held, actions taken, and relationships formed in response to concerns related to the natural environment and social issues with regard to the design, acquisition, production, distribution, use, reuse, and disposal of the firm’s goods and services” (Haake & Seuring, 2009, p. 285; Zsidisin & Siferd, 2001, p. 69).

It is worth noting that very similar concepts focused solely on environmental aspects of sustainability are also commonly discussed in the literature. Generally, the use of “green” (i.e., green supply chain management, green purchasing, etc.) implies a narrower focus on environmental impacts relative to economic or financial measures, rather than the triple bottom line perspective of sustainability which requires the additional consideration of social factors.

Organizational motivations for pursuing sustainability within supply chains can be similar to those for traditional supply chain management, namely reducing risk and creating competitive advantage. Particularly for firms with consumer facing brands, the business practices of suppliers can be a major vulnerability to a brand’s reputation. Clothing retailers, for example, have often been subject to negative news coverage and subsequent consumer pressure regarding labor issues in garment factories around the world. Documented use of child labor, long hours, substandard pay, and unsafe working conditions have forced many of the largest brands, such as Nike, H&M, Walmart, and Gap to more closely monitor the operations of companies in their extended supply chains. Attention from NGO’s can also influence public sentiment, potentially weakening or strengthen a company’s brand. For instance, the National Resource Defense Council

recently published a sustainability "report card" for products of major tissue brands, focused largely on how the raw materials of each brand are sourced. Paper towels under the Kirkland brand of Costco and Up & Up of Target were both given "F" grades, while brands belonging to Trader Joe's and Whole Foods received grades of "A" (Skene & Vinyard, 2019).

Working with suppliers to improve the sustainability of their operations helps firms reduce risk to their brand value by decreasing the likelihood of negative publicity. Sustainable supply chain management can also create competitive advantage by earning customer trust and increasing reliability of supplier networks (Krause et al., 2009). For organizations pursuing broader sustainability strategies though, improving sustainability within supplier networks may simply be a necessary step in achieving organizational goals. This reflects a growing realization that the sustainability of any given firm cannot exceed that of its suppliers (Krause et al., 2009; Miemczyk et al., 2012). In this context, the role of purchasing becomes central to an organization's sustainability strategy.

Sustainable Procurement in the Higher Education Context

Although it is becoming more common, sustainability is typically not a primary consideration in the procurement functions of most organizations. In many contexts, especially those in private industry, the performance of purchasing managers is much more likely to be assessed on the basis of cost savings than on environmental impact mitigation. The public sector has traditionally placed greater emphasis on sustainable and socially responsible procurement, such as government contracting policies that favor women and minority owned businesses or those requiring LEED certification for new and renovated buildings.

Formal policies that are developed to guide purchasing decisions by taking into account environmental sustainability are often referred to as Environmentally Preferable Purchasing (EPP) programs or simply "Green Procurement." In the United States, EPP programs were initially developed by state and federal government agencies to encourage "the purchasing of environmentally preferable products/services whose environmental impacts have been considered and found to be less damaging to the environment and human health when compared to competing products/services" (Li & Geiser, 2005, p.

707). Although initially developed for use in the public sector, EPP or broader sustainable procurement policies can now be found in many contexts such as healthcare (see Kaiser Permanente, 2012), retail dining (see Starbucks, 2006), and consumer technology (see Apple, 2019).

In the context of higher education, universities are increasingly placing greater emphasis on sustainability in procurement functions. According to the National Association of Educational Procurement (NAEP), results from their annual Green Procurement Survey indicated that 40% of responding institutions had a formal green procurement policy in 2016, up from 24% in 2009 (NAEP, 2016). Data from the Association for Advancement of Sustainability in Higher Education (AASHE) show that, among the 341 institutions with current ratings in the Sustainability Tracking and Reporting System (STARS), two-thirds (n = 226) "have written policies, guidelines or directives that seek to support sustainable purchasing across commodity categories institution-wide" (AASHE, 2020).

Sustainable procurement programs in university contexts can be broad, addressing a variety of expenditure areas such as energy and power purchase agreements, construction and renovation projects, food and beverages, professional services, and capital equipment. Environmentally preferable purchasing policies though are often more narrowly focused on commodity products that support the day to day operations of universities, such as cleaning products, office supplies, furniture, etc. Due to the vast selection of these kinds of products, it is not rational or even feasible for procurement managers to assess the relative environmental attributes of all competing products. Instead, EPP policies typically rely on third party certification systems to identify and assign purchasing preference to different products. Examples of certification systems commonly utilized in EPP guidelines include BIFMA Level for institutional furniture, EPEAT and ENERGY STAR for consumer electronics, BPI for compostable products, OEKO-TEX for textiles, SaferChoice for chemical ingredients, and WaterSense for water efficiency of consumer products. Green procurement guidelines recently implemented across the University of California cited nearly two dozen different certification programs to be considered when purchasing various goods (UC, 2020).

Paper Purchasing in Higher Education: Policies and Trends

Seemingly all EPP guidelines for paper products focus on recycled content and/or certification programs that ensure responsible sourcing. The basis for many EPP guidelines, including those related to paper products, is the Comprehensive Procurement Guideline program developed by the U.S. Environmental Protection Agency (EPA). This program is intended to reduce materials use in government operations and promote greater utilization of recovered waste materials by requiring federal agencies to maximize recovered content when purchasing certain types of products. The Comprehensive Procurement Guidelines cover 33 different types of paper products with recommended levels of post-consumer recycled fiber for each, including, for example, copy paper (30%), notepads (30%), envelopes (10-20%), bathroom tissue (20-60%), napkins (30-60%), corrugated containers (25-50%), and tray liners (50-75%) (EPA, 2007).

As noted in the previous section, most EPP guidelines rely on third-party certification systems to assign purchasing preferences based on sustainability attributes. For paper products, the most commonly cited certifications in the United States are those of the Forest Stewardship Council (FSC), the Sustainable Forestry Initiative (SFI), and the Programme for Endorsement of Forest Certification (PEFC). Though the policy details, requirements, and administration methods of these certification schemes can differ substantially, the general focus of these programs is how and where wood materials are being sourced. Among NGO's, the FSC certification system is often held in highest regard in terms of operational standards and governance structure (World Wide Fund For Nature, 2015; Skene & Vinyard, 2019; Environmental Paper Network, 2018). Additionally some third-party certification programs focus on sustainability aspects of the manufacturing processes used in paper production. The Green Seal certification and UL's ECOLOGO program consider factors such as the chemicals used as bleaching agents, noxious emissions, fiber use efficiency, and potential contributions to acid rain and climate change.

With regard to recycled content, many universities have established or proposed procurement policies that prioritize high levels of recycled content as a key consideration in purchases of paper products. Colgate University, for example, proposed a policy in 2012 that would eliminate purchases of non-recycled office paper, as did American

University in 2013. Princeton University implemented a University-wide policy in 2004 requiring all printing, copying, and writing grade papers to be certified 100% post-consumer recycled content. This policy identifies Aspen 100, produced by Boise Cascade, as the preferred product for purchases made through the University's OfficeMax supplier catalog. Furthermore, the policy states that "OfficeMax will ship Aspen 100, (Part #P1054922) in lieu of all other general purpose office paper," as an apparent effort to enforce the purchasing policy (Princeton University, 2004).

To help understand how prevalent such commitment to purchasing recycled content paper is among universities, annual purchasing data representing 247 AASHE member institutions in the U.S. were analyzed. Products with "FSC-Recycled" certification or an equivalent 90% post-consumer recycled content (PCRC) accounted for 100% of office paper expenditures at approximately 5% (n = 12) of institutions, at least 90% of office paper expenditures at nearly 10% of institutions (n = 23), and at least half of all office paper expenditures at 39 institutions (15.7%). Among the 39 institutions reporting at least half of all office paper expenditures on FSC-Recycled products, approximately half (n = 21) were private and the remaining public, including some large research institutions such as the Universities of Iowa, Washington Seattle, and California Berkley. For comparison purposes, the proportion of office paper expenditures on FSC-Recycled or equivalent products at Penn State was approximately 19.5% in 2017 (AASHE, 2020).

Basic Considerations of Fibrous Materials

Fiber is a general term used to describe tubular or cylindrical elements of plant matter having cellulose as the primary constituent (Biermann, 1996). It is the basic component of paper, accounting for between 60 to 100% of the paper content depending on the product type (Schaffrath & Tillmann, 2013). Fiber for papermaking is obtained by a pulping process, in which lignocellulosic materials are mechanically and/or chemically broken down to separate material components. Wood is the most important source of fibrous raw materials for papermaking, accounting for around 90-95% of worldwide virgin pulp production. Pulp from other natural fiber sources such as straw, bagasse, and bamboo effectively account for the remaining 5% (Blechschmidt et al., 2013; FAO, 2017). Depending on the intended use, pulp can be produced from lignocellulosic plant

fibers having varying compositions of cellulose, hemicellulose, and lignan. For this reason, most tree species can be used for pulp production, although the processing requirements may differ and some are better suited for pulp production than others for a variety of reasons.

Due to fundamental differences in anatomy and chemistry, the hardwood versus softwood distinction is commonly used to describe basic wood fiber characteristics. For instance, one important attribute of fiber for pulping is length. The length of fibers used in a pulping mix dictate much of the production cycle, such as processing requirements, mechanical and visual properties of the product, and usability as a secondary fiber source. Fibers from softwood trees, which is a generic term typically applied to Gymnosperm tree species, average 3-3.6mm in length, though some notable exceptions do exist (e.g., longleaf, shortleaf, and slash pines average 4.6-4.9mm; redwood 7.0mm). Hardwoods, which is a similarly generic term commonly applied to Angiosperm tree species, typically produce fibers significantly shorter in length, usually in the range of 0.9-1.5mm (Biermann, 1996). Fiber length generally contributes to strength properties of paper, since longer fibers produce a more intertwined web when pressed into sheets. However, because longer fibers easily become folded and linked together, obtaining an even fiber distribution becomes more difficult as length increases, resulting in a paper product with a rough or inconsistent surface. As such, the shorter length fibers of hardwood trees produce a smoother, more uniform sheet of lower strength than the longer length fibers of softwoods (Biermann, 1996).

Another consideration of fibrous materials that lends itself to the hardwood-softwood distinction is chemical composition, namely the proportional presence of cellulose, hemicelluloses, and lignin compounds in the material. The most important of these compounds for papermaking is cellulose, which accounts for 40-50% of the dry weight of both hardwoods and softwoods (Pettersen, 1984). Cellulose, the most abundant organic polymer on Earth, is a linear glucan polymer of 1,4-β-bonded anhydroglucose units with a degree of polymerization (DP) in excess of 10,000 in unaltered wood (Biermann, 1996; Pettersen, 1984). In the cell walls of plants, hydrogen bonding occurs between the hydroxyl (OH) groups and oxygen (O) atoms of adjacent cellulose chains, firmly holding together groups of these long, straight molecular chains to form microfibrils. These

aggregations of cellulose molecules contribute greatly to the fibrous structure of lignocellulosic material and ultimately the mechanical properties of paper made from plant fiber.

Like cellulose, hemicelluloses are also carbohydrates, in this case mixtures of polysaccharides composed of mannose, galactose, glucose, 4-*O* methylglucuronic acid, xylose, and arabinose. Unlike cellulose though, hemicelluloses are rarely crystalline or fibrous, instead providing structural support as a filler material of sorts for cellulose fibers (Biermann, 1996). Although hemicelluloses account for similar dry weight proportions of softwoods and hardwoods, around 25-35%, the dominant polymer formulations present in each differ; xylans being the primary polymer in hardwoods and galacto/glucomannans the primary polymers in softwoods. The key characteristic of cellulose and hemicellulose compounds that makes papermaking possible is the presence of hydroxyl groups, which encourage the formation of hydrogen bonds that hold individual fibers together to create a sheet of paper.

For the purposes of papermaking, the greatest chemical distinction between hardwood and softwood is the proportional quantity of lignin, a complex polymer composed of phenylpropane units. In plant cells, lignin acts as a binder or adhesive of cellulosic fibers, analogous to the role of cast concrete surrounding steel reinforcement bar in a building. In this case the concrete, or lignin, provides stiffness and rigidity to the structure while the steel rebar, or cellulose, provides tensile strength. Lignin, however, does not directly bind to cellulose molecules but instead covalently links to the hemicellulose molecules as part of the lignocellulosic matrix. Although the basic lignin monomers dominant in hardwoods (coniferyl and sinapyl alcohols) differ from those in softwoods (coniferyl alcohol only), the functionally important difference lies in the overall proportion of lignin relative to cellulose and hemicelluloses. In hardwoods, lignin typically accounts for 18-25% of the dry weight of wood, whereas in softwoods that proportion is generally 25-35% (Biermann, 1996).

The overall proportion of lignin is a vital consideration in papermaking for multiple reasons. First and foremost, lignin binds fibers together in unaltered or natural wood. The production of paper relies on the formation of a fiber web, in which individual or small bundles of fibers are connected and intertwined. Arranging fibers to create these

networks requires them to first be freed or separated from one another. This process, called pulping, uses various methods to alter the chemical bonds that link lignin polymers to those of. Due to greater processing requirements and resulting lower yields, the costs of separating fibers of a given raw material generally increase as the proportion of lignin in that material increases.

Another reason lignin is a major consideration in papermaking relates to how the fiber web of paper is formed. As previously mentioned, the individual fibers that make up paper are held together by hydrogen bonds. These bonds form among the cellulose and hemicellulose molecules of layered fibers to produce a network of closely linked fibers. Lignin, however, does not form hydrogen bonds and therefore its presence can inhibit the formation of such bonds between fibers. As such, lignin content in paper is generally negatively correlated to strength properties of the paper. This is the case in newsprint, which utilizes mechanical pulping methods that produce high fiber to pulp yields by retaining most of the lignin content in the fiber. For most other paper grades, both pulping and refining processes are used to reduce or effectively eliminate lignin from cellulosic fiber for papermaking.

Virgin Fiber Production

Virgin fiber used for paper manufacturing comes from pulpwood. Pulpwood describes timber and other wood materials that are produced and marketed with the primary intention of being used to manufacture paper. Trees harvested for pulpwood are usually of smaller diameter and/or lesser quality than those harvested for sawing into lumber or producing utility poles. Pulp mills therefore serve an important role in the forest management practices of many regions by creating demand for relatively low value trees and providing landowners with opportunities for more frequent harvests. Whereas softwood sawtimber must be at least nine inches DBH (diameter at breast-height) to be marketable for lumber production, pulpwood can be harvested at diameters of just five or six inches DBH. Pulp mills are an important outlet for small diameter trees, particularly those produced from forest thinning operations in the industrial pine plantations of the southern United States. Trees harvested for pulpwood are usually chipped on site or at a pulp mill.

In 2010, the United States produced 222.2 million green tons of pulpwood, approximately three-quarters of which came directly from trees, known as roundwood, while the remaining quarter came from wood industry mill residues (Piva et al., 2014). Mill residues useful for pulping are mostly generated during the primary processing of logs. Slabs, edgings, and veneer cores are byproducts that are often chipped and used for pulping. Again, pulp mills are an important outlet for these materials since alternative uses, such as for producing biomass energy, can present less value to sawmill operators.

Over three-quarters of the total pulpwood production in the United States comes from the Southeastern and South Central regions, most notably North Carolina, South Carolina, Georgia, Alabama, Louisiana, and Mississippi. Nationally, Georgia and Alabama alone accounted for approximately 25% of total pulpwood production in 2010. Not surprisingly, these regions were also home to 83 of the nation's 136 pulp mills in 2010 and approximately 74% of its pulping capacity. Other important regions for pulpwood production in the United States include: the Pacific Northwest where Washington and Oregon together account for about 9% of total national output, the Lake States where Wisconsin, Minnesota, and Michigan account for approximately 6.5% of production, and New England where Maine accounts for around 3.7% of the national total. For comparison purposes, pulpwood production in the Mid-Atlantic region, which is primarily composed of New York, Ohio, Pennsylvania, and West Virgina, accounted for less than 3% of national output. Among those Mid-Atlantic states, Pennsylvania leads in pulpwood production with approximately 1.76 million green tons in 2010, or about 0.8% of the national total (Piva et al., 2014).

The silvicultural practices employed in the Southeastern United States contribute greatly to the region's dominance in pulpwood production. Nearly 75% of the region's pulpwood production comes from softwoods (Piva et al., 2014). Southern pine species, which include loblolly, slash, shortleaf, and longleaf, account for the vast majority of that. Relative to other major pulpwood species groups in the United States (e.g., spruce, fir, aspen, birch, maple), southern pines are fast-growing and easily cultivated. The region also benefits from its terrain, which allows much of its timberland to be easily accessed for harvesting and planting, compared to the mountainous terrains of the New England and Pacific Northwest regions.

These attributes make the Southeastern United States well-suited for intensively managed tree plantations, which are a primary factor in its dominance in wood production. In 2011, there were about 45 million acres of planted forests in the south, accounting for about 22% of the region's timberland and over 70% of all planted timberland in the United States (Robertson et al., 2011). The pine plantations of this region are managed to maximize wood fiber production, which typically entails applications of pesticides and fertilizers, as well as actively suppressing other forms of vegetation through manual cuttings and the use of herbicides. Under optimal growth conditions, tree plantations can produce wood fiber at a significantly faster rate than natural forests. Consider, for instance, that planted forests account for only about 6.4% of the approximately 331 million hectares (819 million acres) of forests in North America but are responsible for 36% of its annual roundwood production (Payn et al., 2015; USDA, 2019). In the pine plantations of the Southern United States, trees can be harvested for pulpwood on rotations of as little as 15-20 years.

Pulpwood plantations are a major source of fiber in other areas of the world as well. The five largest producing countries of roundwood from plantations account for 68% of global plantation production (approximately 562 million cubic meters of roundwood in 2012), including Brazil (23%), the United States (18%), China (11%), India (8%), and Chile (7%) (Jürgensen et al., 2014). These rankings will likely shift, however, as new plantations developed over the past few decades reach maturity. Between 1990 and 2015, the global area of forest plantations grew 66% to nearly 280 million ha (685 million acres) and now account for around 7% of global forested area (FAO, 2016; Payn et al., 2015). It is estimated that 44% of global annual roundwood production will be supplied by plantation forests in 2020 (Jürgensen et al., 2014).

Secondary Fibers and Remanufacturing

Secondary fibers, also referred to as recovered or recycled fibers, are useful fibers that are sourced from previously manufactured paper and board products. Unlike virgin fibers, which are unaltered and sourced directly from lignocellulosic plant materials (i.e., wood), secondary fibers have already undergone the processing needed to make plant fibers useful for paper production. As such, the processes of remanufacturing this

material into new paper and board products differs in some important ways from paper production using virgin fiber. Secondary fiber feedstock must often be sorted by paper type before pulping, depending on the final product the fiber will be used for. Since the lignin in secondary fiber sources has already been substantially altered or eliminated, the repulping process to separate the fibers from one another requires significantly less energy than for virgin fibers.

However, secondary fibers necessitate additional separating and cleaning processes to remove non-fiber contaminants such as staples and paperclips, glass fragments, adhesives, wax coatings, plastic films, and various chemical additives and fillers used in prior production processes. One such process is deinking, which is key to producing paper from recycled fiber. Deinking systems vary depending on the type of materials used as feedstock and the paper grade to be produced. In all cases though, the primary goal of deinking is to detach and remove printing ink pigments and dirt specks from the fibers to increase brightness and visual quality of the remanufactured paper product. The two general methods used for deinking are floatation and washing. Selective floatation takes advantage of the hydrophobic nature of contaminant particles, including ink. In this method, air is injected into the pulp suspension to generate intentionally-sized bubbles that attach to contaminant particles as they ascend, creating a layer of contaminant containing foam on the surface of the suspension that can be easily removed. In nonselective flotation, flocculants are applied to agglomerate contaminants which can then be removed using air bubbles in a way similar to selective floatation. Washing is a secondary process that is more common to mills in the United States than in Europe and is best suited for small ink particle sizes (Holik, 2006). Washing utilizes dispersants to free contaminants in the pulp suspension, which are then washed out as water is removed from the fiber mat.

Fiber Recovery and Reuse

Recovered fiber is typically categorized by source and type. Most broadly, recovered fiber can first be categorized as either pre-consumer or post-consumer content. Definitions for these categories can vary, but the general distinction is whether or not the material reached its intended user or fulfilled its intended purpose prior to recovery. For instance, newspapers recovered from households are a source of post-consumer fiber but

overrun newspaper stock recovered at a printer is a pre-consumer source of fiber, since the newspapers were never sold to consumers. In its definition of post-consumer fiber, the Environmental Protection Agency (EPA) includes "all paper, paperboard, and fibrous wastes that enter and are collected from municipal solid waste" (2002). According to the Forest Stewardship Council (FSC), post-consumer reclaimed material is:

Material that is reclaimed from a consumer or commercial product that has been used for its intended purpose by individuals, households or commercial, industrial and institutional facilities in their role as end-users of the product. Examples of post-consumer fiber include old newspapers and magazines from residential and office collection, reclaimed household scrap paper, reclaimed office waste paper, used corrugated boxes, and commercial transport packaging. (FSC, 2004)

Pre-consumer fiber is synonymous with manufacturing wastes, and is defined by the FSC as "material that has been reclaimed from a process of secondary manufacture or further downstream, in which the material has not been intentionally produced, is unfit for end use and not capable of being re-used on site in the same manufacturing process that generated it" (2004). As it is defined by the FSC, pre-consumer fiber can also be referred to as post-industrial fiber, since the definition is intended to include only materials recovered from processes downstream of the paper mill. These definitional boundaries are more narrow than those used by the EPA, which allows for mill wastes so long as they that are generated after the initial papermaking process is complete, including "those manufacturing operations up to and including the cutting and trimming of the paper machine reel into smaller rolls or rough sheets" (2002). Depending on the definition, examples of pre-consumer fiber may include cuttings, trimmings, scraps, printing overruns, returns, obsolete inventories, misprints, and other undeliverable products.

Although the exact parameters that determine what does and does not constitute pre-consumer recovered materials may seem insignificant, the final determination dictates how the fiber, and the subsequent products that contain it, can be sold. According to the Federal Trade Commission, which has issued guidance for the use of environmental marketing claims, it is deceptive to market a product as containing recycled materials "unless it is composed of materials that have been recovered or otherwise diverted from

the waste stream," and that advertisers "should have substantiation that the pre-consumer material would otherwise have entered the waste stream" (§260.13, 2012). This is the same premise on which the FSC and the EPA base their qualifications for "reclaimed" and "recovered" fiber. This is an important distinction because in the pulp and paper industry, as with other industries, residual wastes from primary processing can be utilized elsewhere in the production process with relative ease. In paper production, this mill waste is called broke and is generated on a continuous basis as trims as well as from off-specification paper. Nearly all mill broke is fed back into the production process and serves as an important stock source for mixing with recycled fibers.

Trends in Paper Recycling

Globally, the proportion of total paper production that is recovered and collected for reuse has increased from around 41% in 1998 to around 57% in 2017 (FAOSTAT, 2019). During that same period of time, however, global paper production increased 37%, topping out at approximately 455 million tons in 2017 with projections exceeding 530 million tons by 2030 (EPN, 2018; FAOSTAT, 2019). Much of this new capacity has been developed in Asia, where production increased tenfold between 1970 (21 million tons) and 2015 (210 million tons). Asia now accounts for nearly 50% of global paper production, up from just 15% in 1970. Half of that production, or one quarter of the global output, comes from China, which surpassed the United States as the global leader in paper production in 2009. Total production aside, the increase in paper recovery over the past two decades is promising yet still presents opportunities for improvement.

Maximizing the recovery rate of paper can reduce demand for fiber from virgin sources (National Council for Air and Stream Improvement, 2013). Many regions of the world, however, are approaching the upper limits of what can be practically recovered. Since some products become contaminated during use, are not recyclable, or get utilized for other purposes, it is not possible to recover 100% of the paper produced (EPN, 2018). The maximum recovery rate for paper has been estimated to be around 80% (CEPI, 2011; EPN, 2018; European Paper Recycling Council, 2016; World Business Council for Sustainable Development, 2019). Recent recovery rate figures include 68% in the United States (American Forest & Paper Association, 2019), 72% in Europe (WBCSD, 2019), and nearly 80% in Japan (EPN, 2018).

In many countries there is greater demand for recovered fiber in export markets than there is domestically, and so a large proportion of the paper recovered is exported for pulp production elsewhere. Until recently this had been the case in the United States, which exported 40% of the approximately 52 million tons of recovered paper it collected in 2017. Nearly two-thirds of this exported material went to China. In 2018, China set much more stringent contamination limits on the grades of recovered paper it would accept and effectively ceased imports of mixed or unsorted paper.

According to a joint MIT-AF&PA study, the Chinese export market for recovered paper from the United States in 2016 exceeded domestic capacity for those materials, especially mixed papers (Olivetti et al., 2018). That is, the United States does not currently have the industrial capacity to utilize all the recovered paper each year that it had previously exported to China. One major reason for this is the use of single-stream recycling systems in residential waste collection. Paper recovered from these systems is more likely to be heavily contaminated with food waste and other materials such as broken glass (WBCSD, 2015). Furthermore, unsorted or mixed paper is more costly to process for recycling into new paper products. Increasing the capacity for processing mixed paper and improving the residential collection systems are two methods identified in the study for increasing utilization of recovered paper in the United States (Olivetti et al., 2018).

Environmental Impacts of Virgin and Recycled Fiber

The pulp and paper industry is resource intensive, requiring large amounts of fiber, energy, chemicals, and water. However, the resources required for, and the environmental impacts from, producing paper products can differ dramatically between those made from virgin fiber sources and those from recovered fiber sources. The following subsections discuss resources considerations related to raw wood material, forest ecosystems, energy, greenhouse gas emissions, and water.

Wood Use

Perhaps the most obvious difference between virgin and recovered fiber sources is the impact on wood resources, since the vast majority of virgin fiber used in paper

production comes from trees (FAO, 2017). Consider, for example, the production of uncoated freesheet paper (i.e., copy or printing paper) in North America. Producing one ton of this paper from virgin sources would require approximately four tons of green wood (Andrews & Hart, 2013), or the equivalent of about 24 trees. For one ton of janitorial paper such as bathroom tissue and paper towels, about 4.9 tons of wood or approximately 29 trees would be needed if using only virgin fiber. And for a ton of coated freesheet, such as that used in high-end glossy magazines, about 3.5 tons of wood or 20 trees would be needed (EPN, 2018). Alternatively, if these products were manufactured using 100% recycled fiber, they would not require virgin fiber at all and so have no direct impact on wood resources.

It is worthwhile noting the range of virgin fiber requirements among various paper products. Some paper products, such as that used for newspaper, may require less than two tons of green wood per ton of paper while other products, such as bathroom tissue, can require nearly five tons of green wood to produce a ton of product. The range of input requirements can vary due to many factors, but two of the primary drivers are the pulping processes used for each product and the use of fillers or additives in the final products. Chemical, or Kraft, pulping processes generally produce yields of 65-70% when used for brown paper applications. That is, 1000 pounds of virgin wood fiber would produce 650-700 pounds of pulp when measured using an equivalent moisture-weight basis. For paper products that undergo a bleaching process, such as copy paper or bathroom tissue, the yield is typically only 40-50%. This is far less than the 95% yield of newsprint, which is made using a mechanical pulping process that, unlike chemical pulping, is not intended to minimize lignin content and therefore utilizes most of the wood (Biermann, 1996). For this reason, utilizing recycled fiber in some applications, such as copy paper and bathroom tissue, can be far more effective at reducing impacts on wood resources than in other applications, like newsprint or unbleached containerboard.

Furthermore, these lower grades of paper are already the primary outlets for recovered fiber, since mixed paper and old cardboard boxes (OCC) cannot efficiently be upcycled into higher value paper products (WBCSD, 2015). According to one recent analysis, the global average for recycled content in printing and writing paper (i.e., copy

paper) is only 8%, compared to 34% in tissue products, 56% in packaging, and 68% in newsprint (Van Ewijk et al., 2018).

For most people, having to harvest fewer tress is a perhaps the most obvious benefit of using recycled fiber in paper products. Since some amount of virgin fiber will always be needed for new production, even if fiber recovery systems and paper production processes were optimized, it is important to consider some of the commonly cited benefits associated with virgin pulp production. Most notably, approximately 25% of the pulpwood used to produce virgin pulp in the United States comes from mill residues. Utilizing this waste material in pulp production contributes substantially to the efficiency with which other wood products, such as dimensional lumber and plywood, are manufactured. Additionally, not harvesting trees for pulp production does not necessarily result in fewer trees being harvested since those same trees can be used for many different purposes.

Finally, it has been argued that reducing demand for virgin wood fiber can have a detrimental impact on forest preservation. This is because lower demand could reduce the economic value of forestland, possibly encouraging landowners to seek higher financial returns by developing the land for other purposes (NCASI, 2013). This relationship may be less applicable to pulpwood markets, however, since many of the trees that would otherwise be harvested for pulpwood could instead be harvested for higher value outputs (e.g., lumber) in the future. Ultimately, displacing virgin fiber with recycled fiber reduces the volume of trees being harvested for pulp production, if not preserving them then at least allowing them to be used more efficiently for higher value purposes.

Ecosystem Disturbance

Beyond simply using wood, forestry operations associated with pulpwood production can have broader impacts on ecosystems and surrounding environments. One LCA quantified the disturbance on forest biomes resulting from the production of virgin coated freesheet (VCF), commonly used for magazines and brochures, by three of the largest integrated pulp and paper mills producing VCF in the United States. According to that analysis, producing 2500 tons of VCF caused forest disturbance to an area equivalent to 5400 acres at a mill in Maine, 7100 acres at a Maryland mill, and 8400 acres at a mill located in Wisconsin (Schultz, 2015). Based on the productivity of the forests that supply

fiber to these mills, anywhere from 12 to 34 acres of forest are disturbed per thousand cubic feet (MCF) of timber produced. Furthermore, the same study concluded the forestry operations to supply these mills impacted over 100 endangered animal species, including species of snakes, bats, salamanders, fish, and birds. Meanwhile, the production of 2500 tons of coated freesheet made of 100% post-consumer recycled fiber was shown to have no direct impact on forest biomes or endangered species.

Energy Considerations

Another major area of environmental impact from paper production relates to energy consumption. Pulp production, whether from virgin or recovered fiber, requires a lot of energy. According to the Energy Information Agency, pulp and paper manufacturing consumes 6% of all delivered energy in the United States (EIA, 2016). This distinction of delivered energy is important and is discussed below. In terms of total energy, it is widely accepted that producing pulp from recovered fiber requires significantly less energy than producing pulp from virgin fiber (EPN, 2018; NCASI, 2013; Paper Task Force, 2002; Schultz, 2015; WBCSD, 2019). The production of office paper from virgin fiber, for instance, requires 87% more total energy than when produced using recovered fiber. Likewise, producing corrugated boxes from virgin fiber requires 49% more total energy than doing so with recovered fiber (NCASI, 2013; Paper Task Force, 2002).

Pulping recovered fiber requires significantly less total energy, about half as much in many cases, because the fibers are effectively pre-processed. That is, recovered fiber has already undergone the energy intensive process of separating the cellulosic fibers. The most common methods for breaking down and separating virgin fiber involve large amounts of heat. In chemical pulping processes, which account for 80% of global manufacturing capacity (FAO, 2017), wood chips are cooked in chemical baths inside of pressurized digesters. This process degrades and solubilizes the lignin and hemicellulose components of the wood which allows for much of it to be removed as residual waste, resulting in the lower pulp yields described earlier in this section.

Although a great deal of energy is needed to produce the steam used for heating the wood chips, it is important to note that much of the energy needed comes from burning those same residual wastes generated during the pulping process. Since this mill waste is

primarily composed of organic material derived from trees, it is generally considered a biomass fuel.

Most virgin pulp mills utilize combined heat and power (CHP) systems that produce both heat and electricity from burning wastes. As a result, these mills can typically produce 50-65% of their energy needs onsite (Paper Task Force, 2002). This explains why the distinction of delivered energy requirements versus total energy requirements is important. When considering only delivered energy, virgin pulp mills can actually require up to 15% less energy than recycled pulp mills. And because the fuel is derived from wood waste, it is largely considered a form of renewable energy. In this context, the pulp and paper industry is among the largest users and producers of renewable energy (Muller & Demel, 2013).

Greenhouse Gas Emissions

In terms of greenhouse gas (GHG) emissions associated with manufacturing paper products, it is difficult to conclude that one type of pulp is generally preferable to the other due to the wide variation of factors specific to each facility such as pulping methods, energy sources, and fiber transportation networks. In one analysis of site-specific data, no statistically comparable differences in GHG emissions existed between most virgin and recycled pulp mills producing equivalent products (NCASI, 2013).

In the case of virgin fiber production, however, special consideration needs given to the fiber source since some forests have greater carbon densities and sequestration capacities than others. For instance, one study of Oregon forests found that managing carbon dense forests for fiber or wood production can result in net increases of carbon emissions relative to preserving the forests or reducing harvests cycles on them. This was largely because the net productivity rate of coastal forests peaks around 80-125 years of age or roughly twice the average age at which the forests are now harvested (Law et al., 2018). Forest operations also produce a great deal of residual organic materials, known as slash. Slash is generated when trees are harvested and processed into logs or bolts by removing limbs, branches and leaves, smaller diameter sections of the stem, and root systems. This material is typically left in the forest to naturally decompose, releasing large quantities of carbon dioxide. One study estimated that decomposition of logging

residues above and belowground accounts for 42% of the carbon loss caused by wood harvests in U.S. forests (Harris et al., 2016).

Water

Water is a key component in pulp and paper manufacturing. Water is used to create slurries for fiber separation and bleaching during pulp production, to produce fiber suspensions for paper manufacturing, and to make steam for heating and cleaning processes. Although both virgin and recycled pulp production require large amounts of water, processing virgin fiber with chemical pulping methods almost invariably consumes significantly greater quantities of water. Using best available techniques for each type of pulp mill, a deinked (i.e., recycled) tissue mill may produce as little as 15% as much effluent as an equivalent bleached kraft mill (EC BREF, 2001; NCASI, 2013). Results from the previously cited LCA of 100% recycled versus 100% virgin coated freesheet (VCF) paper indicated that the production of 2500 tons of the recycled content paper consumed 22 thousand cubic meters of water, whereas the same production using virgin content consumed more than four times as much water at each of the comparison mills (Schultz, 2015).

Impact Summary

Despite the variation that exists between individual mills, and the many factors to be considered over entire value chains of multiple products, the widely accepted conclusion in the literature is that manufacturing paper from recycled fiber is less impactful on the environment than doing so with virgin fiber. Generally, manufacturing recycled paper results in less forest disturbance, impacts fewer ecosystems, requires less energy, consumes less water, uses less toxic chemicals, and generates no more GHG than manufacturing virgin paper. Furthermore, recycling paper has repeatedly been shown to have lower environmental impacts than the most common alternative methods of disposal, namely landfilling and incinerating. (Van Ewijk et al., 2018; WBCSD, 2015) The optimized paper production and recovery system has been described as a cascading one, in which fiber from virgin sources is used, recovered, and recycled into new paper products multiple times and, at the end of its useful life, burned for energy to displace combustion of fossil fuels (WBCSD, 2015).

CHAPTER 2
Sustainability Metrics for Organizational Fiber Consumption: A Critique

Abstract

This descriptive study presents a critical examination of sustainability metrics related to fiber consumption and corporate attempts at quantifying environmental impacts in the form of footprint-type measures. The methods currently used by organizations for assessing and reporting sustainability performance related to the consumption of paper products have proven inadequate. The information that most organizations currently rely on to manage sustainability of paper consumption is restricted to the presence of third-party certification labels (i.e., FSC, SFI, PEFC, etc.), proportion of recycled content, and overall measures of paper use. This information is of limited use for determining impact of paper consumption. The disconnect between measuring consumption and its associated impact is leading more companies to investigate their own paper supply chains. The critique presented here examines two examples, provided by Apple and British Airways, of organizational attempts to calculate forest footprint metrics and the ultimate impact those efforts had on improving the sustainability performance of their operations. Existing methods for assessing impact are reviewed and recommendations for moving the forest footprint concept forward are proposed.

Introduction

One challenge that organizations have faced as attention to sustainability has grown is how to best assess the performance of sustainability initiatives. From an operational perspective, measuring the impact of sustainability practices is necessary for assessing the efficacy and value of those practices, for gauging progress toward sustainability goals, and for identifying opportunities for improvement. Sustainability metrics can also serve as an important tool for communicating organizational values to, and engaging with, interested stakeholders.

As expectations for companies to engage in sustainability reporting have increased, the use of sustainability metrics has become more widespread. According to the Governance and Accountability Institute, 90% of companies listed on the S&P 500 issued formal sustainability reports in 2019, a substantial increase over the 20% that did so in 2011 (GAI, 2020). A separate analysis by the Investor Responsibility Research Institute found that over 90% of sustainability reports issued by S&P 500 companies in 2018 included environmental performance metrics (IRRCI, 2018). Most direct measures of environmental performance focus on the internal operations of an organization, which often include energy consumption, air emissions, water usage, and waste generation at company-owned facilities.

There is growing pressure though to expand the scope of sustainability reporting to include performance measures of both upstream and downstream activities. This reflects a growing realization that the sustainability of any given firm cannot exceed that of its suppliers (Krause et al., 2009; Miemczyk et al., 2012). For example, Microsoft recently announced updates to its supplier code of conduct requiring suppliers to calculate and report greenhouse gas emissions data (Joppa, 2020). Similarly, through its "Supplier Clean Energy Program," Apple is pressuring its suppliers to transition to renewable energy sources to reduce the carbon footprint associated with manufacturing Apple products. As of June 2020, over 70 manufacturing partners have committed to 100% renewable energy for Apple production (Apple, 2020).

The Scope 3 Standard, which allows organizations to assess GHG emissions across their value chains, is perhaps the best-known sustainability metric for assessing organizations' indirect environmental impacts. Beyond Scope 3, however, there are few metrics for measuring environmental impacts from company activities at the supply chain level that are both well-developed and widely applicable. In the case of procurement or sourcing, the metrics used to evaluate and report sustainability performance often focus on the overall reduction of purchased materials, the acquisition of products carrying third-party environmental certifications, or the overall ratio of virgin to recovered material components. While such metrics are useful for encouraging better purchasing decisions, they have limited utility for assessing the environmental impact of those decisions.

Expectations for organizations to report sustainability performance are growing. This applies not just to publicly traded companies or large manufacturers, but to organizations of all types including universities, government agencies, retailers, hospitals, restaurants, entertainment venues, and agricultural producers, to name a few. Furthermore, the expectations for reporting that are placed on these organizations increasingly extend beyond their own operational boundaries to include evaluations of environmental and social impact in upstream activities.

Since forest products are ubiquitous in the operations and/or supply chains of practically all organizations, these trends toward sustainability disclosure and performance measurement may create both opportunities and potential challenges for the forest products industry. The frequency of terms such as "fiber footprint," "paper footprint," and "forest footprint" being used in sustainability reporting suggests a growing interest in, and need for, a formal method for quantifying impact of organizational activities on forests. In response to these trends, this paper offers a critique of the forest footprint and other similar concepts. Background information on corporate applications of these concepts and their relation to other key sustainability metrics are first discussed. Footprinting initiatives of two prominent companies, British Airways and Apple, are then examined in terms of methodology and outcomes. Following this, possible methods for quantifying a fiber footprint are reviewed, with the advantages and disadvantages of each being evaluated. Finally, the opportunities and challenges associated with developing the metric are discussed, along with the need for forestry experts and industry professionals to be involved in any further development of the concept.

Background

Paper, or rather the fiber it is composed of, is a worthwhile area to focus sustainability efforts because of the potential environmental burdens associated with its production. The Union of Concerned Scientists has identified wood products, including wood pulp, as one of the "big four" agricultural commodities driving global deforestation. This is especially true in places like Indonesia, where from 2000-2010 deforestation for the purpose of establishing pulpwood plantations exceeded that of palm

oil plantations (USC, 2016). Even responsibly sourced paper products, however, can still have sizeable impacts on environmental indicators, due to the energy, chemical, and water intensive processes involved in converting trees into paper. As such, it is important that sustainability and procurement professionals understand both where their paper products come from and how they are manufactured.

Consumption of forest products has long been an area of emphasis in organizational sustainability reporting. Traditionally, most reporting efforts have generally focused on overall reductions in paper consumption, use of recycled paper products, and the role of certifications in purchasing decisions. Stakeholders are increasingly demanding though that organizations become more actively engaged in sustainably managing their supply networks, including those involving forest products. The following sections present background information on the methods that organizations use to report sustainability performance and the metrics employed to assess fiber consumption.

Sustainability Reporting and Fiber Procurement

The methods used by large, publicly traded companies for reporting sustainability performance usually adhere to, or at least loosely follow, one or more of the standards established by major reporting frameworks, such as CDP (previously the Carbon Disclosure Project), Global Reporting Initiative (GRI), International Integrated Reporting Council (IIRC), Task Force for Climate Related Financial Disclosures (TCFD), and the Sustainability Accounting Standards Board (SASB). It is important to note that sustainability reporting remains a voluntary business practice for most organizations in the United States. The Securities and Exchange Commission (SEC) does require publicly traded companies to disclose environmental, social, and governance (ESG) matters that are deemed material to stakeholders, but the "materiality" approach to disclosure law has meant that most environmental matters considered in the major reporting frameworks do not involve disclosures required by the SEC (Riesenberg & Beller, 2019).

Even within the major reporting frameworks, however, the notion of materiality still guides the reporting process. This is especially true among the frameworks intended to inform financial investment decisions, such as the IIRC and SASB. For example, SASB's online materiality mapping tool is designed to help reporting organizations identify "sustainability issues that are likely to affect the financial condition or operating

performance of companies" by industry (SASB, 2020). Since materiality is determined with regard to financial and operational performance, sustainability issues associated with wood and fiber sourcing are not broadly considered impactful for most industries. So, for instance, despite the intensity of paper consumption in finance, insurance, legal, education, and healthcare services industries, companies operating in these spaces are not expected to report on paper procurement practices as part of the SASB framework.

The CDP and GRI frameworks, which are geared toward broader groups of stakeholders than the SASB and IIRC, are the most widely used among S&P 500 companies. These frameworks also produce the most in-depth reporting regarding wood and fiber sourcing and organizational impacts on forests. Unfortunately, however, most companies outside the forest products industry fail to report on these topics. For instance, among the 319 S&P 500 companies to report on the CDP climate change section in 2019, only 42 also reported on the forests section. Similarly, over half of S&P 500 companies utilized GRI standards for reporting but only 5% of those companies submitted comprehensive reports that would have covered forest topics regardless of the materiality determination (GA Institute, 2020).

Sustainability Metrics for Fiber Procurement

Many organizations nonetheless report on fiber procurement practices in some manner. One increasingly common method is through disclosure of sustainable procurement policies and environmentally preferable purchasing (EPP) programs. These policy documents outline purchasing guidelines used by organizations or specific purchasing commitments they have made. For example, Starbucks has committed to purchasing only FSC certified materials for solid wood used in flooring, furniture, and casework in its stores (2006). Target has stated its goal to source all fiber used in its owned-brand products and packaging from certified suppliers, with a preference given to FSC (2017). Even the Portland Trailblazers NBA franchise has published purchasing guidelines that prioritize 100% recycled content for all paper products (Green Sports Alliance, 2019).

Beyond broad purchasing policies, many organizations attempt to quantify impact of fiber consumption by comparing current levels of paper use to past levels. For example, according to its 2015 sustainability report, Enterprise Holdings Inc. set a five-year target

for reducing companywide paper use by 40%, though it's not made clear how paper use was measured (2015). Bank of America discloses its annual paper usage by weight, allowing stakeholders to compare total usage as well as overall proportions of recycled and certified inputs by weight from one year to the next (2019). Universities that participate in the Sustainability Tracking and Reporting System (STARS), meanwhile, disclose fiber use in terms of expenditures. In this case, institutions report total copy paper expenditures along with a breakdown of those expenditures by products having different levels of recycled or certified content (AASHE, 2019).

As can be seen, there are many ways organizations go about disclosing fiber use, including through the major sustainability reporting frameworks, internally developed reports, publication of sustainable procurement guidelines, and supplier disclosures. There is also a great deal of variance among the metrics used in those disclosures. The metrics companies most commonly use to report fiber consumption include usage reduction goals, sourcing commitments for various levels of certified and/or recycled content, total usage, proportions of usage based on content types, and usage by application (ex., office, food service, packaging, janitorial, etc.). Additionally, these measures of use can be presented on the basis of weight, volume, and spend ($).

The wide variation that exists among the reporting methods and metrics utilized by companies to disclose information related to fiber consumption is an obvious limitation to their utility. As sustainability metrics, however, the greatest limiting factor associated with the assortment is that none can serve as a reliable measure of environmental impact. For instance, while measures that emphasize the use of certified materials are useful for encouraging better purchasing decisions, they have limited utility for assessing the environmental impact of those decisions. Likewise, organizational goals for consuming relatively less paper than in the past are not a particularly effective method for measuring sustainability performance, since the impact of both the baseline and target levels of consumption are unknown.

Without metrics to quantify impact of fiber consumption, the metrics currently used to describe consumption (ex., proportion of certified content) or changes to it (ex., usage reduction) are not adequate for use as measures of sustainability performance. Unlike procurement metrics that seek to maximize expenditures on products carrying third-party

environmental certifications or to reduce overall usage, sustainability metrics that assess environmental impact (i.e., footprints) can provide organizations a roadmap of sorts on which they can develop strategies for actually becoming more sustainable.

Forest, Fiber, and Paper Footprints

Using the concept of a footprint to understand ecological impacts of human activity specifically on forest ecosystems is not at all a novel idea. Perhaps the most well-documented method for doing this is the Ecological Footprint (EF) from the Global Footprint Network. This methodology, which situates forests as a key indicator, was first popularized in the mid-1990's (see Wackernagel & Rees, 1996). In reviewing literature on the topic, the earliest reference to a "forest footprint" was found in a 2001 report published by World Wildlife Foundation, titled "The UK's Forest Footprint." Unlike the EF, the footprint described by the WWF was not a methodology for calculating impact but rather a simple method for presenting information to help others appreciate the wide-ranging impacts that the United Kingdom has had on global forests (WWF, 2001).

The Forest Footprint Disclosure (FFD) project, which was launched by the Global Canopy Programme in 2009 and since merged with the Carbon Disclosure Project (now CDP), seems to have been a driving factor in popularizing the concept of a forest footprint and its use in corporate sustainability reporting. Like the CDP now, the FFD requested companies voluntarily disclose information related to their use of commodities linked to global deforestation (i.e., timber, soy, beef and leather, palm oil, and biofuels). While the FFD helped companies reduce supply chain risks by identifying practices associated with global deforestation, it did not produce final aggregate measures of those companies' impacts on forests. Much like the WWF example mentioned above, the footprint developed by the FFD was a tool for understanding areas of potential impact rather than a method to quantify it. Nonetheless, the FFD certainly increased exposure of the forest footprint concept to broader audiences through the participation of over 100 companies before its merger with CDP, including large multi-nationals with consumer facing brands like Nike, PepsiCo, and L'Oréal (FFD, 2012).

Example: British Airways

As an original participant in the FFD when it was launched in 2009, British Airways (BA) attempted to calculate a measure of its forest footprint a decade ago. According to its 2010 sustainability report, the company "took inspiration from the Forest Footprint Disclosure Questionnaire and investigated our impact in even greater detail than was required by developing our own methodology" for measuring a forest footprint (British Airways, 2010, p. 29). The company estimated the minimum size of its forest footprint to be 250 acres of deforestation in 2009, increasing to 314 acres of deforestation in 2010 (BA, 2010; BA, 2011). It should be noted that deforestation, as measured by BA, describes the permanent loss of forest, either due to ecological damage caused by intensive harvesting operations or conversion of land for other uses. Figure 3.1 below is a depiction of BA's estimated forest footprint that the company included in its 2013 CDP forests report. This total footprint was calculated by considering separately the impact from their consumption of each of the "big five" commodities driving global deforestation (i.e., timber, soy, beef and leather, palm oil, and biofuels).

Acre of forest - TIMBER	Acre of forest - BEEF	Acre of forest - PALM	Acre of forest - SOY	Total
102	19	14	58	193

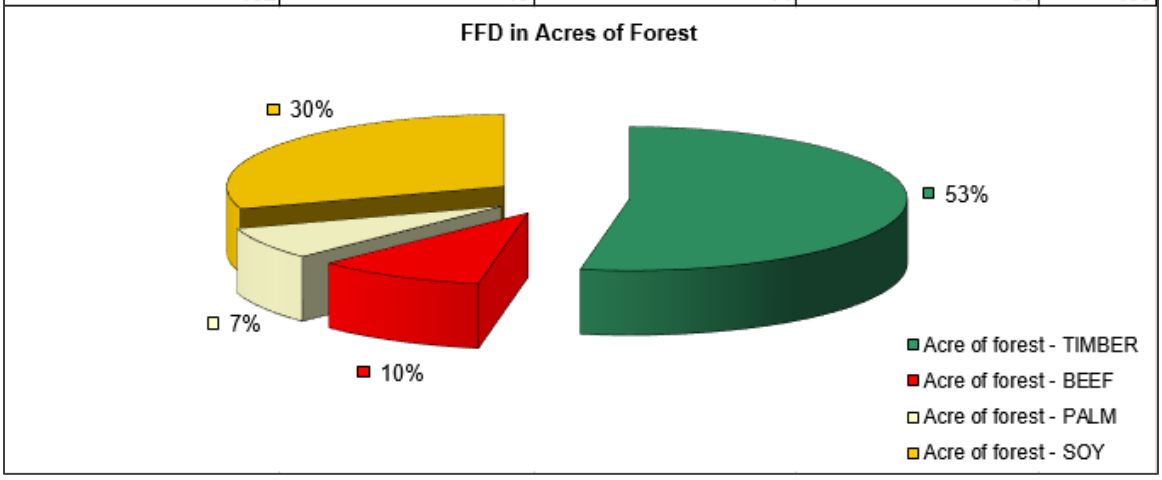

Figure 2.1 Forest footprint per commodity in acres of deforestation
Source: British Airways, 2013

Though seemingly well-intentioned, the methods that British Airways developed and ultimately used to calculate impact from these areas of consumption were rudimentary and unlikely to produce valid results. Consider the method used to calculate impact of

timber commodities, which focused on the company's use of paper products. The company used invoice data from key suppliers of paper products to first calculate the total weight of each product purchased. Suppliers were then asked to provide certification information and country of origin for each product. For any product not certified or for which the supplier did not provide information, it was assumed to contribute to deforestation. For certified products (i.e., FSC, PEFC, ISO14001), 30% of the total consumed weight was attributed to causing deforestation, reflecting the maximum proportion of non-certified materials in FSC Mix products. After calculating the portion of total consumed weight that was non-certified, or "at risk," for each product, the company then estimated the area of global deforestation contributed to by each. These estimates were calculated based on two broad assumptions: first, that one metric ton of uncoated virgin printing paper consumes 24 trees, and second, that the average tree density of forests is 542.95 trees per acre (BA, 2012).

It is not difficult to appreciate the inadequacies of this method. These assumptions were applied to all paper products of all origins. So, for instance, 24 trees were assumed to be used per metric ton of 80gsm A4 printing paper, as well as per metric ton of 220gsm A4 printing paper, bathroom tissue rolls, traymats, waxed beverage cups, cardboard boxes, and sick bags[1]. This assumption ignores fundamental properties of paper products and the substantial variation that can exist among them. For example, the proportional weight of non-fiber components (i.e., fillers, binders, pigments, other additives) would likely be much greater in the glossy cardstock used for onboard menus than in the tissue used for cocktail napkins. Likewise, pulping yields for unbleached kraftliner used in boxes can exceed 70%, whereas yields for bleached pulp used in writing paper are typically less than 50% (Biermann, 1996).

The use of these assumptions without regard for geographic considerations is also hugely problematic. In calculating its annual forest footprint, British Airways applied these assumptions to paper products sourced from many countries, including Portugal,

[1] See sourcing spreadsheets from Xerox and Gist under section 8.4 of the company's 2013 CDP Forests report (www.cdp.net).

Sweden, Austria, the United States, Brazil, Russia, and Malaysia, among others. As with the pulping processes, the species of trees used to produce the fiber can be a significant factor in yield due to differences in the chemical composition of the wood, namely differences in lignin content. Yields for aspen, for example, which has a lignin content of around 20%, are typically near 55% for bleachable-grade kraft pulp, whereas the equivalent pulping yield for Scots pine is about 45%, largely due to its relatively higher lignin content about around 27% (Biermann, 1996). Chipping yields, too, can differ substantially among common pulpwood species, ultimately influencing raw material requirements. Since the species mixes that are predominantly used for pulpwood will differ among the sourcing locations, the input requirements per metric ton of paper will also vary. Perhaps more importantly, tree density, along with most any other measure of forest productivity, is particularly sensitive to regional differences. It is unlikely the assumed density of nearly 543 trees per acre is representative of all forest sources. Applying region-specific estimates of forest stand density to the footprint calculation could have dramatically altered the results. Finally, among other things, the use of these assumptions precludes consideration of differing rates of growth or fiber production among the forest sources, for example the differences between Sweden and Brazil or even the Southeast and Northeast regions of the United States.

The effort made by British Airways to quantify the impact on forests from its operations was commendable, particularly since it exceeded the reporting requirements of the FFD and appears to have been novel in its design. The exercise, which involved engaging suppliers, was an effective way to communicate strategic priorities to stakeholders more broadly. As the company noted in one report, “by reducing its impact on deforestation, British Airways has an opportunity to differentiate itself from the competition. This proactive move also reduces the growing risk of being criticised for unethical procurement.” (BA, 2012, p. 13).

Beyond the impact on perceptions of external stakeholders, however, the usefulness of the company’s forest footprint measure is questionable. The overly simplistic, and perhaps misguided, approach to quantifying deforestation impact seems unlikely to have been able to produce valid estimates of actual impact. As such, the value of the company’s forest footprint metric as a measure of sustainability performance was

severely limited. Nor was the method effective for identifying high-risk materials or fiber intensive products, instead serving primarily to simply encourage further procurement of certified products. Despite the major shortcomings, the British Airways forest footprint played a prominent role in the company's sustainability reporting from around 2009 until 2014 (see BA, 2010 through 2015). The company's annual environmental reports have not made mention of the metric since.

Example: Apple

Perhaps the best corporate example of attempts to quantify forest impact on a company-wide basis comes from Apple. The company introduced its paper and packaging initiative in 2015, which broadly sought to increase efficiency of material use, expand the use of recycled and renewable content, source virgin fiber responsibly, and increase availability of sustainable fiber. According to its Paper and Packaging Strategy report, the first step Apple took toward achieving these goals was to develop a comprehensive understanding of its current fiber use (2017). This involved separately analyzing the fiber composition of all packaging materials for each Apple product, including yield losses that occur in secondary manufacturing processes such as die-cutting and printing (i.e., post-industrial/pre-consumer fiber). Individual product-level results were multiplied by the total number of units sold, with results from all products then being aggregated to produce a measure of annual product-related fiber consumption. The company also analyzed fiber consumption of Apple facilities, such as that from printing, food and janitorial services, and retail stores.

The sum of this fiber consumption represented what Apple referred to as its total corporate fiber footprint. Unfortunately, detailed information explaining Apple's methodology for calculating its fiber footprint is not publicly available. However, in its Paper and Packaging Strategy report (2017), the explanation the company offers of its approach suggests the methodology it developed was both more sophisticated and more thorough than that used by British Airways five years prior.

First and foremost, Apple analyzed fiber consumption on a per application basis. Rather than simply aggregating the weight of all paper products used, Apple recognized that inherent differences in material composition and fiber properties of various paper products make some applications more impactful than others. By doing so, the company

could identify “impact hotspots” to guide footprint reduction efforts (Apple, 2017, p. 13). For example, Apple was able to identify specific packaging applications that accounted for significant portions of its virgin fiber consumption, and thus opportunities for reducing impact through redesigning those packaging applications to use less material overall and greater proportions of recycled fiber.

Additionally, the company analyzed its fiber footprint on the basis of the pulp inputs used in its paper products instead of simply the amount of paper products used. This of course allowed it to distinguish between the fiber and non-fiber components of its paper and packaging applications. More importantly though, as a measure of impact, analyzing its footprint in terms of pulp use enabled Apple to better link its consumption of fiber to the production of fiber further upstream in its supply chain. This was particularly important since a key goal for Apple was not just to source virgin fiber responsibly but to protect or create sustainably managed forests capable of supplying an amount of fiber equivalent to that consumed by the company (Apple, 2018).

Calculating the forested land area required to produce a supply of fiber equivalent to the unique pulp demands of a particular organization though is a difficult task, especially for companies not involved in forest management or pulp production. In contrast to British Airways, Apple sought out expertise for help in performing this task, ultimately partnering with The Conservation Fund (TCF) to estimate its forested land area requirements. Using a carbon accounting method (see Smith, et. al., 2006), TCF calculated the disposition of sequestered carbon in Apple’s paper and packaging products over their lifetimes. The total carbon contained in and emitted from those materials was then applied to regional land-based estimates of carbon densities in forests (TCF, 2019). This method allows for land area requirements to be estimated by comparing forest carbon stocks in different geographical regions to the harvested carbon in different wood products.

The results of these calculations for Apple are not publicly available, however, the sustainable forestry projects ultimately funded by the company provide some insight into the outcomes. Through its collaboration with TCF, Apple funded projects in 2015 that purchased and placed conservation easements to ensure sustainable management on over 36,000 acres of working forests in the United States. This forested land area primarily

consisted of the 32,600 acre Reed Forest in Maine, with the rest being the 3600 acre Brunswick Forest in North Carolina (Apple, 2018). At the time, it was estimated that the collective annual fiber production of these forests was equivalent to about half of the virgin fiber consumed by Apple for its product packaging in 2014 (Jackson & Selzer, 2015). It was later reported that over 13,000 metric tons of wood were harvested collectively from the forests in 2016, about equal to 30% of Apple's 2015 virgin fiber demand for packaging (Ohnesorge, 2017). Additionally, Apple has improved responsible management on more than a million acres of forest in China through a partnership with the World Wildlife Fund (WWF), including helping 320,000 acres achieve FSC certification (Apple, 2020). For the past four years, the company has consistently reported that the annual sustainable fiber production capacity of its forest projects exceeded the amount of virgin fiber used in its packaging that year (Apple, 2017; 2018; 2019; 2020).

Discussion of the Forest Footprint Examples

The two footprinting initiatives profiled here illustrate the spectrum on which efforts to measure organizational impact on forests can occur in the absence of a standard methodology. Despite its obvious shortcomings, the approach taken by British Airways was nonetheless admirable for multiple reasons. Whether by intention or necessity, the method employed by BA for measuring deforestation impact was quite simple. The simplicity of its design is a valuable feature since it could help make the footprint measure broadly accessible to many types of organizations. This is especially important for companies that lack resources to invest in sustainability assessments, consume a diverse assortment of forest products, or have little power to exercise over suppliers to obtain pertinent sourcing/production information. At the same time, the simplicity of the BA forest footprint methodology is a major limiting factor in the method's validity. The in-depth analysis of fiber consumption conducted by Apple, on the other hand, in conjunction with the carbon accounting method employed by TCF, is not an approach that could be easily replicated by most organizations. While Apple's fiber footprint measure is likely far more accurate than was BA's, its broader value as a sustainability

metric is limited to those organizations having either the knowledge resources or financial resources to employ it.

Apple's footprint metric also benefited from the comprehensiveness of its methodology. By investigating the material properties and fiber characteristics of every packaging component, the company has developed an in-depth understanding of its fiber usage and the effect each application has on its footprint. The deficiencies of BA's methodology with regard to completeness were previously discussed. It should be noted, however, that key information for analyzing fiber use would have likely been less accessible to BA than it is to Apple, making such a comprehensive analysis even more challenging. This is due to how the airline company uses fiber and its position in the supply chain relative to the fiber source.

Consider that Apple is directly involved in the design of its packaging and, according to its 2019 supplier list, has major paper product manufacturers, such as Stora Enso Oyj and Shenzhen YUTO Packaging Technology, within its first tier of suppliers (Apple, 2019). Conversely, the fiber used by British Airways largely comes in the form of undifferentiated finished products and is sourced from distributors that are further removed from the raw materials. For instance, according to its 2013 CDP disclosure, BA's largest supplier of paper products was the supply chain and logistics management company GIST Limited, which supplied approximately 1700 metric tons of coffee cups, hand towels, tray mats, napkins, etc. Manufacturing information for those products is not readily available. Even in the case of its inflight magazines, BA obtained its paper use data from Cedar Communications, the marketing company that designs and manages production of the publications. In its disclosure, the supplier of the paper used by Cedar was identified as Antalis, a major European paper distributor that ultimately supplied BA products that were produced by various other companies, including Stora Enso Oyj (Cedar file, CDP 2013). So, for example, while Apple obtains paper products directly from Stora Enso, BA obtains its paper products from Stora Enso only after they pass through multiple intermediaries. As the relative distance in a supply chain between a company and supplier increases, the efficiency with which information is passed typically decreases.

Forest Footprint Metrics and Perspectives of Sustainability Assessment

Perhaps the best way to view the different approaches taken by Apple and British Airways toward measuring forest footprints is through application of the performance improvement and transparency perspectives proposed by Maas and colleagues (2016). These perspectives describe organizational motives for engaging in sustainability assessment practices and reflect differing beliefs about the fundamental purpose of sustainability management. Ultimately, the methodologies that organizations develop and utilize for assessing sustainability performance can be largely attributed to the perspective taken toward sustainability management.

The performance improvement perspective of sustainability management prioritizes internal applications for sustainability data. The value of the assessment process, including the collection, analysis, and communication of sustainability performance information, is derived from its usefulness for supporting better management decision-making (Maas, et al., 2016). The core purpose of sustainability management, from this perspective, is to understand and improve sustainability performance, with potential participation in external reporting practices a secondary objective. For this reason, assessment methods and resulting performance measures generally require greater detail and context-specificity than those developed primarily for reporting purposes. Maas, et al., noted that external stakeholders are typically concerned with aggregated data representing an entire company or division, but to be useful for managing sustainability performance, "specific figures on concrete production processes, production sites and product components as well as on alternative ways of production, product design and organization are required" (2016, p. 239).

The transparency-orientated view of sustainability management, by contrast, prioritizes external reporting practices. In this perspective, the primary purpose of measuring sustainability performance is to "enable stakeholders to assess the company's impacts and problems" (Maas, et al., 2016, p. 238). Sustainability assessment methods and selection of performance indicators are strongly influenced not by operational needs or contextual suitability, but instead by stakeholder expectations of what should be measured and reported. Assessments pursued for the purpose of complying with government or industry-wide reporting mandates are common examples of this.

Companies that operate with a transparency perspective engage in sustainability assessment first and foremost in order to report sustainability performance. Some companies may view sustainability reporting practices as useful methods for gaining legitimacy in an industry or market, exhibiting self-regulation in an effort to avoid new government regulation, or even for signaling concern for environmental issues without actually addressing them (i.e., greenwashing) (Schaltegger & Burritt, 2010). Whatever the motivation, this perspective emphasizes the collection of information for the sake of communicating it.

The approaches taken by Apple and British Airways in developing their forest footprint metrics seem to largely align with the performance improvement and transparency perspectives of sustainability management. Apple's analysis of packaging components at the product-level, for example, is reflective of a performance improvement perspective since the information gained from that process is more valuable for supporting internal decision-making than it is for external reporting. Furthermore, Apple then utilized that information to guide design modifications of packaging components in order to reduce its consumption of virgin fiber. While Apple has reported broadly on these efforts in various company documents (ex., environment reports, supplier codes of conduct, packaging strategy, etc.), the forest footprinting initiative was not associated with or included in any kind of standardized sustainability reporting system.

The approach taken by BA, on the other hand, more closely resembles the transparency perspective of sustainability management. The company openly acknowledged that its attempt at measuring forest impacts was directly related to its participation in the FFD reporting project (see first paragraph of section 3.1). Also, rather than analyze the unique fiber properties (i.e., geographic source, pulping process, fiber composition, species, etc.) of the various types of paper products they purchase, BA chose instead to measure fiber use by applying broad assumptions to aggregated purchasing data. Due to the lack of precision and reliability associated with its methodology, it is highly unlikely the information BA gained from its footprinting exercise was useful for actually improving the sustainability performance of its fiber consumption practices.

Ultimately, the utility value of the approaches taken by Apple and British Airways to measure forest impacts could be determined based on their outcomes relative to stated goals. According to Apple, the company's assessment of its fiber consumption led to significant reductions in the use of non-renewable packaging materials, greater use of recycled fiber, and the conservation and/or sustainable management certification of hundreds of thousands of acres of forest in the United States and China (see Apple, 2017). Specifically, Apple stated a goal in 2015 of sourcing 100% of the wood fiber in its packaging from either recycled sources or responsibly managed forests and by 2018 reported doing so. Similarly, the company announced a partnership with the World Wildlife Fund in 2015, with a stated goal of creating 300,000 acres of FSC certified forests in China (Apple, 2016). In 2018, the company reported that the project had achieved this goal by transitioning approximately 320,000 acres into FSC certification over the previous two years.

In the case of British Airways, there is less evidence available to suggest significant forest impact reductions were made as a result of the company's footprinting exercise. A 2014 strategy document on deforestation puts forth a vison of achieving a "0 forest footprint" and promoting forest protection (BA, 2014). It appears, however, that the company has made no further mention of its forest footprint metric since publishing its environmental responsibility report the same year. Although it seems some progress was made with engaging suppliers in disclosing product sourcing information, the proportion of purchased paper goods by weight carrying certification actually decreased from 38% in 2013 to 33% in 2014. The absence of company information touting accomplishments relating to reductions in deforestation and the company's seemingly abrupt abandonment of the forest footprint metric after 2014 suggest that BA's sustainability assessment of its paper procurement processes did not lead to improved sustainability performance.

Possible Methods for Footprinting Organizational Fiber Consumption

Developing a simple method for estimating the forested land area needed to sustainably meet the unique fiber demands of any particular organization presents many challenges. For most organizations, these challenges stem from the diversity of products within their fiber profile, as well as their position in the overall paper supply chain. That

is because each paper product will have unique fiber characteristics such as the proportion of fiber in the product relative to non-fiber components (i.e., fillers, additives), how the fiber was processed (i.e., pulping method), what tree species were used, and where those trees were grown. As such, each product will require special consideration.

Furthermore, since most organizations are final consumers of the products, they are far removed from the early stages of the products' life cycles such as extraction of raw materials and primary processing. As a result, obtaining all the information that would be necessary for calculating a precise measure of forested land area would be prohibitively costly for most organizations, if even possible. Where chains of custody do allow for tracing fiber back to its source, many important variables related to manufacturing yields and product composition may be treated as proprietary information that suppliers aren't willing to disclose, thus leaving inevitable gaps in the footprint calculation. The following sections review possible approaches for quantifying impact of organizational fiber consumption on forest resources using established methods.

Material Flow Analyses

Studies that quantitatively link paper products back to forests or raw materials are typically done in either very broad contexts (e.g., national or global) or highly defined contexts (e.g., product specific LCA). Organizations with a wide range of fiber needs are neither very broad nor highly defined. In the case of very broad contexts, material flow analyses have been conducted to measure flows related to paper consumption. Material flow analysis (MLA) is a method for identifying and measuring material flows so that the material inputs and outputs of a system are balanced. For example, by analyzing data related to pulp production and paper consumption from the Food and Agriculture Organization of the United Nations (FAO), as well as data on recycling utilization from the Confederation of European Paper Industries (CEPI) and treatment of municipal solid waste from the Organization for Economic and Cooperative Development (OECD), Van Ewijk et al. (2018) estimated the various materials streams of global paper flows in 2012. Figure 3.2 below is a Sankey diagram from that study and serves as a useful visualization for understanding some of the complexities involved with tracing fiber from a product to its source.

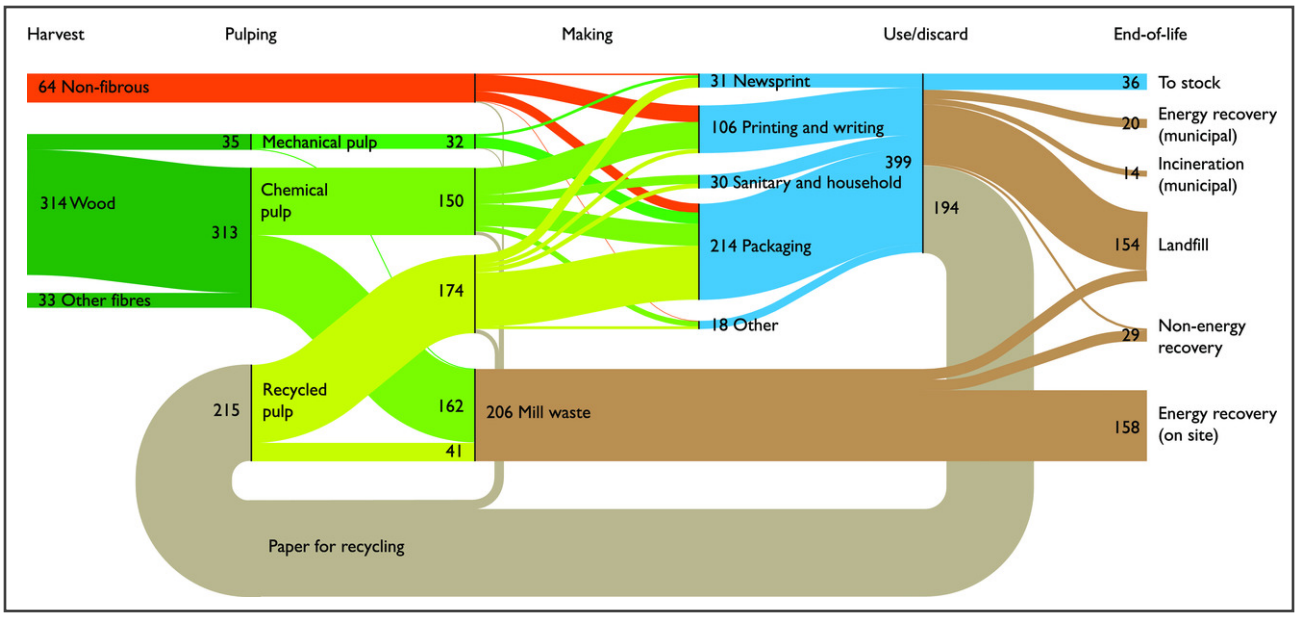

Figure 2.2 *Global paper flows in 2012 in megatonnes*
Source: Van Ewijk et al., 2018

For instance, the diagram in Figure 2.2 shows that a combined 313 megatonnes (i.e., metric megatons, Mt) of virgin fiber flowed into the production of 150 Mt of chemical pulp, resulting in a global average yield of approximately 48%, compared to an average yield of around 81% for pulp from recycled paper. The diagram also depicts the flow of non-fibrous materials (i.e., fillers, additives, coatings, etc.), which account for approximately 15% of total inputs by weight, into paper products. For example, the flow of non-fibrous materials accounted for 30% of inputs in the production of printing and writing paper and about 10% of inputs in packaging production. Although results from this and other studies utilizing material flow analyses are valuable for understanding global flows of fiber, they are of limited value for understanding fiber consumption within a single organization since the input/output yields represent global production averages rather than the specific products that make up an organizations' unique fiber profile.

Material flows analysis (MLA) has also been used in combination with forest product conversion factors to quantify the wood fiber contents of material streams at different steps of the paper industry supply chain. One study calculated conversion factors that could be used to estimate the volume of wood fiber, in terms of roundwood equivalents

(RWEs), consumed in each material stream after accounting for non-fiber components and changes in moisture content across stages of production (Ervasti, 2016).

A RWE is a defined volume of solid wood, usually a cubic meter (m^3), representing the wood fiber of a tree as measured under the bark. RWE is a standard metric used widely in many industry sectors and international reporting organizations (see FAO document). It is a potentially attractive approach to calculating an organizational footprint because it uses a single measure of wood volume as the common denominator across all stages of pulp and paper production. In the previously mentioned study, the author analyzed European data from 2010 to estimate the wood fiber contained in one metric ton of paper was equivalent to 3.1 RWEs (Ervasti, 2016). Similarly, the Global Timber Organization has employed a universal conversion factor of 3.5 RWEs per one metric ton of paper, while the FAO uses 3.6 RWEs (2010).

Conversion factors such as these could potentially be very valuable in calculating a fiber footprint because they provide a direct link between the paper products being consumed and the raw material they are primarily composed of. For example, an organization purchasing 500 metric tons of copy paper per year could apply a simple conversion factor of 3.5 to conclude its fiber consumption is equivalent to 1750 RWEs, from which point additional sources of data could be used to estimate the land required to sustainably produce that volume of fiber.

However, the context described here is not an appropriate application for these general conversion factors. Just as with the global average yields obtained from the material flow analyses discussed above, these and other forest products conversion factors are appropriate only "when looking at a large population in the aggregate" (FAO, 2010, p. 1). The author of the 2016 study cautions that the conversion factors presented "should only be used for total paper and for a large geographical region" (Ervasti, p. 17). In the context of an individual organization, it is highly unlikely the consumption of each different paper product is proportionately similar to the share of total paper production that product accounts for. Since these conversion factors are calculated using global production and trade data, they simply are not representative of paper use in narrower contexts.

Life-cycle Assessment

As previously mentioned, there are also numerous examples of studies that quantitatively link paper products back to forests or raw materials in narrowly defined contexts or at much smaller scale. For example, one LCA study considered here measures impacts of producing one type of paper product, virgin coated freesheet (VCF), at three specific mills (see Schultz, 2015). In this narrow context, measures such as wood input requirements and forest disturbance area per unit of production can be calculated separately for each individual mill, thus allowing for comparisons among multiple producers of a single product. For instance, the wood input requirements per metric ton of VCF paper were around 3.7 cubic meters at a mill in Maine and 4.5 cubic meters at a mill in Wisconsin (Schultz, 2015).

Unfortunately, the data used in this and other LCAs to calculate wood input requirements of pulp and paper production in North American mills are not widely accessible. Few, if any, companies share these statistics publicly. Rather, the dominant source of this information is the Mill Asset Database from RISI Inc., a forest products industry data and analysis provider. The database includes many mill specific measures, including annual wood inputs and total production capacities which can then be used to estimate wood inputs per unit of production (see Schultz & Suresh, 2018). The costs for obtaining these type of data are prohibitive for most organizations; the minimum cost for access to the Mill Asset Database is $5000[2]. Likewise, most organizations lack the expertise needed to conduct an LCA of the products in their own fiber profiles.

Organizations seeking to understand the environmental impact of their fiber consumption then are generally limited to either using broad-based averages that are not representative of their unique fiber profiles or complex and potentially expensive methods that exceed the needs of the institution. One attempt at bridging the gap between broad-based averages and hyper-specific LCAs is the Paper Calculator 4.0 offered by the Environmental Paper Network (EPN, 2018). This online tool calculates and compares

[2] Based on RISI quote received via email; "Typically the minimum cost for access is $5k." (September 25, 2019)

environmental impacts of various paper products to highlight the benefits of using recycled fiber. Impact is measured with 24 different indicators, including wood use and forest disturbance area, using aggregated data from multiple life-cycle inventory databases.

For organizations in North America, it can be expected that the Paper Calculator 4.0 can estimate fiber consumption more accurately than simply applying one of the universal conversion factors described above. Unlike those conversion factors, which represent average wood use among all paper products, the Paper Calculator 4.0 provides impact estimates for 14 different paper grades (e.g., uncoated freesheet, corrugated container, tissue, etc.). This allows organizations to obtain estimates of fiber use that are more representative of the particular mix of products they consume.

However, the impact measures used by the calculator are again largely based on aggregate industry data, in this case primarily from North American mills. As previously mentioned, the particular operational processes of individual mills and the composition of their products can vary widely, making measures based on aggregate data unreliable. This is especially important when considering impacts related to wood use and area of forest disturbance, since such measures are highly dependent on localized factors unique to individual mills. In reviewing the Paper Calculator 4.0, the National Council for Air and Stream Improvement (NCASI) noted that "broad averaging can automatically put impacts of manufacturing out of context, especially spatially-specific ones" (2019, p. 2). So while the Paper Calculator 4.0 offers organizations a method for estimating fiber consumption that is preferable to the use of conversion factors that are based on global pulp and paper production, it is nonetheless limited in its ability to estimate fiber consumption associated with a specific mix of products.

The Need for a Standardized Forest Footprint Metric

At present, there are no widely used methods for organizations to analyze the fiber consumption associated with their own unique mix of paper products. While product-specific LCAs can provide the most accurate and comprehensive accounting of environmental impacts, they are prohibitively costly and exceed the needs of most organizations. Conversely, using global conversion factors to estimate institutional-level

fiber consumption would be a simple but likely highly inaccurate method. The opposite ends of the spectrum on which these methods fall could be represented by the approaches taken by Apple and British Airways, respectively. Thus, there is a need to develop a valid method for calculating the forest footprint of organizations that is both broadly applicable and based on contextually-specific characteristics of purchased paper products. Without a valid and widely accepted method for quantifying impact, organizations will continue to rely on inadequate measures of consumption or possibly follow the lead BA and Apple by developing their own methods, likely with similarly mixed results.

A Forest Footprint Measured in RWE

One promising approach is to use roundwood equivalent (RWE) volume as the basis of a forest footprint metric. As previously noted, a RWE is equal to a cubic meter (m^3) of solid wood, or wood as measured under bark. Roundwood equivalent volume is an appropriate metric on which to base organizational forest footprints for multiple reasons. First, RWE is already a very widely-used international standard metric for measuring the volume of wood fiber required to produce a standard unit of a wood product. For instance, according to average conversion factors reported by the FAO, a cubic meter of bulk fuel pellets requires 1.52 RWE, a cubic meter of non-conifer veneer requires 2.29 RWE, and a cubic meter of green rough sawnwood requires 1.73 RWE whereas the same amount of dried and planed sawnwood requires 2.56 RWE. For paper products, the output of the RWE conversion factor is usually a measure of weight rather than volume. Nationally reported examples from the FAO include 2.50 RWE per metric ton of newsprint in Canada, 3.50 RWE per metric ton of coated paper in the Netherlands, and 4.90 RWE per metric ton of household tissue products in Finland (FAO, 2009).

Another reason RWE is an appropriate metric on which to base organizational forest footprints is because it is a ratio of raw materials to finished products. As such, it is effectively a measure of resource use efficiency. The forest footprint of an organization, as measured by RWE, could vary based on types of paper products within its fiber profile, the proportion of total fiber consumption each product accounts for, and the fiber characteristics associated with each product. The process of analyzing fiber consumption to calculate a RWE-based footprint would help organizations to better understand the resource intensiveness of different paper products and identify areas of consumption that

may have disproportionate impact on their footprints. Due to differences in the types, relative quantities, and fiber characteristics of the paper products being consumed, the RWE-based footprint of every organization should vary. Among organizations having similar fiber needs, significant differences in RWE calculations could point to differences in organizational purchasing policies and priorities. For instance, an airline that requires a minimum of 50% recycled content in paper products may have a RWE-based footprint that is much lower than that of another airline that merely encourages the purchase of products containing recycled fiber.

Finally, using RWE as the basis for a forest footprint metric is advantageous because it is not tied to any single supply chain or fiber source. Although it might seem more sensible to measure the impact of an organization's fiber consumption in terms of acres of forest or number of trees, since these are units most stakeholders have experience with or can easily visualize, contextual factors make measuring fiber consumption in these terms inappropriate for most organizations. This is due to the fact that most organizations purchase a wide variety of paper products from multiple suppliers having many fiber sources (ex., British Airways). Calculating a footprint for paper consumption in terms of forested land area would necessitate a great deal of knowledge about the fiber sources, such as the particular regions where the roundwood used to produce the pulp was harvested, the forest types and species mix of those regions, rates of forest growth and production, and the types of fiber used in the product. Few organizations have access to the kinds of information that would be needed to confidently estimate the forested land area required to supply an amount of fiber roughly equal to their consumption.

It must also be recognized that most industrial forests are managed with the goal of generating revenue through multiple fiber output streams. This means the roundwood harvested from a single forest, even a single tree, may be used for pulp, sawnwood, engineered panels, and fuelwood depending on harvest cycles, thinning operations, market demands, and natural disturbances. So, for example, the fiber an organization consumes through its use of office paper may be roughly equal to the total amount of fiber produced annually from a 1000 acre tract of natural mixed species forest in Wisconsin. However, if only 40% of the total fiber produced annually from that forest is used for pulp production, organizational claims suggesting a fiber footprint equal to 1000

acres would not represent reality. Rather, in this example 2500 acres might be more accurate. This simple example is intended to illustrate the difficulty of fairly expressing paper consumption in terms of forested land area. Organizations attempting to do this without having extensive knowledge about their fiber sources, or without providing the contextual information necessary for evaluating the claims, run the risk of misleading stakeholders and themselves by applying an incorrect metric.

Application

Calculating an RWE-based footprint would nonetheless require significant effort. For an organization to do this, a first step would likely be to analyze its purchasing history to identify primary paper products and major vendors. Basic product information, such as the unit weight, virgin/recycled content, and COC/certification identifiers, could be easily obtained from invoices, product packaging, product specification sheets, and online resources. These initial steps would look quite similar to the method employed by British Airways to gather information. To further refine the footprint metric, however, more detailed information about manufacturing processes, product composition, and fiber sources would be needed.

Possibly the most feasible option for obtaining this information would be to request it directly from the manufacturer. A request for information (RFI) could be issued directly to manufacturers or indirectly by way of their vendors to obtain basic information about products and processes that is otherwise not publicly available. A request for information is a document that organizations commonly issue to potential suppliers in an effort to obtain information about suppliers' ability to meet the organization's procurement needs. Although RFI's are most often issued before purchasing decisions are made, they can also be used by used by organizations seeking greater transparency from current suppliers.

Key information that would need to be obtained from manufacturers includes the mass per unit area (i.e., grammage) of the product. Grammage of paper products is a standard measure that could serve as the basis from which all conversions could then be made. Knowing the grammage of the product would be necessary to calculate the total weight of the product consumed annually by the organization, and subsequently the total weight of the various fiber components. To do this, the organization would also need to

know approximately what proportions of the product's weight are accounted for by fiber and non-fiber (ex., binders, pigments, fillers, etc.) components. Finally, basic information about the tree species from which the fiber is sourced and the pulping methods used to process it would allow organizations to apply average process yields from the literature, such as those published in "Handbook of Pulping and Papermaking" (Biermann, 1996) and "Forest Products Measurements and Conversion Factors" (Briggs, 1994). These same publications include the various conversion factors necessary for translating the total weight of fiber in the purchased product to RWE, ultimately allowing the organization to generate a context-specific estimate of fiber consumption.

One obvious challenge with this proposed method is that manufacturers would not be required to provide the requested information. Completing RFI's can be a time consuming process, so it is likely that manufacturers would feel less compelled to complete RFI's for buyers whose accounts are not deemed to be strategically important or valuable. As such, application of an RWE-based footprint metric as described here might remain limited to larger organizations with significant purchasing power.

Growing demand from organizational buyers and other stakeholders for these kinds of information, however, could encourage manufacturers to voluntarily disclose it upfront. The Paper Profile, for example, is an environmental product declaration program utilized by many major paper producers in Europe, including Stora Enso, Mondi, and International Paper (Paper Profile, 2021). This voluntary program provides participating member organizations a standard method for presenting relevant information about environmental aspects of individual products in a uniform way. This allows potential customers, particularly organizational buyers with green purchasing requirements, to easily obtain pertinent information needed for purchasing decisions without having to submit extensive questionnaires in the form of RFI's.

In fact, the Paper Profile product declaration already includes information about product composition that would be key to calculating an RWE-based footprint. Outside of Paper Profile product declarations, this information, including proportional weights of fillers, binders, moisture, and pulp types, is generally not easily obtainable for most paper products. Figure 3.3 below shows how product composition information is presented in the Paper Profile with excerpts from the product declarations of four different Stora Enso

paper products: A) “Multicopy” office paper, B) “NewsPress” standard newsprint paper, C) “StellaPress” coated mechanical magazine paper, and D) “LumiSilk” woodfree coated magazine paper. The variation seen in the these product composition declarations illustrates the necessity of product-level analyses as part of any footprint calculation, especially for organizations that consume a diversity of paper products (ex., British Airways).

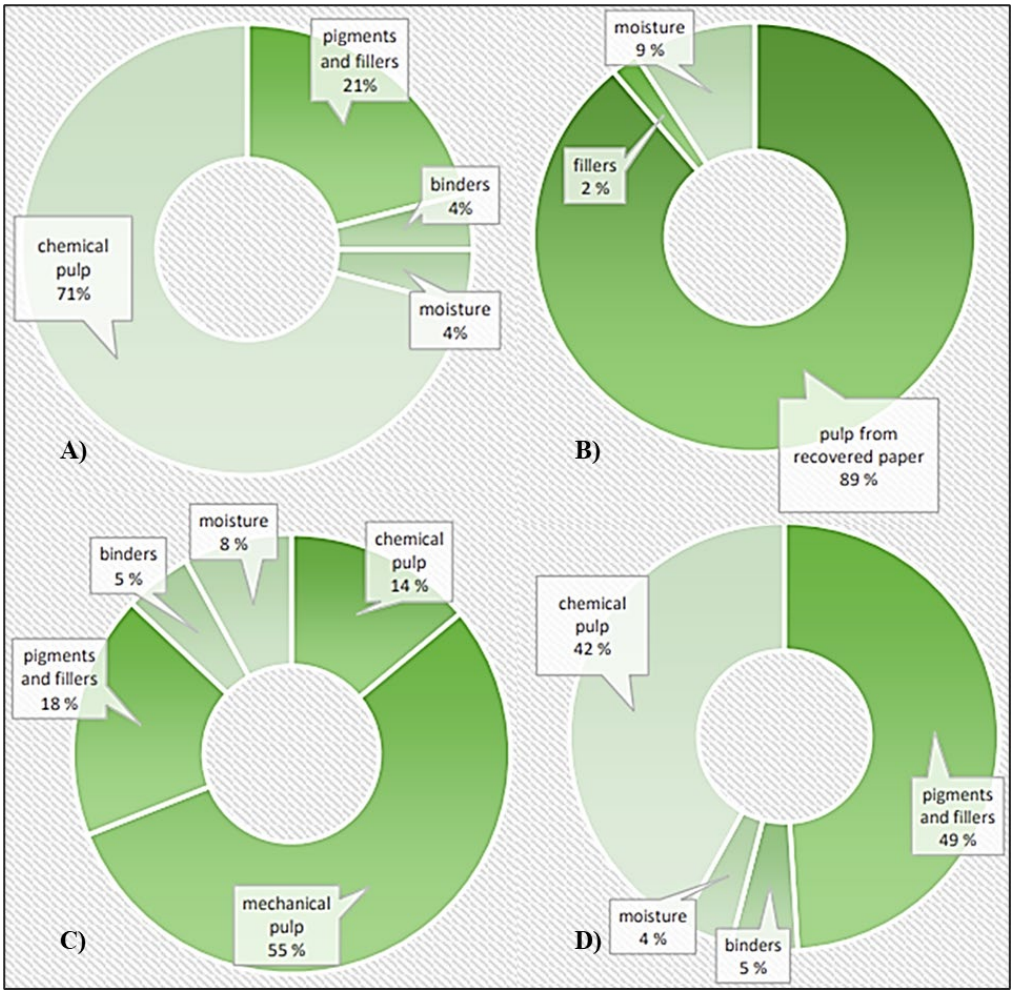

Figure 2.3 Paper Profile product composition declarations from Stora Enso
Source: Stora Enso, 2021

Discussion

It is clear there is a need for metrics that more substantively assess the sustainability of organizational fiber consumption. An RWE-based footprint, combined with traditional measures of consumption, would be a useful method of organizations to assess their

overall consumption of raw materials relative to the products they use. There are, however, obvious limitations to the information that such a metric would provide. For instance, an RWE-based footprint would not reflect the sustainability of forest management practices or harvesting operations associated with fiber production. Nor would it measure any of the other environmental impacts from paper production, such as effluent discharge or greenhouse gas emissions. Even in terms of wood use, and RWE-based footprint would not account for differences in the ecological or cultural value of different types of wood materials, such as old-growth trees from primary forests versus timber crops of managed tree plantations, or locally sourced domestic species versus exotic species imported from other regions of the world.

Ultimately, the value an organization creates from calculating its forest footprint will be derived from the information it gathers in the process. The footprint is one part, albeit an important one, of a comprehensive understanding of organizational fiber consumption. It should not be intended to replace the sustainability practices that organizations commonly use today to manage paper use, but rather to compliment existing measures by providing new insight. By identifying key areas of consumption and subsequently investigating each to determine material composition, processing methods, and fiber sources, organizations can develop a more thorough understanding of their own operations and the impact they have on forests.

The information gathered in this exercise could drive improvements in sustainability performance. An organization could, for example, discover that a key supplier sources fiber from a region in which deforestation is common or perhaps landownership is disputed by indigenous groups. It could also be discovered that one product requires significantly less wood fiber to produce than an equivalent alternative product. By developing more nuanced understandings of their fiber supply chains, organizations can make better-informed purchasing decisions.

Summary

Sustainability reporting has become a nearly ubiquitous business practice among organizations of all types. Very often, these reporting efforts will include any of a broad assortment of measures intended to address issues related to the use of paper products.

The most commonly employed metrics, however, represent measures of product consumption rather than the environmental impacts associated with it. This descriptive study sought to explain the growing interest of organizations in understanding and quantifying environmental impacts associated with consumption of forest products. Companies that are committed to reducing impacts on forests that result from their use of paper products cannot continually improve their sustainably performance simply by reducing consumption or purchasing only certified materials. Once these "low-hanging fruit" solutions have been exhausted, making substantive changes that improve sustainability performance requires a more comprehensive understanding of organizational fiber consumption.

The two corporate footprinting initiatives highlighted here demonstrate the need for a standardized method of calculating an organization's forest footprint. Although LCA methods such as those used by Apple might offer the most informative approach, they are not a practical solution for organizations with many paper products to evaluate and limited resources available for doing so. On the other hand, utilizing broad measures that represent national or global averages to calculate impact in the unique context of a specific organization, such as was done by British Airways, is a method that is widely accessible but also highly unreliable.

A forest footprint measured in units of roundwood equivalencies (RWE) is a potential solution worthy of further investigation. The RWE unit is already a standard measure widely used for calculating the flow of wood materials through various conversion processes. Using RWE-based wood conversion factors could offer a compromise of sorts between the global averages of BA's approach and the product-level LCA approach of Apple. Organizations could estimate their use of raw materials (i.e, wood) by applying conversion factors and process yield data from the literature that more closely represent their particular context. In order to do this, however, organizations would need to obtain pertinent information about the raw materials and processing methods of each paper product.

Since most producers do not make these types of information publicly available, organizational buyers would likely need to obtain it through submitting requests for information (RFI). Alternatively, producers could also make this information more easily

accessible through environmental product declarations such as the Paper Profile program. Such declarations could even include a product-level RWE metric, calculated by the manufacturer and representing the wood input requirements for producing that particular product. This could provide potential buyers with useful information on which to compare products as well as simplify the process for organizations to calculate overall RWE-based footprints.

Conclusions

The methods currently used by organizations for assessing and reporting sustainability performance related to the consumption of paper products have proven inadequate. The information that most organizations currently rely on to manage sustainability of paper consumption is restricted to the presence of third-party certification labels (i.e., FSC, SFI, PEFC, etc.), proportion of recycled content, and overall measures of paper use. This information is of limited use for determining impact of paper consumption. The disconnect between measuring consumption and its associated impact is leading more companies to investigate their own paper supply chains. The dramatically different methods developed by Apple and British Airways for quantifying their forest footprints underscore the need for developing a formal, standardized methodology for measuring impact of fiber consumption.

Due to the complexity of fiber supply chains and the many factors that need consideration, from forest biology and harvesting operations through pulp production and product manufacturing, it is recommended that any further efforts to develop sustainability metrics related to the consumption of forest products, including paper, should involve engagement with the forest products industry. Widespread adoption of any new sustainability metric would be difficult without industry buy-in. More importantly though, industry input would help ensure the validity and feasibility of any proposed methodology for quantifying impact. Industry involvement could also encourage support for development of a uniform environmental product declaration program similar to the Paper Profile but designed to compliment any new sustainability metrics.

PART TWO

An Investigation of Factors Influencing Paper Purchasing Decisions in Organizational Contexts

CHAPTER 3

Literature Review

Introduction

The second major component of the research is a study investigating the roles of contextual factors and personal characteristics in the purchasing decisions of Penn State University employees. This second component is rooted in the social sciences, specifically in the fields of consumer behavior, industrial-organizational psychology, and organizational behavior. Specifically, the research investigates the extent to which green purchasing decisions of administrative staff are influenced by individual factors such as attitudes and beliefs, and organizational factors such task autonomy and organizational support for the environment. The theoretical framework for the study is based in the theory of planned behavior (TPB). An overview of research related to organizational purchasing and, importantly, the gaps that currently exist in the literature, is provided below. Following this, the theory of planner behavior is introduced, along with a discussion of research applications in sustainability.

Research on Organizational Purchasing & Sustainability

This study seeks to understand how attitudes related to personal consumption influence occupational purchasing decisions and employee outcomes. From a theoretical perspective, the methodologies of the study, such as the identified research population and application of secondary data sources, present unique opportunities to make theoretical contributions in multiple fields. For instance, studies on procurement in organizations and supply chain management tend to focus on procurement professionals at the manager and executive levels (e.g., Anthony Swaim et al., 2016; Philippart, 2016; Goebel et al., 2018; Sánchez-Rodríguez & Martínez-Lorente, 2004; Walker et al., 2008),

since these individuals are more likely to be involved in developing purchasing strategies, setting purchasing goals, and managing supplier relationships.

Not surprisingly then, the majority of research in SCM/SSCM, as well as CSR, is conducted at either the institutional or organizational levels of analysis. The former is generally focused on factors that are external to the organization (i.e., government regulation, stakeholder pressure, industry dynamics), and the latter generally focused on factors internal to the firm. Although organizational level, also referred to as macro level, research often considers the perceptions, attitudes, and behaviors of organizational members, its emphasis is on those members in top leadership positions since their actions and decisions are directly related to the overall strategy and operations of the organization, and as such thought to be reflective of the firm as a whole. According to one literature review, the most commonly cited theories in SSCM research are macro level theories borrowed from the economics, organizational management, and political science fields, including resource-based theory (RBV), stakeholder theory, institutional theory, and transaction cost theory (TCT) (Touboulic & Walker, 2015).

Thus, one contribution to both the SSCM and CSR literatures of this research is the individual level of analysis used. Unlike macro level research, which is generally concerned with organizational outcomes, micro level research considers how factors like perceptions, attitudes, and behaviors impact individual and group-level outcomes, such as employee satisfaction and team performance. These studies typically fall into the realms of organizational behavior or I/O psychology and often draw heavily on theories, frameworks, and concepts most closely associated with psychology. The lack of micro level research has been pointed to as a weakness of the SSCM field. Investigations of the human aspects of SSCM, such as the role of decision-making processes, interactions, perceptions, and behaviors in the implementation of SSCM programs have been identified as a promising area of contribution to the SSCM field (Touboulic & Walker, 2015).

In a decentralized purchasing context such as that of Penn State, it makes sense that individual employees with administrative purchasing responsibilities be included in the scope of SSCM. Otherwise efforts made by organizational leaders to implement SSCM practices could fall short, since actual purchasing decisions are still being made by many

employees operating beyond the prescribed parameters of those practices. For instance, procurement managers in an HEI may require apparel suppliers to complete an extensive vetting process to determine whether the upstream supply chain meets ethical standards. However, a staff level employee conducting an apparel sale for members of a department within that HEI could select the least expensive supplier without ethical considerations of the supply chain. In this case, the integrity of the SSCM practice could fairly be called into question.

This is not unlike the role of individual employees in organizational CSR practices. In one review of CSR literature, the authors called for CSR researchers to place greater emphasis on micro level investigations, noting that "although CSR takes place at the organizational level of analysis, individual actors are those who actually strategize, make decisions, and execute CSR initiatives" (Aguinis & Glavas, 2012, p. 953). Likewise, in another review of how organizational behavior is being applied to the study of CSR, the authors noted that "although it is on behalf of corporations that acts of CSR are planned and completed, it is truly individuals who advocate for, comply with, and participate in CSR" (Rupp & Mallory, 2015, p. 212).

Another opportunity for contribution from this research comes from the type of goods being purchased that is the focus of the study. Over the past two decades, SSCM and green procurement research has largely focused on areas of procurement that are vital and strategically important to companies, particularly those in manufacturing and production contexts (Haake & Seuring, 2009; Boström et al., 2015; Mosgaard, 2015). From the perspective of Kraljic's (1983) stages of purchasing sophistication model, the SSCM and green procurement literatures have primarily focused on quadrants II-IV; those areas of purchasing that are of high strategic importance and/or have highly complex supply markets (see Figure 3.1 below). This is understandable, since these are the areas that have the greatest impact on profits, often account for the majority of total costs, and present the greatest risk if supplies are interrupted (Kraljic, 1983). In some cases, managing these supplier relationships can also be a key source of competitive advantage.

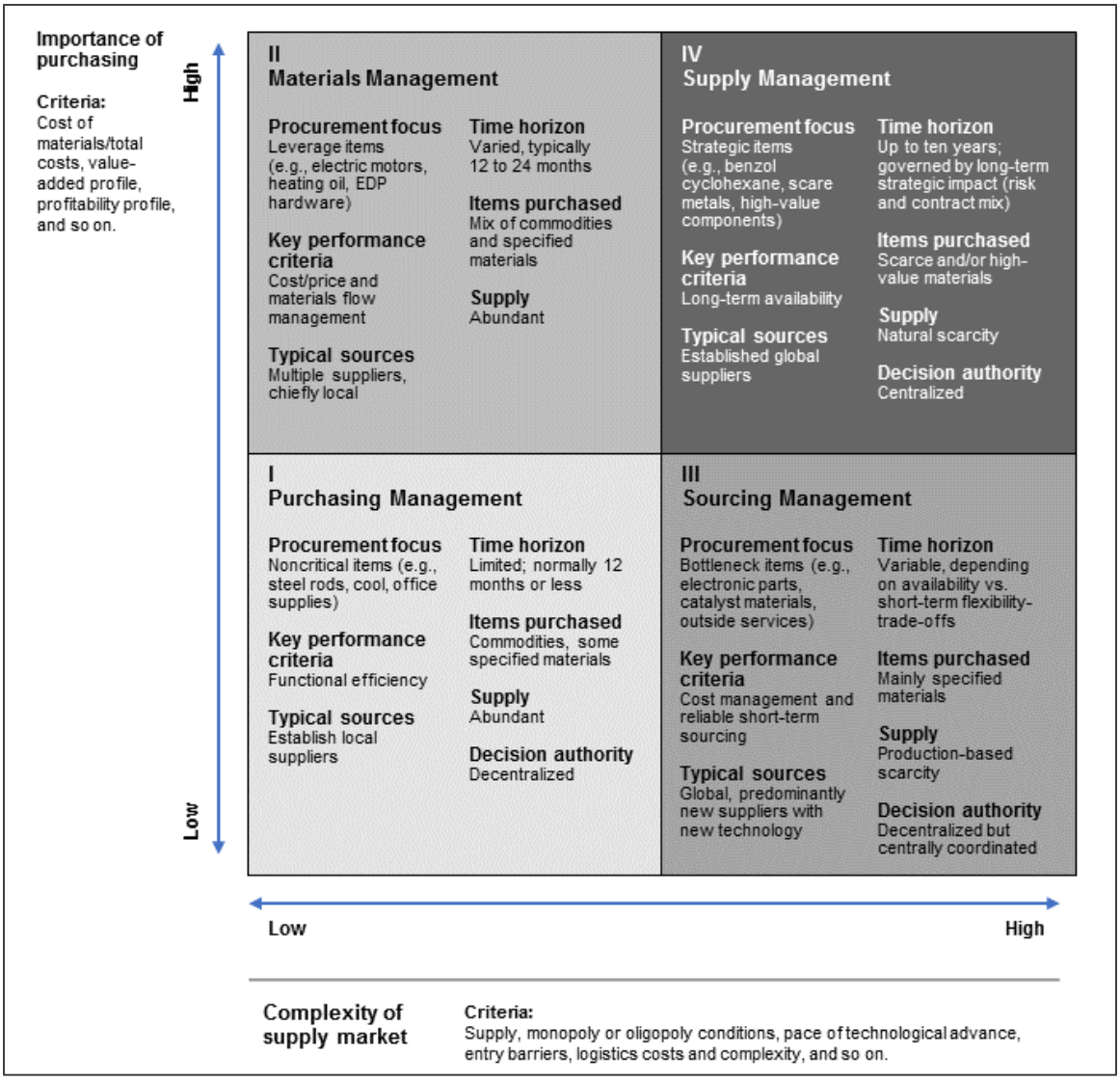

Figure 3.1 Stages of Purchasing Sophistication
Source: Kraljic, 1983

The current study, however, is concerned with office supplies, which are classified as noncritical items in quadrant I of Kraljic's (1983) model. Referred to here as minor procurement, this generally includes all those areas of procurement that present little risk to an organization. That is, goods and services that are not part of core operations, are readily and widely available from multiple sources, have little impact on profits, are not strongly associated with the organization's brand or image, etc. These are the areas of procurement that typically warrant minimal attention. Another term closely associated with minor procurement is non-product related procurement. According to Mosgaard and colleagues (2013), non-product related procurement "is, for instance, stationaries, paper,

buildings, and light bulbs - all products that are not directly transformed into the product produced and sold by the company" (p. 137). Examples of minor and/or non-product related procurement items often include office supplies, commercial cleaning products, landscaping services, cafeteria food, and travel arrangements.

Although minor procurement is rarely prioritized in the SSCM practices of most organizations and has received only limited attention in the SSCM literature, it can nonetheless pose a significant risk to environmental sustainability. Consider, for instance, the role of minor procurement in service industries. According to one commonly cited study involving the procurement practices of 216 firms, the Danish Environmental Protection Agency found that minor items accounted for approximately 50% of total procurement by value among service providing companies, compared to about 10% among production companies (Danish EPA, 2010). It is worth noting here that HEI's are generally considered to be service providers. According to the North American Industry Classification System, colleges, universities, and professional schools belong to the educational services sector (NAICS 6113), which is classified as a service-providing industry along with sectors such as arts and entertainment, retail trade, finance and insurance, health care, and food services. As growth in service sectors outpaces that in manufacturing, especially in developed economies, the share of total procurement accounted for by minor items can be substantial. Furthermore, minor procurement items can themselves represent huge industries with major impacts on the environment. For example, the office stationery wholesaling sector in the United States (NAICS 424120), which includes companies such as Staples Inc. and Veritiv Corporation, sold approximately $34 billion worth of paper products in 2019 (Patel, 2019). When taken together, the value of these products and the potential environmental impact of their production should merit greater consideration from procurement professionals.

Finally, this research also makes contributions to the literature through its application of constructs from both the consumer and organizational behavior fields. The opportunity to draw on concepts from both fields arises with the focus on minor procurement decisions of administrative support staff. For minor procurement in decentralized purchasing contexts, employees typically have greater discretion for making purchasing decisions than in contexts involving major procurement. This is due to many reasons.

First, minor items typically do not need to meet complex specifications to ensure quality or compatibility with current processes. Likewise, non-product related items have little or no exposure to customers, and so present relatively low risk to a company's image or brand. For reasons such as these, minor procurement decisions rarely need approval from others in the organization (Mosgaard et al., 2013). Additionally, since minor procurement has little impact on firm profits and is not of strategic importance, efforts spent on managing it are minimized, including the development and communication of formal policies that guide it (Haake & Seuring, 2009). Finally, for most administrative support staff, purchasing office supplies is just one of many tasks they are responsible for and likely spend only a small portion of their time doing it (Mosgaard et al., 2013). The absence of strong internal and external drivers to purchase certain products creates flexibility for employees to make purchasing decisions based on their own attitudes and beliefs, thus to some extent allowing them to behave more like end-consumers than organizational buyers.

Theory of Planned Behavior

Understanding and, ultimately, being able to predict human behavior has long been the focus of much research in the social sciences. While the theoretical origins of such research can usually be found in psychology, applications of the various theories are widespread among social science fields. Research in the public health field, for instance, has commonly utilized behavioral science to study the determinants of unhealthy behaviors of people or measure the efficacy of interventions in improving health outcomes. Political science, too, has drawn on this research; for example, to better understand civic engagement among various groups or the likelihood of participation in public programs and services. More recently, theories of human behavior and decision processes have been used broadly in sustainability research.

Behavioral dispositions, such as general attitudes and personality traits, received much attention as possible measures for predicting specific behaviors but evidence supporting the purported relationships was inconsistent. The lack of support for causal relationships between attitudes and associated behaviors led some researchers to doubt the relevance of attitudes in behavioral decision-making processes (Ajzen, 1991;

Montaño & Kasprzyk, 2015; see Abelson, 1972; Wicker, 1969). The theory of reasoned action (TRA) (Fishbein, 1967) and, by extension, the theory of planned behavior (TPB) (Ajzen, 1985), were developed to better explain the role of attitudes in the formation of intentions and, ultimately, in determining actual behaviors.

With regard to attitudes, Fishbein first concluded that general attitudes toward a topic and attitudes toward specific behaviors associated with the topic are not equivalent predictors of behavior. For example, attitudes about environmental sustainability would likely be a far weaker predictor of recycling behaviors than would attitudes toward recycling. Although it may seem intuitive, the realization that the predictive power of attitudes on behaviors depends in part on how closely their measures correspond with one another was unexpected. This was because values and knowledge, which are the foundations of beliefs on which attitudes can be formed, are thought to be stable across contexts (Fishbein & Ajzen, 2011). As such, it was expected that general attitudes would influence behaviors in consistent ways across different contexts. In developing the TRA, Fishbein emphasized the need to understand the impact of contextual factors on behavioral decisions.

The TRA and TPB models are presented below in Figure 3.2. A simplistic explanation of TPB is that, according to the model, behavior is a function of salient beliefs applicable to the behavior (Ajzen, 1991).

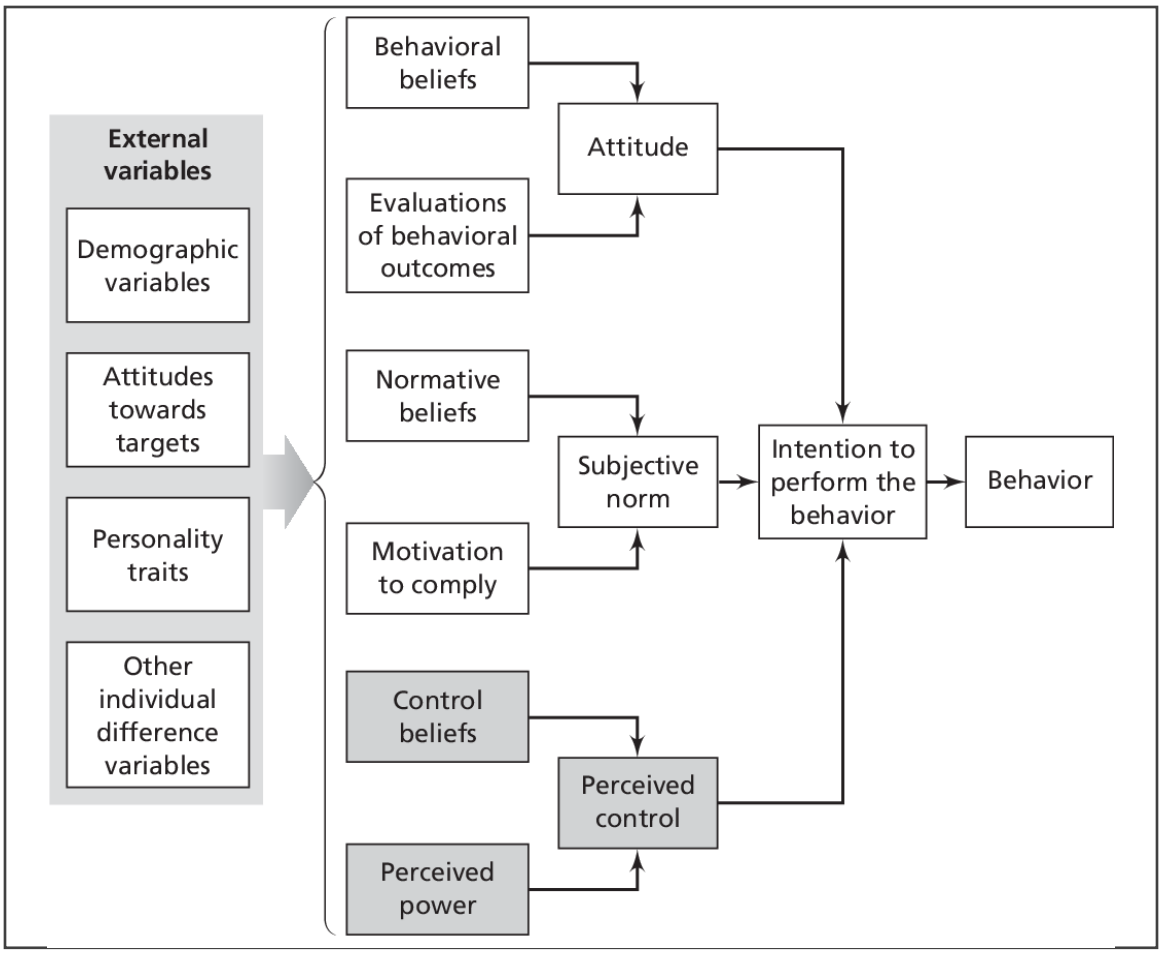

Figure 3.2. Theory of Reasoned Action and Theory of Planned Behavior
Note: Unshaded boxes in upper part show the Theory of Reasoned Action; entire figure shows Theory of Planned Behavior
Source: Montaño & Kasprzyk, 2015, p. 98

As was noted earlier, TPB is an extension of TRA, with the fundamental difference being the addition of perceived control (discussed below). Central to both theories is the direct relationship between behavioral intention and behavior. According to Ajzen (1991), "intentions are assumed to capture the motivational factors that influence a behavior; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior" (p. 181). The general expectation, then, is that the likelihood of performing a behavior increases as the strength of the behavioral intention increases. The three conceptually independent determinants of intention that make up the core of the TPB are discussed in greater depth below.

Attitude

Key to both TRA and TPB is that attitudes toward behaviors are not the same as attitudes about the broader subject, or "object," affiliated with the behavior. Although attitude toward a behavior is expected to be reflective of that toward the broader object, the behavioral attitude is driven by more salient beliefs relevant to the specific behavior in question. Behavioral beliefs describe the expected outcomes or attributes of performing a behavior. For instance, a consumer might believe the following about purchasing organic produce: a) it's probably better for the environment; and b) it certainly costs more money.

The second factor influencing the formation of attitudes regarding a behavior is evaluation of those expected behavioral outcomes. That is, how positive or negative are the expected outcomes perceived to be? Continuing with the organic produce example, that same consumer might perceive the potential environmental impact of purchasing organic produce to be somewhat positive and perceive the financial impact of doing so as very negative. In this case, the attitude toward purchasing organic produce is not strongly positive since the costs are perceived as both highly likely and very negative, whereas the benefits are perceived as only somewhat likely and moderately good. Although the consumer in this example might express a very "green" or pro-environmental attitude generally and may have strongly positive attitudes about other green behaviors such as conserving energy or recycling, their beliefs and outcome evaluations regarding the particular behavior of purchasing organic produce suggest they are unlikely to form an intention to engage in that behavior.

Subjective Norm

The social environment in which people live can strongly influence their behavioral intentions. The influence of the social environment on behavior is reflected in the idea of social norm, which generally refers to behavior that is approved of or deemed acceptable among members of a social context, such as a team, community, or broader society (Fishbein & Ajzen, 2011). Although social norms are shared and established collectively among many members of a group, the perceived pressure to comply with those norms is often associated with just one or a few people representative of that group. That is, people

tend to focus more on gaining the perceived approval of select individuals rather than the perceived approval of group members more generally.

A commonly applied framework for understanding social pressure is that developed by French and Raven (1959), which identified five bases of power that can be sources of influence over the behavior of others. As would be expected, the perceived ability to punish (i.e., coercive power) or reward (i.e., reward power) others for behaving in a certain way are two sources of social power. Perhaps more common though, and certainly of more interest to the current study, are behavioral decisions made without anticipation of either rewards or punishment. One basis of such social power is referred to as legitimate power, which results from the belief that a person has some right to prescribe behavior by way of their role in an organization or society. Similarly, expert power is social influence derived from a person's knowledge or skills. Finally, referent power describes the influence someone can have over people who strongly identify with them.

Subjective norm, the second determinant of intention in the TPB, considers the role of social pressure in the formation of intentions. Subjective norm is defined as an individual's perception that most people who are important to them think they should or should not perform a particular behavior (Fishbein & Ajzen, 2011). The strength of subjective norm in influencing behavioral intention results from both the perceived approval or disapproval of important referent individuals as well as personal motivation to comply with those referents (Montaño & Kasprzyk, 2015).

As with the other determining factors of the TPB model, subjective norm is behavior specific since the influence of a normative referent on behavioral intention may differ by situation. For instance, an individual would likely be more motivated to comply with the behavioral expectations of their doctor when considering whether or not to join a gym than they would be when considering what brand of car to purchase. Simply put, the influence of a doctor as a normative referent is strongest for health-related behaviors. For non-health related behaviors, such as purchasing a car, that same individual may weigh more heavily the behavioral expectations of other referents like friends or family members.

Perceived Control

The final determinant of the TPB model, and that which distinguishes TPB from TRA, is perceived control. By adding perceived control as a determinant of intention, Ajzen (1991) extended TRA to address that model's "limitations in dealing with behaviors over which people have incomplete volitional control" (p. 181). Beyond having a favorable attitude toward a behavior and a subjective norm that is supportive of it, individuals must also believe they possess the requisite resources and opportunities for performing the behavior. Perceived control is defined as "the extent to which people believe that they are capable of, or have control over, performing a given behavior" (Fishbein & Ajzen, 2015, p. 155).

This concept of behavioral control is similar to, but different from, the concept of perceived locus of control (i.e., Rotter, 1966). Locus of control refers to a person's belief that, in general, their outcomes are either determined by their own behaviors (i.e., internal locus of control) or by circumstances outside of their control (i.e., external locus of control). Although both concepts reflect an individual's perception of control over outcomes, behavioral control is much more context-specific and reflects perceptions related to a particular behavior. This is in contrast to locus of control, which is a more generalized expectancy of control that is relatively stable across contexts (Ajzen, 1991).

There are many additional constructs and definitions in the literature that relate to the idea of control, including achievement motivation, agency, self-determination, and autonomy to name just a few. Among these, Bandura's (1977) concept of self-efficacy is most closely related to perceived control. Like perceived control, self-efficacy is context-specific and refers to "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). Though Ajzen has long acknowledged the similarities between the constructs, his position now seems to be that self-efficacy and perceived control are effectively measures of the same theoretical construct (see Fishbein & Ajzen, 2010; 2015).

An individual's control beliefs regarding a particular behavior may be informed by many things, including their own past experiences with the behavior, the known or perceived experiences of others, personal judgements of ability related to skills or knowledge, availability of requisite resources and opportunities, anticipated obstacles or

impediments, and second-hand information about the behavior (Ajzen, 1991; Fishbein & Ajzen, 2015). It is not difficult to appreciate the influence that perceived control can have over behavioral decision-making processes. Although theoretically distinct, the popular understanding of self-confidence is very applicable to perceived control. It makes sense that people who believe they possess more resources, opportunities, abilities, skills, etc. to perform a behavior would anticipate fewer obstacles and less difficulty in doing it. Simply put, they would be more self-confident. Self-confidence, or a lack thereof, can strongly influence the activities we choose to participate in, how we prepare for them, the resources we are willing to commit them, and the effort we are willing to expend in performing them (Ajzen, 1991; Bandura, 1997).

Theory of Planned Behavior in Sustainability Research

The theory of planned behavior has become one of the most prominent frameworks for explaining sustainability related behaviors of individuals (Norton et al., 2015). For example, TBP has been used to explain decisions to engage in sustainable agricultural practices, environmental activism, household waste reduction, recycling, energy conservation, carpooling, and use of public transportation (Fielding, Terry, Masser, & Hogg, 2008; Fielding, McDonald, & Louis, 2008; Graham-Rowe, Jessop, & Sparks, 2015; Tonglet, Phillips, & Read, 2004; Abrahamse & Steg, 2009; Bachmann, Hanimann, Artho, & Jonas, 2018; Heath & Gifford, 2002).

As was alluded to earlier, TPB is very commonly used to explain decision making processes of consumers as well, especially in contexts involving green purchasing decisions. Some examples of green purchasing behaviors the TPB framework has been applied include decisions related to consumer electronics, organic personal care products, eco-friendly restaurants, product packaging, organic food, local food, and green hotels (Young et al., 2010; Yeon Kim & Chung, 2011; Kim, Njite, & Hancer, 2013; Martinho et al., 2015; Yazdanpanah & Forouzani, 2015; Kumar & Smith, 2018; Han, Hsu, & Sheu, 2010).

Of particular interest to researchers investigating these types of purchasing decisions is what is known as the "attitude-behavior gap," which describes the difference between a person's general attitude about an issue and their actual behavioral decisions related to

that issue. For example, a large proportion of consumers may report being concerned about climate change yet only a small minority of those same consumers choose to purchase electricity exclusively from renewable sources. The attitude-behavior gap here is represented by those consumers who express concern for the climate but fail to translate those concerns into purchasing behaviors that are aligned with their attitude. Often, a goal of such research then is to identify factors driving the behavioral decisions that appear to conflict with an associated attitude. Factors that constrain green purchasing decisions may include a lack of knowledge about the product, limited availability, and sacrifices in terms of performance, costs, or convenience (Moser, 2015).

Interestingly, as widely applied as TPB has been to green purchasing for personal consumption, there appear to be far fewer examples of its application to purchasing in organizational contexts. One identified study utilized survey data from 257 supply managers representing a variety of industries (Swaim et al., 2016). Using a TPB framework, Swaim and colleagues found pro-environmental attitudes of supply managers to be the strongest predictor of environmental behavioral intentions, particularly in cases where the managers perceive ambiguity regarding the sustainability objectives of their organization (2016). Another study published in 2016 investigated determining factors of sustainable procurement behaviors among 206 government procurement managers (Nadeem et al.). This study utilized an adapted TPB framework to conclude that environmental awareness of procurement managers is positively related to sustainable procurement behaviors but is mediated by their affective commitment to change. The following year, Nadeem and colleagues (2017) proposed a conceptual model based in-part on TPB to explain sustainable procurement behaviors in organizations. In this model, it was posited that personal values, leadership style, and environmental awareness each influenced sustainable procurement decisions and that these relationships were moderated by organizational culture. Although only conceptual, this paper is interesting in that it draws on theories from both I/O psychology and organizational behavior.

Political Ideologies: Liberalism and Conservatism

The role of political ideologies in decision making processes has received surprisingly little attention from scholars in the organizational sciences. Traditionally

considered to be in the realms of political science or social psychology, research from these literatures suggest the saliency of political orientations has very real influence over the ways people search for and interpret information, perceive their environment, and form beliefs (Feygina, Jost, & Goldsmith, 2010; Jost, Glaser, Kruglanski, & Sulloway, 2003; Kahan, 2012; Slothuus & de Vreese, 2010). As such, the relatively few studies investigating political ideologies in organizations have largely been at the organizational level of analysis, focusing on ideologies of CEO's and top management teams.

Many conceptualizations of political ideology have been developed, studied and debated since the mid-20th century (see Jost, 2006). More generally, ideologies are thought to be frameworks for organizing values, beliefs, and attitudes. For the purposes of this paper, political ideology is defined as an interrelated set of moral and political attitudes that possesses cognitive, affective, and motivational components (Tedin, 1987; Jost, 2006). Studies of political ideology most often utilize broad distinctions of left versus right, or liberal versus conservative. Despite the broad and seemingly ambiguous nature of these constructs, a substantial body of evidence exists to support a theoretical justification for their use. It is important to note that these constructs are treated only as "indicators of – imperfect, crude proxies for – a latent or unobserved shared disposition that orients information processing" (Kahan, 2016, p. 10). Nonetheless, the liberal-conservative distinction has been proven to be a simple yet powerful method for classifying core political belief systems.

There have been many dimensions noted in the literature on which the liberal-conservative distinction has been based. Some of the most commonly cited characteristics distinctions are open-mindedness versus closed-mindedness (Carney, Jost, Gosling, & Potter, 2008), emphasis on shared versus personal responsibility (Skitka & Tetlock, 1993), preference for equality versus acceptance of inequality and desire for versus resistance to social change (Skitka & Tetlock, 1993; Jost, et al., 2003). Janoff-Bulman (2009) applied approach-avoidance motivation theory to political ideologies, positing that liberalism (approach) focuses on the welfare of others, social justice, and positive change, whereas conservatism (avoidance) emphasizes security, protection, and social order. Other ideas or characteristics associated with conservatism include authoritarianism, dogmatism, self-reliance, economic efficiency, ownership rights, tradition, individualism,

and preservation of social norms. Liberal associations include egalitarianism, human rights, equality, the natural environment, market regulation, inclusion, intervention, and collectivism.

CHAPTER 4

Methodology

Introduction

This chapter introduces the methodology used in part two of the research. A general overview of the research plan and flowchart outlining significant tasks, processes, and phases of the research are first presented. Following this, contextual factors of the research study are discussed along with an analysis of purchasing data used to identify the research population. Methodologies for data collection and survey development are then described. Finally, descriptions of the survey items and other variables used for testing the hypothesized relationships are provided. The data dictionary, survey questionnaire, recruitment communications, consent form, and IRB approval documents can be found in Appendices B through F.

Research Overview and Methodology Outline

Part two of the research study utilized survey data and organizational data from secondary sources to test the stated hypotheses. An electronic survey questionnaire was administered to collect self-reported data. Penn State employees who had placed purchase orders for copy paper products were surveyed to measure environmental involvement, attitudes toward green purchasing, behavioral and normative beliefs related to purchasing recycled copy paper, purchasing task discretion, and recycled copy paper purchasing intention. Secondary purchasing data were obtained from the Department of Purchasing Services and linked to survey respondents to measure past purchasing behaviors. The questionnaire was reviewed for validity and contextual suitability by a panel consisting of management scholars, representatives from the Department of Purchasing Services, and administrative support staff employees with purchasing responsibilities. Feedback resulting from the review was considered and modifications deemed necessary were

made prior to the instrument's final administration. Following review, pilot tests were conducted in which the online questionnaire was administered to ensure proper functioning. The instrument was submitted to the Institutional Review Board to confirm that all applicable laws and regulations were followed. Further explanation of the survey instrument, measures, and administration methods is provided in subsequent sections.

The flowchart presented in Figure 4.1 below outlines the major tasks associated with the research study, organized into four phases. Phase one represents the research design processes, including development of the initial survey instrument and preliminary analysis of anonymized purchasing data. Phase two represents processes related to preparing for data collection, including survey validation and IRB approval. Phase three involved actual data collection, both from survey administrations and secondary sources. Finally, phase four involved processing and analyzing the research data and testing the research hypotheses.

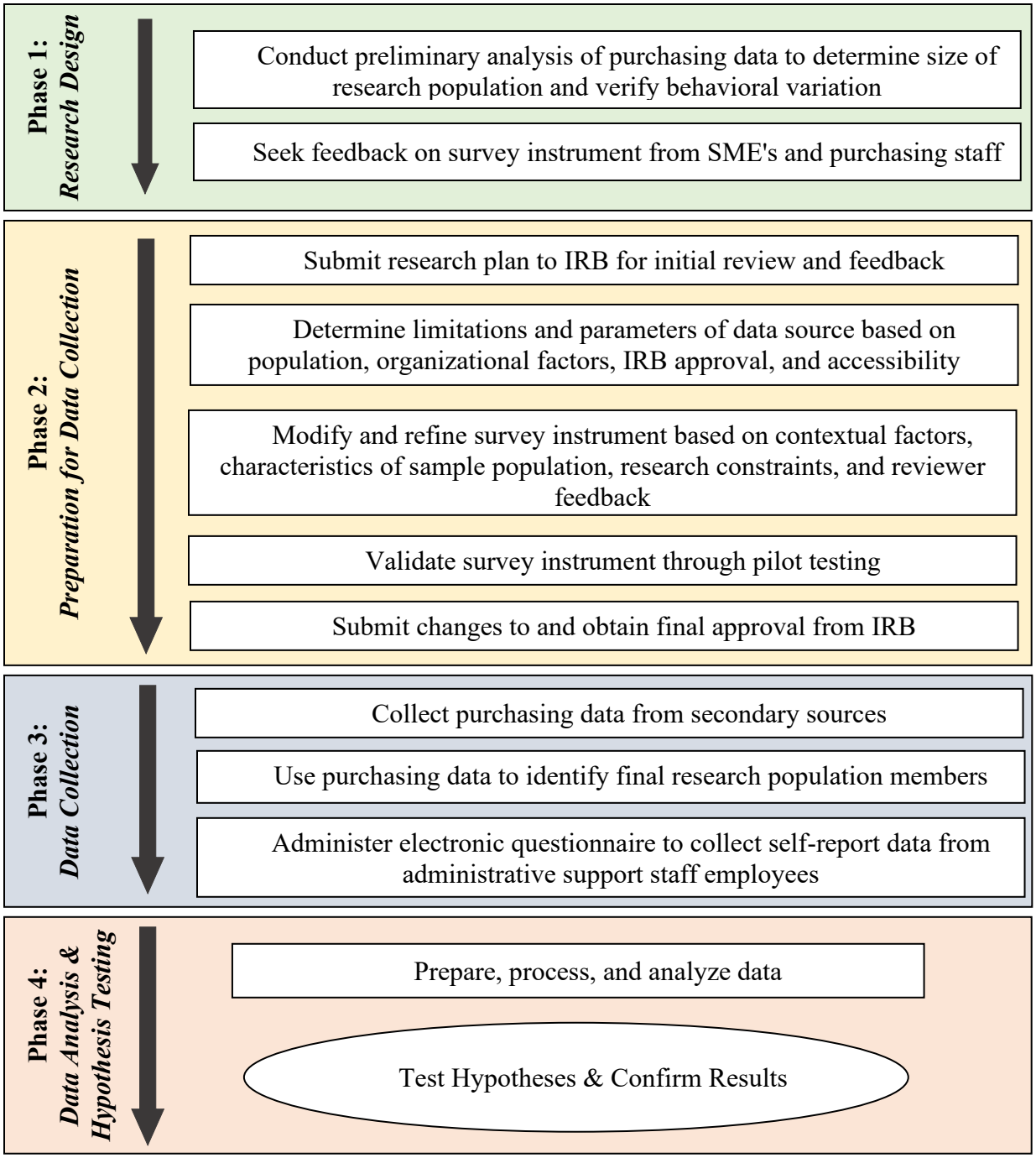

Figure 4.1 General outline of research tasks

Research Context and Population

The organizational context of the research is The Pennsylvania State University. Founded in 1855 as the state's first and only land-grant institution, Penn State University is now the largest public university in Pennsylvania, with over 97,000 students[3] enrolled across 26 campuses and affiliated locations[4]. Additionally, the University has over 35,000 employees, approximately 90% of whom are employed on a full-time basis[5] (PSU, 2019).

The population of interest for the research was University employees with purchasing responsibilities for non-critical items (i.e., minor procurement), particularly office supplies. Since a large majority of office supplies, and the vast majority of copy paper, consumed by Penn State are believed to be purchased from Penn State General Stores, the research utilized data from Purchasing Services to determine the size and identify members of the research population. Penn State General Stores (GS) is a University operated, on-campus supplier of a wide variety of office and janitorial products. It is also the only approved vendor of office and janitorial supplies listed in the University's electronic purchasing catalog, called eBuy[6]. Employees wishing to purchase office supplies through the eBuy system are directed to an Office Depot electronic catalog, which essentially hosts items from the GS catalog alongside the many non-GS products sold by and shipped from Office Depot warehouses. As a result of this partnership, transaction data associated with GS will include both direct purchases from GS as well as indirect purchases of non-GS items from Office Depot.

Although over 3000 employees typically complete at least one purchase through the eBuy system each year (Sheth, 2018), this study focused only on those employees who

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[3] Includes students at all levels of academic standing and enrollment, as of Fall 2018.

[4] Includes main campus at University Park, 19 Commonwealth campuses, as well as the Dickinson School of Law, Great Valley School of Graduate and Professional Studies, Penn State Hershey College of Medicine, Penn State Law, the Pennsylvania College of Technology, and the World Campus

[5] Does not include student workers (work study, student interns, graduate assistants/fellows, etc.), as of Fall 2018.

[6] Penn State retired the eBuy platform in summer 2020, replacing it with a platform called ShopOnLion. This coincided with the University's replacement of its Integrated Business Information System (IBIS) with SIMBA.

have purchased copy paper products. More specifically, the research focused only on those employees who had purchased standard copy paper products in FY 2019-2020. That is, copy paper that is letter size (8.5”x11”), white in color, 20lb. in weight per 500 sheets, and 92 brightness. Common non-standard copy paper products include those of different sizes (e.g., legal, ledger, etc.), higher weight and/or greater thickness, higher/lower brightness, and assorted colors.

Limiting the study to purchases of a single type of product was advantageous for multiple reasons. First, the product attributes on which purchasing decisions are made will be directly comparable across purchasing outcomes. Since all products have the same functional attributes (i.e., size, weight, color, application, etc.), the effect of differences in price, environmental certifications, and fiber content should be more pronounced. Furthermore, studying purchases of a single type of product reduces the variability in how buyers evaluate and compare different sustainability related attributes. For copy paper products, the primary sustainability related attributes are environmental certifications and fiber source. Finally, limiting the study to a single type of product allowed for “apple to apple” comparisons between purchasing decisions. That is, since all of the products included in the analysis are direct substitutes of one another, a decision to purchase one is effectively a decision not to purchase another.

Identifying the Research Population

An initial analysis of purchasing data was conducted to determine the approximate size of the research population. Purchasing data of all General Stores and Office Depot orders from FY 2018-2019 were obtained from Purchasing Services. This dataset contained orders for approximately 19,000 unique items. The total spend represented by these items for FY 2018-2019 was $7.3 million. Filters using keywords were then applied to the item descriptions of the approximately 19,000 items to identify paper products of interest to the research. Examples of words used to filter items include paper, tissue, napkin, towel, corrugated, package, box, folder, note, book, ream, cup, plate, bowl, roll, shipping, sleeve, board, toilet, carton, Kraft, facial, recycled, pads, covers, etc. A dichotomous “Fiber Product” variable was then created to identify items confirmed as paper products. After applying each filter, the remaining items were reviewed

individually and, using the “Fiber Product” variable, marked as “1” if a paper product and “0” if not. For instance, applying the keyword “ream” as a filter produced an item list containing both copy paper products as well as coffee creamer products. In this case, the creamer products were identified with a “0” and the copy paper products with a “1”.

After multiple rounds and variations of filters applied to the purchasing data, the list of identified paper products included 719 unique items, totaling approximately $1.6 million. Using keywords associated with copy paper as filters, this same process was then repeated on the 719 paper product items, with the results then being further filtered to identify standard copy paper items. Once completed, the list of standard copy paper products included 58 unique item numbers, totaling $556,047.66. It was found that only 24 of these items accounted for more than 98% ($545,845.64) of that spend.

The 24 standard copy paper product items served as the basis for initially identifying and estimating the size of the research population during the planning phase of the study in early 2020. To estimate the size of the population, a representative from Purchasing Services pulled all purchase orders from the 2019 calendar year containing any of those 24 item numbers, then exported and anonymized the Penn State user ID associated with each purchase order. Analysis of the resulting purchase order data indicated there were approximately 3500 orders involving the 24 item numbers, placed by 924 unique buyers. Thus, the initially estimated size of the research population was 900-950 members.

Due to the COVID-19 pandemic and its impact on University operations during the spring semester of 2020, it was decided that the list of standard copy paper products to be used for identifying the research population should be reevaluated using purchasing data from the 2019-2020 FY. Initial comparisons between the purchasing data of the two fiscal years indicated a decrease of about 32% in spend on the 24 copy paper products. The overall proportions of spend accounted for by each product were compared between the fiscal years and found to be similar. Five additional item numbers were added to the list to account for changes in purchasing behaviors during the spring 2020 semester as a result of the University effectively ceasing on-campus operations in response to the pandemic. For instance, Purchasing Services allowed employees to purchase and ship single reams and partial cases (five reams) from Office Depot to residential addresses during that time.

Tables 4.1 and 4.2 provide detailed information for the 29 copy paper products and associated purchasing summary data from the 2018-2019 and 2019-2020 fiscal years. As can be seen, total spend on these products decreased 31.9% from $547,218 in 2018-2019 to $372,504 in 2019-2020. Since the price of paper products can fluctuate with market conditions, comparing only the change in expenditures may not provide an accurate measure of change in consumption. A better measure may be the number of individual reams purchased, which decreased by nearly 41k from 140,323 to 99,380 over the two years, a difference of 29.2%. Although the majority of this decrease in paper purchasing is likely attributable to the University's shutdown in spring 2020, it is difficult to determine the exact impact of the shutdown on purchases since the University also began implementation of a printing reduction program through SIMBA at approximately the same time.

Table 4.1 Standard copy paper products accounting for greatest spend, FY 2018-19 and FY 2019-20

Product Reference Number	Manufacturer	Description	PSU GS Item Number	Manufacturer Item Number	Total RC (%) [a]	Cert. [b]	Unit Wt. (lbs.)	Reams per Unit
1	American Eagle	Eagle Office Multi-Use 100 Recycled, Case	Z11PSU100CT	Z11PSU100CT	100	FSC-R	50	10
2	American Eagle	Eagle Office Multi-Use 100 Recycled, Skid of 40 Cartons	Z11PSU100SK	Z11PSU100SK	100	FSC-R	2000	400
3	American Eagle	Eagle Office Multi-Use 100 Recycled, Skid of 40 Cartons, Commonwealth Campuses	Z11PS100CCSK	Z11PS100CCSK	100	FSC-R	2000	400
4	American Eagle	Eagle Office Multi-Use 50 Recycled, Case	Z11GOGREENCT	Z11GOGREENCT	50	FSC-M, SFI	50	10
5	American Eagle	Eagle Office Multi-Use 50 Recycled, Skid of 40 Cartons	Z11GOGREENSK	Z11GOGREENSK	50	FSC-M, SFI	2000	400
6	American Eagle	Eagle Office Multi-Use 50 Recycled, Skid of 40 Cartons, Commonwealth Campuses	Z11GREENCCSK	Z11GREENCCSK	50	FSC-M, SFI	2000	400
7	American Eagle	Eagle Office Multi-Use 30 Recycled, Case	Z11PSU30CT	Z11PSU30CT	30	FSC-M, SFI	50	10
8	American Eagle	Eagle Office Multi-Use 30 Recycled, Skid of 40 Cartons	Z11PSU30SK	Z11PSU30S	30	FSC-M, SFI	2000	400
9	American Eagle	Eagle Office Multi-Use 30 Recycled, Skid of 40 Cartons, Commonwealth Campuses	Z11PSU30CCSK	Z11PSU30CCSK	30	FSC-M, SFI	2000	400
10	Boise	Boise ASPEN Multipurpose 100 Recycled, Case	125420	054922-CTN	100	FSC-M	50	10
11	Boise	Boise ASPEN Multipurpose 100 Recycled, Case	PSU100CC	054922-CTN	100	FSC-M	50	10
12	Boise	Boise ASPEN Multipurpose 100 Recycled, Single Ream	1381204	054922	100	FSC-R	5	1
13	Boise	Boise ASPEN Multipurpose 50 Recycled, Case	398140	055011-CTN	50	FSC-M	50	10
14	Boise	Boise ASPEN Multipurpose 30 Recycled, Case	116946	054901-CTN	30	FSC-M	50	10
15	Boise	Boise ASPEN Multipurpose 30 Recycled, Case	P1054901-CTN	054901-CTN	30	FSC-M	50	10

[a] Total recovered content, may include pre- and post-consumer materials
[b] FSC-M is Mixed, FSC-R is Recycled

(Table 4.1 continued on following page)

Table 4.1 (Continued) Standard copy paper products accounting for greatest spend, FY 2018-19 and FY 2019-20

Product Reference Number	Manufacturer	Description	PSU GS Item Number	Manufacturer Item Number	Total RC (%) [a]	Cert. [b]	Unit Wt. (lbs.)	Reams per Unit
16	Boise	Boise ASPEN Multipurpose 30 Recycled, Single Ream	697884	54901	30	FSC-M	5	1
17	Boise	Boise X-9 Multi-Use, Case	196517	OX9001-CTN	0	SFI	50	10
18	Boise	Boise X-9 Multi-Use, Case	196679	OX9001-CTN	0	FSC-M	50	10
19	Boise	Boise X-9 Multi-Use, Partial Case	3620683	OX9001-JR	0	SFI	25	5
20	Boise	Boise X-9 Multi-Use, Single Ream	332063	OX9001EA	0	SFI	5	1
21	International Paper	Hammermill Great White, 100 Recycled, Case	309418	86790	100	FSC-R	50	10
22	International Paper	HP Office Paper, Case	333465	112101CTN	0	FSC-M, SFI	50	10
23	International Paper	HP Office Paper, Case	HEW112101	112101CTN	0	FSC-M, SFI	50	10
24	Domtar	Xerox Vitality Multipurpose Printer Paper, Case	275474	3R02047	0	FSC-M	50	10
25	Unknown	Office Depot Brand EnviroCopy, 30 Recycled, Case	940650	651001OD	30	FSC-M, SFI, GS	50	10
26	Unknown	Office Depot Brand EnviroCopy, 30 Recycled, Partial Case	222202	40430	30	FSC-M, SFI, GS	25	5
27	Boise	Boise ASPEN Multipurpose, 100 Recycled, Case	P1054922-CTN	054922-CTN	100	FSC-M	50	10
28	Boise	Boise Aspen 50 Multipurpose, 50 Recycled, Skid of 40 Cartons	495662	055011-SKD	50	FSC-M	2000	400
29	Boise	Boise ASPEN 50 Multipurpose, 50 Recycled, Case	P1055011-CTN	055011-CTN	50	FSC-M	50	10

[a] Total recovered content, may include pre- and post-consumer materials
[b] FSC-M is Mixed, FSC-R is Recycled

Table 4.2 Purchase history of standard copy paper products, FY 2018-19 and FY 2019-20

	Purchases, 2018-2019 FY				Purchases, 2019-2020 FY				Change from 2018-2019 to 2019-2020 FY			
Product Reference Number [a]	**Units**	**Reams**	**Average Unit Price ($)**	**Total Spend ($)**	**Units**	**Reams**	**Average Unit Price ($)**	**Total Spend ($)**	**Reams**	**Reams (%)**	**Total Spend**	**Total Spend (%)**
[redacted]												

[a] See Table 4.1 for product details

(Table 4.2 continued on following page)

Table 4.2 (Continued) Purchase history of standard copy paper products, FY 2018-19 and FY 2019-20

	Purchases, 2018-2019 FY				Purchases, 2019-2020 FY				Change from 2018-2019 to 2019-2020 FY			
Product Reference Number [a]	**Units**	**Reams**	**Average Unit Price ($)**	**Total Spend ($)**	**Units**	**Reams**	**Average Unit Price ($)**	**Total Spend ($)**	**Reams**	**Reams (%)**	**Total Spend**	**Total Spend (%)**
[redacted]												
[redacted]												
[redacted]												
[redacted]												
[redacted]												
[redacted]												
[redacted]												
[redacted]												
[redacted]												
[redacted]												
Total	**10,983**	**140,323**	**-**	**$547,318.00**	**8,085**	**99,380**	**-**	**$372,503.63**	**-40,943**	**-29.2%**	**-174,814.37**	**-31.9**

[a] See Table 4.1 for product details

The final research population was based on the 26 copy paper products from Table 4.2 that were purchased in FY 2019-2020 (product reference numbers 1-26) [7]. Purchasing history for these products was obtained from Purchasing Services, covering an approximately 12 month period prior to the survey's administration in June 2020, roughly representing the 2019-2020 FY. Purchasing data included the order date, order number, product item number, quantity purchased, and the Penn State user ID (ex., ABC123) of the employee who submitted the order. The data represented approximately 3000 unique purchase orders, each including at least one of the 26 copy paper products. Only Penn State employees who submitted purchase orders totaling at least ten reams (or one case) of copy paper during the research period were selected to participate in the study, resulting in a final research population of 873 cases.

Instrumentation

The research instrument used to collect data for the study was an online questionnaire. The questionnaire was designed and administered electronically via Qualtrics. Electronic questionnaires have many advantages over traditional paper questionnaires. In the case of the current study, the primary advantages are functionality and convenience. Since members of the research population were identified using their Penn State email addresses, that information could then be used to quickly and easily disseminate the survey to the intended recipients. Furthermore, since responses needed to be identified and linked to purchasing behavior, the Qualtrics service could identify and automatically send reminders to non-respondents. Using the Qualtrics service also provided the opportunity to design the questionnaire so that additional and/or different survey items could be presented to respondents depending on values from secondary data sources or responses to previous items. For example, employees who had not previously purchased American Eagle paper products were presented with additional questions to better understand why.

[7] Three Boise Aspen products became unavailable to purchase from Office Depot in early 2019

Another advantage of the Qualtrics service is that the design and appearance of questionnaires can be optimized for viewing on various devices. This encourages greater participation since respondents can just as easily complete the survey on a smartphone or tablet as they would on a desktop computer. More generally, online questionnaires typically require fewer resources, namely time and money, to administer. Since raw data are automatically generated, these data collection instruments are also generally more accurate because the potential of errors in manual response translation is dramatically decreased. Finally, because the survey is not administered verbally, such as over the phone or in-person, interviewer and respondent measurement errors are also minimized (Glasow, 2005; Salant & Dillman, 1994).

Survey questionnaires nonetheless still present the potential for other types of error that should be considered when designing a study. For instance, written surveys of any sort create opportunities for respondents to inadvertently or intentionally skip items, which negatively impacts the error margins for particular variables (Glasow, 2005; Salant & Dillman, 1994). This can be largely avoided, however, when using electronic questionnaires by either reminding or requiring respondents to complete certain items before proceeding. Self-reported data can also be prone to bias, for example as a result of memory decay, social desirability, and common-method variance.

Encouraging Survey Completion

Non-response bias is a common source of error associated with survey questionnaires, due to the generally low response rates that commonly occur with the method. The study took a number of steps to mitigate the likelihood of obtaining an insufficient number of responses. Of these, possibly the most important was to design the survey so that most respondents could complete it in about 12 minutes. Among participants who provided full responses, the average time to complete the survey was about 11.5 minutes; 90% of respondents completed the survey in about 19 minutes or less. The survey introduction was written to describe the purpose of the study, potential benefits of participating, and how responses and related data will be used, reported, secured, and ultimately destroyed. The research design required survey respondents to be linked to secondary purchasing data and as such could not utilize an anonymous survey design. This could have adversely affected employee willingness to participate, so it was important for

recruitment information to state that the study was for research purposes only and that participation was completely voluntary; the decision to participate or not to participate would only be known to members of the study team, and that all responses were confidential and would only be reported in aggregate form. Consent information was presented; voluntary consent was implied by participating in the survey. The survey remained active for a period of two weeks, during which two additional reminder emails were sent to nonrespondents.

Elicitation Phase

The items for measuring the constructs involved in the research model are summarized in the final sections of this chapter. Wherever possible, items and associated constructs that have been thoroughly studied and validated in the literature were used in the study. Abbreviated versions of constructs using only a subset of the originally prescribed items were in some cases used to limit the total time required to complete the survey. Since the research context was well-defined, modifications to item wording were made to maximize contextual relevance. Items were pretested and final constructs selected based on measures of internal consistency through reliability and principal-components analyses.

A critical step in applying the TPB model is obtaining input regarding the behavior of interest from the research population prior to measurement. In public health studies, particularly those involving an intervention, this step is often called formative research. In TPB studies, the elicitation phase is intended to identify commonly held salient beliefs associated with the behavior being studied since such salient beliefs are assumed to be the antecedents of the core TPB constructs.

Ideally, the elicitation phase would have consisted of open-ended interviews being conducted to identify attributes and sources of normative pressure related to purchasing recycled copy paper. Montaño and Kasprzyk recommend the TPB researchers interview at least 15 subjects from the research population, approximately half of whom would have performed the behavior of interest (i.e., purchased recycled copy paper in the past twelve months) and half of whom would not have performed it (i.e., purchased only virgin copy paper) (2015). Responses from these interviews would then be content

analyzed to identify the most commonly held salient beliefs from which a model set could then be selected and measured in the final instrument.

Unfortunately the rapidly changing research protocols during the COVID-19 pandemic in early 2020 prevented traditional elicitation phase activities from being carried out. Considering the well-defined context and homogenous population, however, eliciting responses for in this scenario would likely have been less fruitful than in studies involving a more diverse research population and/or a more general behavioral target (ex., purchasing recycled products rather than purchased recycled copy paper). Instead, behavioral beliefs and sources of normative pressure were identified through literature review and consideration of contextual factors. The final survey instrument was pretested by administering the questionnaire to a small group of participants (n = 5), including members of the research population and subject matter experts, to ensure functionality of the instrument and contextual appropriateness of the terminology used.

Measures of TPB Constructs

The TPB literature emphasizes the value of including both indirect and direct measures of core TPB constructs when designing survey questionnaires. In fact, one literature review identified reliance on only either direct or indirect measures as a substantial and common weakness in TPB research (Oluka et al., 2014). Utilizing both types of measures is considered a best practice for multiple reasons. First, direct measures are often more strongly associated with behavioral intention and performance than indirect measures. For this reason, direct measures are generally more useful than indirect measures for understanding the individual roles of attitude and subjective norm in the formation of behavioral intention in a given context (Montaño & Kasprzyk, 2015). Indirect measures, however, are important because they can be used to identify factors that discourage the desired behavior. For example, an indirect measure of attitude might indicate a strong belief among respondents that recycled copy paper causes copy machines to jam. If the subsequent direct measure of attitude is then found to be predictive of the decision to purchase recycled copy paper, then an intervention could be designed that might highlight the jam-free guarantee of recycled products or the positive experiences of other users. Indirect measures are important both for validating the TPB

model as a whole and for determining how to best apply the results from the study in practice.

Behavioral Norms

Subjective norm was calculated as a latent variable reflecting both normative beliefs and motivations to comply with the associated referent groups. Since the research is focused on purchasing behavior in a professional capacity (as opposed to purchasing for personal use), referent groups specific to the organizational context were selected as these are of most interest to the research and likely to be among the most salient for employees.

Specifically, normative belief strengths were measured by asking participants if they agreed/disagreed that each of the following groups would approve of their purchasing recycled copy paper: my supervisor (IN1), my coworkers (IN2), students (IN3), faculty (IN4), and university leadership (IN5). Similarly, participants were also asked about their motivation to comply with each of these groups (ex. "when it comes to purchasing copy paper, I want to do what _____ thinks I should do") (MC1-MC5). Taking motivation to comply into account effectively weights the behavioral beliefs of important referents while discounting those of unimportant referents. Finally, a direct measure item for normative pressure was also included ("most people who are important to me think I should purchase recycled copy paper") (SND) as a means of confirming the saliency of the identified referent groups and the validity of the latent subjective norm variable.

Following the recommendations of Fishbein & Ajzen (2009), normative belief strength items were scored on a bipolar scale (-3 to 3) while motivation to comply items were scored on a unipolar scale (1-7). The reason for doing this is that the scores for each pair of items were then multiplied to produce an overall score (ex., IN1xMC1=SN1) reflecting the strength and direction of perceived pressure from each referent group (SN1-SN5), potentially ranging from -21 to +21. Table

Behavioral Beliefs

Like the measures of subjective norm, attitude items (IA1-IA7) were also composite measures, in this case composed of item pairs measuring behavioral beliefs and evaluations. The beliefs and evaluations addressed issues commonly associated with recycled copy paper. Specifically, behavioral beliefs were measured by asking

participants if they agreed/disagreed that purchasing recycled copy paper: helps my unit/department be more sustainable (BB1), leads to paper jams and other printer malfunctions (BB2), helps prevent deforestation (BB3), increases the operating expenses of my unit/department (BB4), helps to conserve our natural resources, (BB5), hurts communities that rely on the forest products industry for jobs and economic growth (BB6), and can support local business (BB7). Items BB2, BB4, and BB6 were reverse coded. The final item (BB7) was contextually specific as a key supplier of recycled copy paper is located in the same region as the university. Behavioral belief items were scored on bipolar scale ranging from -3 to +3.

Whereas behavioral beliefs items are intended to measure the subjective probability that a behavior leads to a particular outcome (ex., purchasing recycled copy paper leads to paper jams), behavioral evaluation items are intended to measure positive or negative perceptions of the outcome. This approach of measuring outcome beliefs paired with outcome evaluations is based in the expectancy-value model of attitude formation (Fishbein, 1963). Behavioral evaluation (BE1-BE7) items asked respondents if they agreed/disagreed with statements assessing the value of each outcome (ex., "deforestation is a serious problem"; "it is important to help my unit/department be more sustainable") and were scored on a unipolar scale ranging from 1 to 7. Product scores of behavioral belief and evaluation items were calculated for each outcome (ex., BB1xBE1 = ATT1) as indicators of the instrumental attitude latent variable (ATT1-ATT7).

In line with recognized best practices for TPB studies, direct measures of attitude were also included (Fishbein & Ajzen, 2009; Oluka, et al., 2014). These measures (AD1-AD4) focused on instrumental aspects of the behavior (i.e., good, important, useful, etc.) rather than experiential aspects (i.e., pleasant, exciting, fun, etc.). Since the actual process of purchasing recycled copy paper is effectively the same for all members of the research population, items measuring experiential aspects would likely not have produced sufficient variation in responses. Direct measures of attitude asked participants if they agreed/disagreed with the following statements: purchasing recycled copy paper is a good idea (AD1), it is important to purchase recycled copy paper (AD2), purchasing recycled copy paper does more harm than good (reverse-coded; AD3), and purchasing recycled copy paper is worthwhile (AD4). The four direct measure items were scored on a

unipolar scale ranging from 1-7 and averaged to create a composite score of attitude to measure correlations with the identified behavioral outcomes.

Behavioral Control

The final core predictor in traditional TPB models is, of course, behavioral control. Measures of perceived control often address separately the capacity to perform a behavior (ex., "If I wanted to, I could easily _____" or "I have the ability to _____") and the autonomy to perform a behavior (ex., "Whether or not I _____ is completely up to me" or "I have control over whether or not I _____").

In the case of the current study, it was not expected that members of the research population would face substantial challenges or obstacles to purchasing recycled paper. In the organizational context of the study, the process for purchasing recycled copy paper is nearly identical to that of virgin fiber copy paper. Access, availability, cost, and time to delivery are also effectively the same for both types of paper, with little differentiation among buyers. In general, the resources needed to purchase standard copy paper products are the same, regardless of fiber type.

Since the study is concerned with purchasing decisions related to minor procurement, measures of perceived control addressed autonomy within the purchasing function. Specifically, a single-item measure of task discretion from the European Quality of Life Survey (OECD, 2017) was slightly modified to create a measure of purchasing task discretion. The item, which asked respondents if they agreed/disagreed with the statement, "with regard to making purchasing decisions, I have a great deal of influence in deciding how to do my work" (PTD), was scored on a scale ranging from 1 to 7. Although the generalized wording of the item does not follow the principle of compatibility with regard to the behavioral criterion (i.e., purchasing recycled copy paper), it is intended to reflect the decentralized nature of purchasing authority for minor procurement activities (see Kraljic, 1983).

Behavioral Intention

Behavioral intention was measured with three items based on standard TPB measures and scored on a unipolar scale from 1 to 7: "when purchasing copy paper, I intend to select products made with recycled content" (BI1), "I am willing to purchase copy paper

that contains recycled material" (BI2), and "I plan to choose products that are made from recycled material when purchasing copy paper" (BI3).

Additional Measures

Items and variables that are not part of the core TPB constructs are provided below. Many of these measures represent areas where the study sought to contribute to the TPB literature by exploring antecedent beliefs and the role of task discretion in organizational contexts. Other items included here were used for describing demographic characteristics of the sample population and/or as control variables. Finally, the survey also included a number of exploratory items that will inform development of University procurement guidelines.

Environmental Involvement

Environmental involvement was measured with four items, scored on a unipolar scale from 1 to 7: "I am concerned about the environment" (EI1), "the condition of the environment affects the quality of my life" (EI2), "I am willing to make sacrifices to protect the environment" (EI3), and "my actions impact the environment" (EI4) (Schulwerk & Lefkoff-Hagius, 1995; Wei, et. al., 2017).

Political Ideology

Studies of political ideology most often utilize broad distinctions of left versus right, or liberal versus conservative. Despite the broad and seemingly ambiguous nature of these constructs, a substantial body of evidence exists to support a theoretical justification for their use. It is important to note that these constructs are treated only as "indicators of – imperfect, crude proxies for – a latent or unobserved shared disposition that orients information processing" (Kahan, 2016, p. 10). Nonetheless, the liberal-conservative distinction has been proven to be a simple yet powerful method for classifying core political belief systems. A single measure of political ideology was included in the survey, simply asking "how would you describe your political views?". This item is the same measure that has been used in the American National Election Studies since 1972.

Open-ended Items

A single open-ended item was included in the survey: “If you have any thoughts or comments you'd like to share about paper purchasing and/or paper consumption at Penn State University, please use the text box below.” Responses to this items were not be necessary for testing the hypothesized relationships but could provide additional insight potentially useful for guiding future research or policy development. Responses to this items could be content analyzed to identify common themes.

CHAPTER 5

Sustainability and Minor Procurement: The Role of Employee Purchasing Decisions

Abstract

Purchasing decisions can greatly influence the sustainability performance of organizations. Large organizations, including many Higher Education Institutions (HEIs), have decentralized purchasing systems in which purchasing authority is widely distributed among many employees. Managing sustainability of procurement activities in these contexts is challenging since the outcome is dependent on the purchasing behaviors of many individuals. This study sought to explain the roles of behavioral attitudes and social norms in employee purchasing decisions for copy paper products through application of an extended theory of planned behavior (TPB) model. Approximately 900 employees at the Pennsylvania State University were selected, based on past purchasing activity, to participate in the study by completing an online questionnaire. A total of 263 university employees responded to the survey. Confirmatory factor analysis (CFA) and structural equation modeling (SEM) methods were used to analyze response data. Results from the analyses generally strongly supported the hypothesized relationships. Within the sustainable supply chain management and procurement fields of study, little research has been published on the impact of minor procurement on the sustainability performance of organizations. Likewise, little research has been dedicated to the purchasing decisions of staff level employees, with the bulk instead focused on senior level organizational buyers and supply managers. This research highlights the roles of administrative support employees and minor procurement decisions in sustainable supply chain management strategies of large organizations.

Introduction

Sustainability has become a paramount issue for many organizations, even entire industries, as stakeholders become increasingly ardent in the expectation they take genuine steps to minimize the environmental and social impacts of their operations. Organizations of all types now consider sustainability to be strategically, if not inherently, important to their long-term success. This is especially true in higher education, where institutions face pressure from myriad stakeholders both internal and external to the organization.

Institutions of higher education (HEIs) today often pursue sustainability in a holistic manner, integrating sustainability into their day to day operations as well as their long-term strategic plans. Institutional purchasing has become a crucial component to the overall sustainability performance of HEIs. Purchasing decisions can broadly impact university operations and are also within the scope of institutional control.

One area of university procurement that is commonly a focus of sustainability efforts is paper products. Much of the attention that paper products receive is due to the environmental burdens people often associate with their production, namely deforestation. For instance, the Union of Concerned Scientists has identified wood products, including wood pulp, as one of the "big four" agricultural commodities driving global deforestation. This is especially true in places like Indonesia, where from 2000-2010 deforestation for the purpose of establishing pulpwood plantations exceeded that of palm oil plantations (UCS, 2016). Paper products are also so ubiquitous in university settings (ex., printing paper, textbooks, hand towels, bathroom tissue, napkins, cups, plates, etc.) that nearly all campus users will be directly exposed to them on a daily basis, making them a very visible issue for stakeholders. Another contributing factor to the attention given to paper products is likely that, in terms of ways to improve sustainability performance, changing how paper products are purchased and consumed is a "low-hanging fruit" relative to other major initiatives like banning plastics on campus or becoming carbon neutral.

Reducing paper consumption has long been a focus of organizational sustainability efforts. Despite this, many organizations struggle to decrease overall paper consumption. This is particularly true in record-intensive industries such as health care, government,

and higher education. Organizations that have employed common paper reduction strategies, such as removing personal printers, setting duplex printing as default, digitizing records, and utilizing print management services have experienced varying levels of success. A recent AASHE publication, in which the paper reduction efforts of five institutions were highlighted, reported reductions in paper use ranging 18-32% (Van Leuvan, et al., 2019). Although these are positive outcomes, they suggest that limits exist in the effectiveness of sustainability efforts that focus solely on reducing paper use. The implication then is that beyond paper reduction practices, HEIs and other organizations must also manage the impact of their unavoidable paper consumption.

As a result of these motivations and others, many HEIs have adopted paper purchasing policies or guidelines that prioritize products with sustainability certifications (i.e., FSC, SFI, PEFC) or that contain recycled fiber. Many universities, however, may find it challenging to achieve substantial improvements in purchasing outcomes following implementation of green purchasing policies. This is particularly true for large HEIs with decentralized purchasing systems in which authority for minor procurement (ex., purchasing office supplies) is widely distributed among many employees. Achieving sustainability goals in these contexts may require compliance of hundreds or even thousands of employees across many locations.

Understanding how individual differences and contextual factors influence employee purchasing decisions is important for improving the sustainability of organizations and their supply chains. This study adds to the limited body of literature addressing sustainable purchasing behaviors of administrative staff members in organizational contexts. Through application of an extended theory of planned behavior (TPB) framework, this study investigates antecedents to employee intentions to purchase recycled copy paper in the context of a large research university.

Contributions of this research are derived from the context in which the theoretical framework is applied and the particular research population that was studied. Despite its wide use in studies of environmental behaviors, the application of the TPB framework to study those behaviors in organizational contexts is still relatively new. Furthermore, by studying purchasing decisions in an organizational context through the lens of consumer behavior rather than organizational buying behavior, this research helps to bridge the gap

between the organizational behavior and supply chain management fields of study. Finally, within the supply chain management field of study, relatively little research has been published on the impact of minor procurement on the sustainability performance of organizations. Likewise, very little research has been dedicated to the purchasing decisions of staff level employees, with the bulk instead focused on senior level organizational buyers and supply managers. This research highlights the roles of administrative support employees and minor procurement decisions in sustainable supply chain management strategies of large organizations.

The following sections provide a brief review of literature related to sustainable supply chain management, as well as sustainable procurement and paper purchasing policies in higher education. The extended TPB framework is then discussed, along with presentation of the research model and hypothesis development. As methodological considerations are of paramount importance in TPB research, the sampling design, measures, and administration of the TPB questionnaire are then explained at length, followed by analysis through CFA and SEM procedures. Finally, the results of the study as well as implications and directions for future research are discussed.

Background

Sustainable Supply Chain Management

Within the Supply Chain Management (SCM) field, Sustainable Supply Chain Management (SSCM) has become a dominant domain over the past decade (Rajeev et al., 2017) and is now one of the most dynamic research areas in the broader SCM field (Martins & Pato, 2019). The development of this stream of research is often attributed to the general increase in sustainability concerns following the 1987 issuing of the "Report of the World Commission on Environment and Development: Our Common Future" by the United Nations. That report, often referred to as the Brundtland Report, offered a definition for sustainable development that has since become a standard definition for sustainability in many fields: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). It was not long after that the business concept of the triple bottom line (TBL) emerged, which advocated for companies to measure performance in areas of social

responsibility and environmental impact, in addition to traditional financial measures of performance (Elkington, 1998). Combining these ideas, Slawinski and Bansai defined business sustainability as "the ability of firms to respond to short-term financial, social, and environmental demands, without compromising their long-term financial, social and environmental performance" (2010, p. 1).

The development of supply chain management as an academic discipline largely coincided with the growing awareness of issues related to sustainable development. As the idea of sustainability became prominent in business, it was only natural that the concept be extended to supply chain management since many of the business practices associated with SCM were already intended to increase efficiencies, reduce waste, and mitigate risks among global networks of firms. One definition of sustainable supply chain management that emphasizes the role of sustainability in business practices is, "the set of supply chain management policies held, actions taken, and relationships formed in response to concerns related to the natural environment and social issues with regard to the design, acquisition, production, distribution, use, reuse, and disposal of the firm's goods and services" (Haake & Seuring, 2009, p. 285; Zsidisin & Siferd, 2001, p. 69).

Organizational motivations for pursuing sustainability within supply chains can be similar to those for traditional supply chain management, namely reducing risk and creating competitive advantage. Particularly for firms with consumer facing brands, the business practices of suppliers can be a major vulnerability to a brand's reputation. Clothing retailers, for example, have often been subject to negative news coverage and subsequent consumer pressure regarding labor issues in garment factories around the world. Documented use of child labor, long hours, substandard pay, and unsafe working conditions have forced many of the largest brands, such as Nike, H&M, Walmart, and Gap to more closely monitor the operations of companies in their extended supply chains. Attention from NGO's can also influence public sentiment, potentially weakening or strengthen a company's brand. For instance, the National Resource Defense Council recently published a sustainability "report card" for products of major tissue brands, focused largely on how the raw materials of each brand are sourced. Paper towels under the Kirkland brand of Costco and Up & Up of Target were both given "F" grades, while

brands belonging to Trader Joe's and Whole Foods received grades of "A" (Skene & Vinyard, 2019).

Working with suppliers to improve the sustainability of their operations helps firms reduce risk to their brand value by decreasing the likelihood of negative publicity. Sustainable supply chain management can also create competitive advantage by earning customer trust and increasing reliability of supplier networks (Krause et al., 2009). For organizations pursuing broader sustainability strategies though, improving sustainability within supplier networks may simply be a necessary step in achieving organizational goals. This reflects a growing realization that the sustainability of any given firm cannot exceed that of its suppliers (Krause et al., 2009; Miemczyk et al., 2012). In this context, the role of purchasing becomes central to an organization's sustainability strategy.

Minor Procurement

Over the past two decades, SSCM and green procurement research has largely focused on areas of procurement that are vital and strategically important to companies, particularly those in manufacturing and production contexts (Haake & Seuring, 2009; Boström et al., 2015; Mosgaard, 2015). From the perspective of Kraljic's (1983) stages of purchasing sophistication model, the SSCM and green procurement literatures have primarily focused on quadrants II-IV; those areas of purchasing that are of high strategic importance and/or have highly complex supply markets (see Figure 5.1 below). This is understandable, since these are the areas that have the greatest impact on profits, often account for the majority of total costs, and present the greatest risk if supplies are interrupted (Kraljic, 1983). In some cases, managing these supplier relationships can also be a key source of competitive advantage.

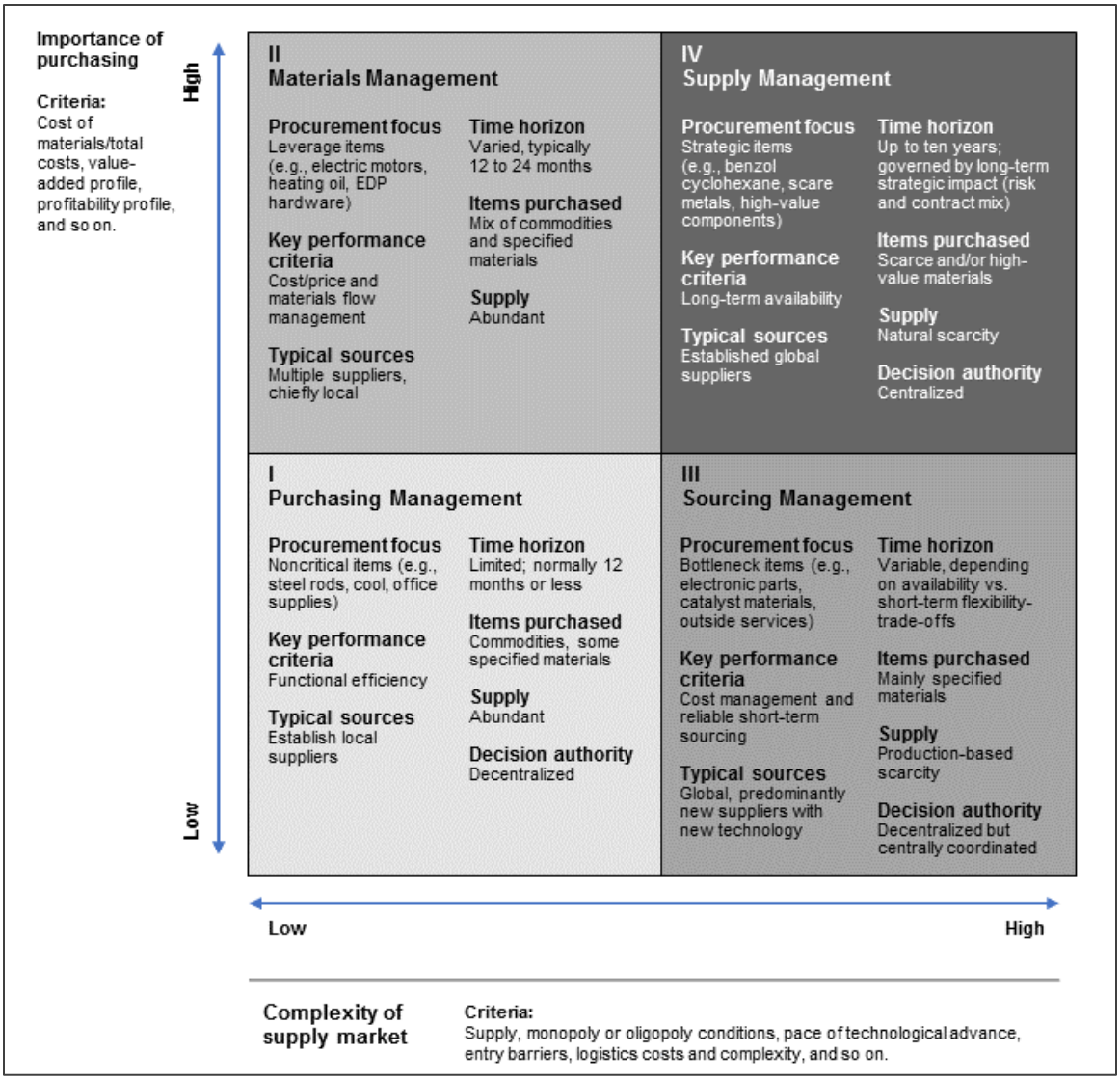

Figure 5.1 Stages of purchasing sophistication
Source: Kraljic, 1983

The current study, however, is primarily concerned with office supplies, which are classified as noncritical items in quadrant I of Kraljic's (1983) model. Referred to here as minor procurement, this generally includes all those areas of procurement that present little risk to an organization. That is, goods and services that are not part of core operations, are readily and widely available from multiple sources, have little impact on profits, are not strongly associated with the organization's brand or image, etc. These are the areas of procurement that typically warrant minimal attention. Other examples of

minor procurement items often include commercial cleaning products and janitorial supplies, landscaping services, cafeteria food, and travel arrangements.

Although minor procurement is rarely prioritized in the SSCM practices of most organizations and has received only limited attention in the SSCM literature, it can nonetheless pose a significant risk to environmental sustainability. Consider, for instance, the role of minor procurement in service industries. According to one commonly cited study involving the procurement practices of 216 firms, the Danish Environmental Protection Agency found that minor items accounted for approximately 50% of total procurement by value among service providing companies, compared to about 10% among production companies (Danish EPA, 2010).

It is worth noting here that HEIs are generally considered to be service providers. According to the North American Industry Classification System, colleges, universities, and professional schools belong to the educational services sector (NAICS 6113), which is classified as a service-providing industry along with sectors such as arts and entertainment, retail trade, finance and insurance, health care, and food services. As growth in service sectors outpaces that in manufacturing, especially in developed economies, the share of total procurement accounted for by minor items can be substantial. Furthermore, minor procurement items can themselves represent huge industries with major impacts on the environment. For example, the office stationery wholesaling sector in the United States (NAICS 424120), which includes companies such as Staples Inc. and Veritiv Corporation, sold approximately $34 billion worth of paper products in 2019 (Patel, 2019). When taken together, the value of these products and the potential environmental impact of their production should merit greater consideration from procurement professionals.

Sustainable Procurement in the Higher Education Context

Formal policies that are developed to guide purchasing decisions by taking into account environmental sustainability are often referred to as Environmentally Preferable Purchasing (EPP) programs or simply “Green Procurement.” In the United States, EPP programs were initially developed by state and federal government agencies to encourage “the purchasing of environmentally preferable products/services whose environmental impacts have been considered and found to be less damaging to the environment and

human health when compared to competing products/services" (Li & Geiser, 2005, p. 707). Although initially developed for use in the public sector, EPP or broader sustainable procurement policies can now be found in many contexts such as healthcare (see Kaiser Permanente, 2012), retail dining (see Starbucks, 2006), and consumer technology (see Apple, 2019).

In the context of higher education, universities are increasingly placing greater emphasis on sustainability in procurement functions. According to the National Association of Educational Procurement (NAEP), results from their annual Green Procurement Survey indicated that 40% of responding institutions had a formal green procurement policy in 2016, up from 24% in 2009 (NAEP, 2016). Data from the Association for Advancement of Sustainability in Higher Education (AASHE) show that, among the 341 institutions with current ratings in the Sustainability Tracking and Reporting System (STARS), two-thirds (n = 226) "have written policies, guidelines or directives that seek to support sustainable purchasing across commodity categories institution-wide" (AASHE, 2020).

Sustainable procurement programs in university contexts can be broad, addressing a variety of expenditure areas such as energy and power purchase agreements, construction and renovation projects, food and beverages, professional services, and capital equipment. Environmentally preferable purchasing policies though are often more narrowly focused on commodity products that support the day to day operations of universities, such as cleaning products, office supplies, furniture, etc. Due to the vast selection of these kinds of products, it is not feasible for procurement managers to assess the relative environmental attributes of all competing products. Instead, EPP policies typically rely on third party certification systems to identify and assign purchasing preference to different products. Examples of certification systems commonly utilized in EPP guidelines include BIFMA Level for institutional furniture, EPEAT and ENERGY STAR for consumer electronics, BPI for compostable products, OEKO-TEX for textiles, SaferChoice for chemical ingredients, and WaterSense for water efficiency of consumer products. Green procurement guidelines recently implemented across the University of California cited nearly two dozen different certification programs to be considered when purchasing various goods (UC, 2020).

Paper Purchasing in Higher Education: Policies and Trends

Seemingly all EPP guidelines for paper products focus on recycled content and/or certification programs that ensure responsible sourcing. The basis for many EPP guidelines, including those related to paper products, is the Comprehensive Procurement Guideline program developed by the U.S. Environmental Protection Agency (EPA). This program is intended to reduce materials use in government operations and promote greater utilization of recovered waste materials by requiring federal agencies to maximize recovered content when purchasing certain types of products. The Comprehensive Procurement Guidelines cover 33 different types of paper products with recommended levels of post-consumer recycled fiber for each, including, for example, copy paper (30%), notepads (30%), envelopes (10-20%), bathroom tissue (20-60%), napkins (30-60%), corrugated containers (25-50%), and tray liners (50-75%) (EPA, 2007).

As noted in the previous section, most EPP guidelines rely on third-party certification systems to assign purchasing preferences based on sustainability attributes. For paper products, the most commonly cited certifications in the United States are those of the Forest Stewardship Council (FSC), the Sustainable Forestry Initiative (SFI), and the Programme for Endorsement of Forest Certification (PEFC). Though the policy details, requirements, and administration methods of these certification schemes can differ substantially, the general focus of these programs is how and where wood materials are being sourced. Among NGO's, the FSC certification system is often held in highest regard in terms of operational standards and governance structure (World Wide Fund For Nature, 2015; Skene & Vinyard, 2019; Environmental Paper Network, 2018). Additionally some third-party certification programs focus on sustainability aspects of the manufacturing processes used in paper production. The Green Seal certification and UL's ECOLOGO program consider factors such as the chemicals used as bleaching agents, noxious emissions, fiber use efficiency, and potential contributions to acid rain and climate change.

With regard to recycled content, many universities have established or proposed procurement policies that prioritize high levels of recycled content as a key consideration in purchases of paper products. Colgate University, for example, proposed a policy in 2012 that would eliminate purchases of non-recycled office paper, as did American

University in 2013. Princeton University implemented a University-wide policy in 2004 requiring all printing, copying, and writing grade papers to be certified 100% post-consumer recycled content. This policy identifies Aspen 100, produced by Boise Cascade, as the preferred product for purchases made through the University's OfficeMax supplier catalog. Furthermore, the policy states that "OfficeMax will ship Aspen 100, (Part #P1054922) in lieu of all other general purpose office paper," as an apparent effort to enforce the purchasing policy (Princeton University, 2004).

To help understand how prevalent such commitment to purchasing recycled content paper is among universities, annual purchasing data representing 247 AASHE member institutions in the U.S. were analyzed. Products with "FSC-Recycled" certification or an equivalent 90% post-consumer recycled content (PCRC) accounted for 100% of office paper expenditures at approximately 5% (n = 12) of institutions, at least 90% of office paper expenditures at nearly 10% of institutions (n = 23), and at least half of all office paper expenditures at 39 institutions (15.7%). Among the 39 institutions reporting at least half of all office paper expenditures on FSC-Recycled products, approximately half (n = 21) were private and the remaining public, including some large research institutions such as the Universities of Iowa, Washington Seattle, and California Berkley.

Research Framework

Understanding and, ultimately, being able to predict human behavior has long been the focus of much research in the social sciences. Cognitive consistency theories heavily influenced psychology research in the mid-twentieth century, with the assumption of attitude-behavior consistency at the core of many behavioral studies. As such, behavioral dispositions, such as general attitudes and personality traits, received much attention early on as possible measures for predicting specific behaviors. Evidence supporting the purported relationships, however, was inconsistent and generally weak. This lack of support for causal relationships between attitudes and associated behaviors led some researchers to doubt the relevance of attitudes in behavioral decision-making processes (see Abelson, 1972; Wicker, 1969). The theory of reasoned action (TRA) (Fishbein, 1967) and, by extension, the theory of planned behavior (TPB) (Ajzen, 1985), were

developed to better explain the role of attitudes in the formation of intentions and, ultimately, in determining actual behaviors.

With regard to attitudes, Fishbein first concluded that general attitudes toward a topic and attitudes toward specific behaviors associated with the topic are not equivalent predictors of behavior (1967). For example, attitudes about environmental sustainability would likely be a far weaker predictor of recycling behaviors than would attitudes toward recycling. Although it may seem intuitive, the realization that the predictive power of attitudes on behaviors depends in part on how closely their measures correspond with one another was unexpected. This was because values and knowledge, which are the foundations of beliefs on which attitudes can be formed, are thought to be stable across contexts (Fishbein & Ajzen, 2011). As such, it was expected that general attitudes would influence behaviors in consistent ways across different contexts. In developing the TRA, Fishbein emphasized the need to understand the impact of contextual factors on behavioral decisions (1967).

The TRA and TPB models are presented below in Figure 5.2. A simplistic explanation of TPB is that, according to the model, behavior is a function of salient beliefs applicable to the behavior (Ajzen, 1991).

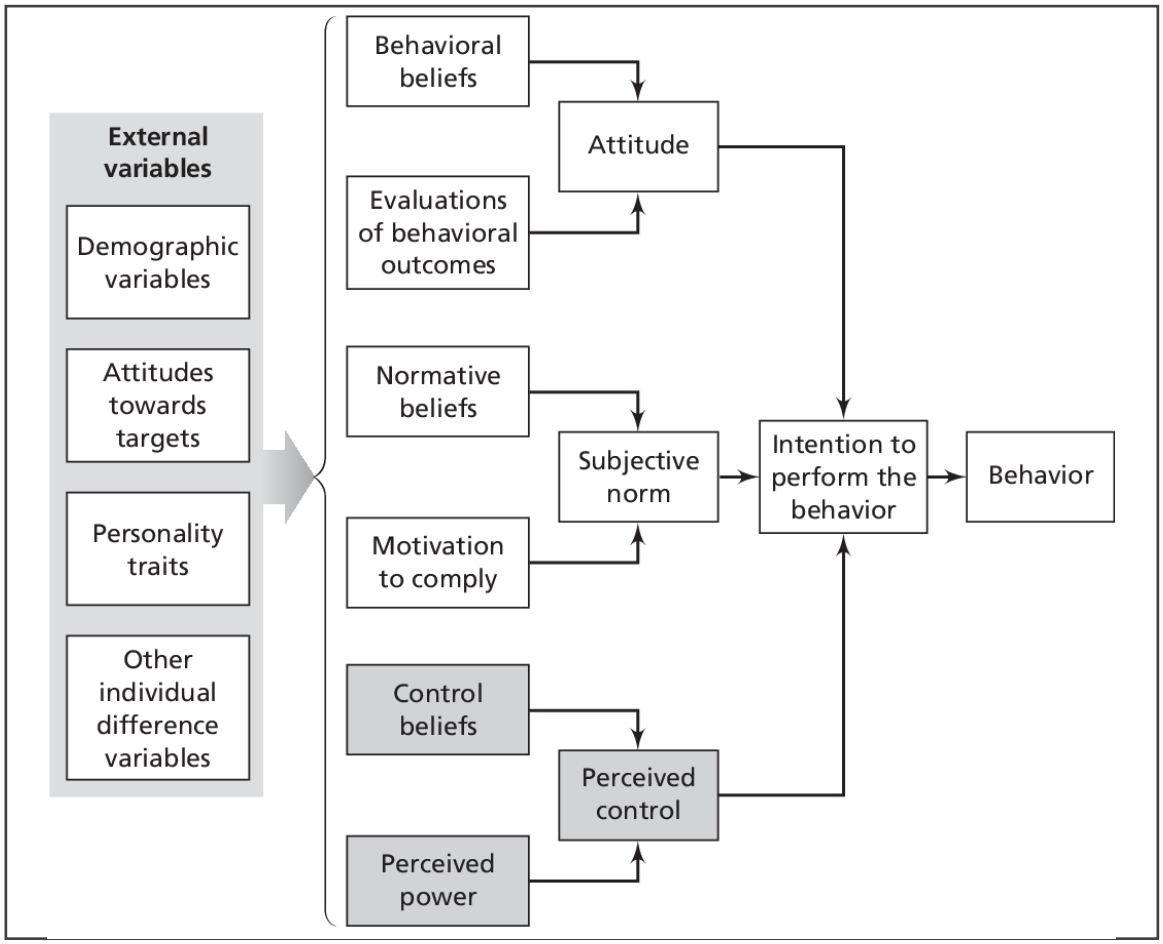

Figure 5.2 Theory of reasoned action and theory of planned behavior
Note: Unshaded boxes in upper part show the Theory of Reasoned Action; entire figure shows Theory of Planned Behavior
Source: Montaño & Kasprzyk, 2015, p. 98

As was noted earlier, TPB is an extension of TRA, with the fundamental difference being the addition of perceived control (see Figure 5.2 above). Including a measure of control as a predictor to behavioral intention is an acknowledgement that few behaviors are entirely volitional, as most require at least some kind of resource (ex., ability, opportunity, knowledge, skill, etc.) that is not universally held by all people. Central to both theories though is the direct relationship between behavioral intention and behavior. According to Ajzen (1991), "intentions are assumed to capture the motivational factors that influence a behavior; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior" (p.

181). The general expectation, then, is that the likelihood of performing a behavior increases as the strength of the behavioral intention increases.

The theory of planned behavior has become one of the most prominent frameworks for explaining sustainability related behaviors of individuals (Norton et al., 2015). For example, TBP has been used to explain decisions to engage in sustainable agricultural practices, environmental activism, household waste reduction, recycling, energy conservation, carpooling, and use of public transportation (Fielding, Terry, Masser, & Hogg, 2008; Fielding, McDonald, & Louis, 2008; Graham-Rowe, Jessop, & Sparks, 2015; Tonglet, Phillips, & Read, 2004; Abrahamse & Steg, 2009; Bachmann, Hanimann, Artho, & Jonas, 2018; Heath & Gifford, 2002).

Similarly, TPB is also commonly used to explain consumer behaviors involving green purchasing decisions. Some examples of green purchasing behaviors the TPB framework has been applied to include decisions related to consumer electronics, organic personal care products, eco-friendly restaurants, product packaging, organic food, local food, and green hotels (Young et al., 2010; Yeon Kim & Chung, 2011; Kim, Njite, & Hancer, 2013; Martinho et al., 2015; Yazdanpanah & Forouzani, 2015; Kumar & Smith, 2018; Han, Hsu, & Sheu, 2010).

Of particular interest to researchers investigating these types of purchasing decisions is what is known as the "attitude-behavior gap," which describes the difference between a person's general attitude about an issue and their actual behavioral decisions related to that issue. For example, a large proportion of consumers may report being concerned about climate change yet only a small minority of those same consumers choose to purchase electricity exclusively from renewable sources. The attitude-behavior gap here is represented by those consumers who express concern for the climate but fail to translate those concerns into purchasing behaviors that align with their attitude. Factors that constrain green purchasing decisions may include a lack of knowledge about the product, limited availability, and sacrifices in terms of performance, costs, or convenience (Moser, 2015).

Interestingly, as widely applied as TPB has been to green purchasing for personal consumption, there appear to be far fewer examples of its application to purchasing in organizational contexts. One identified study utilized survey data from 257 supply

managers representing a variety of industries (Swaim et al., 2016). Using a TPB framework, Swaim and colleagues found pro-environmental attitudes of supply managers to be the strongest predictor of environmental behavioral intentions, particularly in cases where the managers perceive ambiguity regarding the sustainability objectives of their organization (2016). Another study published in 2016 investigated determining factors of sustainable procurement behaviors among 206 government procurement managers (Nadeem et al.). This study utilized an adapted TPB framework to conclude that environmental awareness of procurement managers is positively related to sustainable procurement behaviors but is mediated by their affective commitment to change.

Research applying the TPB framework to explain green purchasing decisions in organizational contexts remains scarce. Among this limited research literature, no studies have been identified that investigate purchasing behaviors of administrative staff employees. Considering the impact that minor procurement can have on organizations' sustainability performance, we apply the TPB framework here to understand green purchasing decisions for office supplies in the context of a large university with a decentralized purchasing system. The extended TPB research model and path diagrams of hypothesized relationships in the study are presented in Figures 5.3 and 5.4 below.

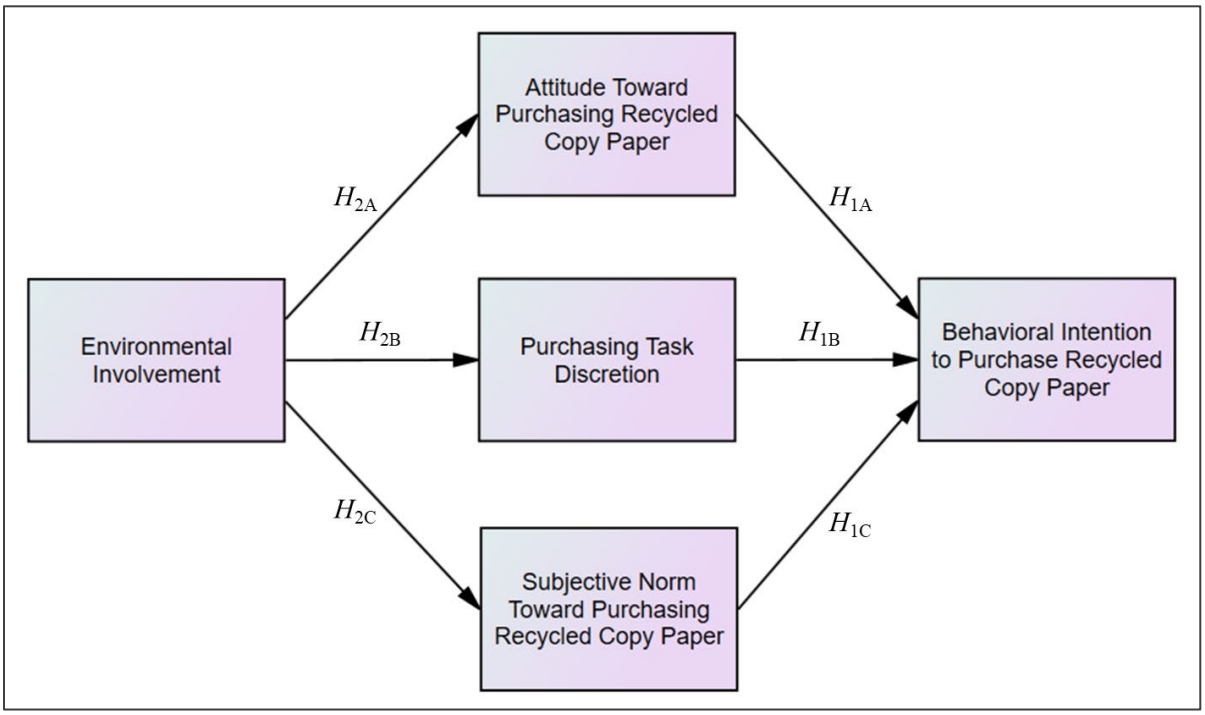

Figure 5.3 Path diagram of hypothesized direct relationships

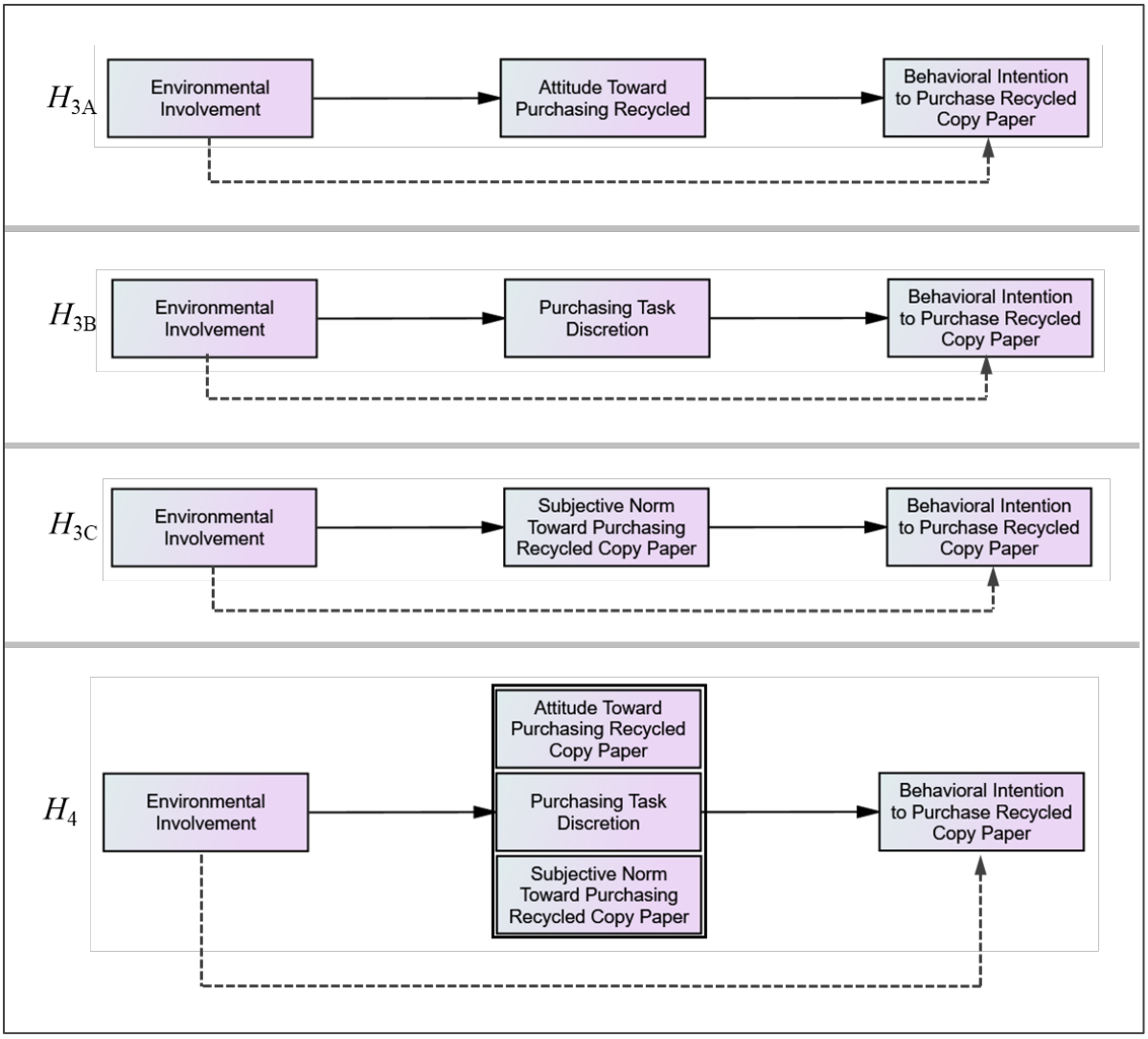

Figure 5.4 Path diagrams of hypothesized indirect relationships

Hypothesis Development

Attitude

Key to both TRA and TPB is that attitudes toward behaviors are not the same as attitudes about the broader subject, or "object," affiliated with the behavior. Although attitude toward a behavior is expected to be reflective of that toward the broader object, the behavioral attitude is driven by more salient beliefs relevant to the specific behavior in question. Behavioral beliefs describe the expected outcomes or attributes of performing a behavior. Beliefs about the outcomes of behaviors, combined with

evaluations of the likelihood of those outcomes, form the basis of behavioral attitudes that can encourage or discourage engagement in the behavior. Thus:

> ***Hypothesis 1A*:** Attitude toward purchasing recycled copy paper significantly and positively influences intentions to purchase recycled copy paper.

Subjective Norm

The social environment in which people live can strongly influence their behavioral intentions. The influence of the social environment on behavior is reflected in the idea of social norm, which generally refers to behavior that is approved of or deemed acceptable among members of a social context, such as a team, community, or broader society (Fishbein & Ajzen, 2011). Although social norms are shared and established collectively among many members of a group, the perceived pressure to comply with those norms is often associated with just one or a few people representative of that group. That is, people tend to focus more on gaining the perceived approval of select individuals rather than the perceived approval of group members more generally.

Subjective norm, the second determinant of intention in the TPB, considers the role of social pressure in the formation of intentions. Subjective norm is defined as an individual's perception that most people who are important to them think they should or should not perform a particular behavior (Fishbein & Ajzen, 2011). The strength of subjective norm in influencing behavioral intention results from both the perceived approval or disapproval of important referent individuals as well as personal motivation to comply with those referents (Montaño & Kasprzyk, 2015).

As with the other determining factors of the TPB model, subjective norm is behavior specific since the influence of a normative referent on behavioral intention may differ by situation. For purchasing behaviors in an organizational context, perceived pressures may come from supervisors, coworkers, organizational leaders, clients, customers, etc. Employees' motivations to comply with these pressures likely differ by their source. Perceptions of approval or disapproval of a behavior among normative referents and the

motivation to comply with those referents form the basis of subjective norms that can encourage or discourage engagement in the behavior. Thus:

> ***Hypothesis 1B*:** Subjective norm toward purchasing recycled copy paper significantly and positively influences intentions to purchase recycled copy paper.

Purchasing Task Discretion

The final determinant of the TPB model, and that which distinguishes TPB from TRA, is perceived control. By adding perceived control as a determinant of intention, Ajzen (1991) extended TRA to address that model's "limitations in dealing with behaviors over which people have incomplete volitional control" (p. 181). Beyond having a favorable attitude toward a behavior and a subjective norm that is supportive of it, individuals must also believe they possess the requisite resources and opportunities for performing the behavior. Perceived control is defined as "the extent to which people believe that they are capable of, or have control over, performing a given behavior" (Fishbein & Ajzen, 2015, p. 155).

There are many additional constructs and definitions in the literature that relate to the idea of control, including achievement motivation, agency, self-determination, and autonomy to name just a few. Among these, Bandura's (1977) concept of self-efficacy is most closely related to perceived control. Like perceived control, self-efficacy is context-specific and refers to "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3).

In TPB studies, perceived control is often conceptualized such that it represents both the capacity and autonomy to perform a target behavior. Behavioral capacity is often associated with internal sources of control (ex., skills or willpower) whereas behavioral autonomy is more associated with external sources of control (ex., authority, money, access to resources, etc.) (Fishbein & Ajzen, 2009). For minor procurement activities in an organizational context, behavioral capacity is not thought to be highly influential in predicting purchasing behaviors. Many office supplies, especially standard copy paper, are commodity-type products that typically do not require specialized knowledge or skills

to purchase. Furthermore, it is unlikely the capacity to purchase copy paper with recycled content would differ from the capacity to purchase copy paper without recycled content.

Autonomy, however, is an influential factor in organizational contexts. The concepts of task autonomy and task discretion have been heavily studied in job design, and have been shown to influence employee motivation, work effectiveness, job satisfaction, and employee well-being (Hackman & Oldham, 1976; Karasek, 1979). Task discretion describes the ability of employees to influence the way they carry out their immediate work activities (OECD, 2017). Just as perceived control reflects, in part, the autonomy to participate in a target behavior, task discretion reflects the autonomy to complete a task by way of participating in a target behavior. Thus:

> ***Hypothesis 1C*:** Purchasing task discretion significantly and positively influences intentions to purchase recycled copy paper.

Environmental Involvement

The concept of involvement is rooted in psychology (see Sherif & Cantril, 1947) but most well-known for its applications in consumer behavior research, where it was further developed to study consumer engagement with advertisements, products, and purchasing decisions (see Cohen, 1983). Consumers can experience high involvement with products, brands, messages, issues, and ideas. Fundamental to involvement is personal relevance. That is, the more relevant a consumer perceives an object to be, based on their inherent needs, values, and interests, the more involved that consumer will become with the object (Zaichkowsky, 1985).

In the case of the environment, consumers with high involvement are more likely to be aware of environmental issues and, importantly, perceive those issues to be personally relevant. Consumers highly involved with the environment are intrinsically motivated to limit their negative impact on the environment, feeling compelled to make sacrifices in order to so do (Wei, et. al., 2017). High involvement contributes to attitude formation, from which behaviors can be linked. For instance, consumers with high environmental involvement (EI) have been shown to be more sensitive to environmental attributes of

products, whereas consumers with low environmental involvement may not respond to those attributes or may discount their value (Schulwerk & Lefkoff-Hagius, 1995).

Within the TPB framework, the direct relationships between the core TPB constructs and the formation of behavioral intentions are reliant on compatibility between the behavioral target and the attitude, subjective norm, and perceived control associated with it. Environmental involvement, however, is reflective of a general attitude. General attitudes do not affect specific behaviors directly, but instead indirectly by directly influencing perceptions of behavioral, normative, and control beliefs (Ajzen & Fishbein, 1980; Bamberg, 2003; Chen & Tung, 2014). Thus:

> ***Hypothesis 2A*:** Environmental involvement significantly and positively influences attitude toward purchasing recycled copy paper.
>
> ***Hypothesis 2B*:** Environmental involvement significantly and positively influences purchasing task discretion.
>
> ***Hypothesis 2C*:** Environmental involvement significantly and positively influences subjective norm toward purchasing recycled copy paper.
>
> ***Hypothesis 3A*:** Attitude toward purchasing recycled copy paper mediates the indirect effect of environmental involvement on intentions to purchase recycled copy paper.
>
> ***Hypothesis 3B*:** Purchasing task discretion mediates the indirect effect of environmental involvement on intentions to purchase recycled copy paper.
>
> ***Hypothesis 3C*:** Subjective norm toward purchasing recycled copy paper mediates the indirect effect of environmental involvement on intentions to purchase recycled copy paper.
>
> ***Hypothesis 4*:** The core TPB constructs of attitude, subjective norm, and task discretion collectively mediate the indirect effect of environmental involvement on intentions to purchase recycled copy paper.

Methodology

Context

The organizational context for this study was a flagship research university in the United States, specifically the Pennsylvania State University. Founded in 1855 as the state's first and only land-grant institution, Penn State University is now the largest public university in Pennsylvania, with over 97,000 students[8] enrolled across 26 campuses and affiliated locations[9]. Additionally, the University has over 35,000 employees, approximately 90% of whom are employed on a full-time basis[10] (PSU, 2019). In terms of paper consumption, the university purchases in excess of 150k reams of copy paper in a typical year, though that quantity has been steadily decreasing in recent years.

Sustainability is prominent throughout the organizational operations of Penn State. In 2016, the university appointed its first Chief Sustainability Officer. The university's Sustainability Institute supports teaching, research, and community engagement efforts aimed at increasing sustainability literacy and commitment toward sustainable practices. Among other things, these efforts include administering a voluntary sustainable office certification program that faculty and staff can participate in. Since 2011, the university has also continuously participated in the Sustainability Tracking, Assessment, and Rating System (STARS), the leading sustainability reporting system among institutions of higher education. The university currently has a gold rating in the STARS program and leads its peers in the Big 10 conference with the highest overall STARS program score (AASHE, 2021).

The research population of the study was employees with purchasing responsibilities for non-critical items (i.e., minor procurement), particularly office supplies. Penn State

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[8] Includes students at all levels of academic standing and enrollment, as of Fall 2018.

[9] Includes main campus at University Park, 19 Commonwealth campuses, as well as the Dickinson School of Law, Great Valley School of Graduate and Professional Studies, Penn State Hershey College of Medicine, Penn State Law, the Pennsylvania College of Technology, and the World Campus

[10] Does not include student workers (work study, student interns, graduate assistants/fellows, etc.), as of Fall 2018.

has a largely decentralized purchasing system, in which purchasing authority is widely distributed among thousands of employees. Since a large majority of office supplies, and the vast majority of copy paper, consumed by Penn State are procured through the university's electronic purchasing catalog, the research utilized data from Purchasing Services to determine the size and identify members of the research population.

Although over 3000 employees typically complete at least one purchase through the university's online purchasing system each year (Sheth, 2018), this study focused only on those employees who had purchased copy paper products. More specifically, the research focused only on those employees who had purchased standard copy paper products in FY 2019-2020. That is, copy paper that is letter size (8.5"x11"), white in color, 20lb. in weight per 500 sheets, and 92 brightness. Common non-standard copy paper products include those of different sizes (e.g., legal, ledger, etc.), higher weight and/or greater thickness, higher/lower brightness, and assorted colors.

Limiting the study to purchases of a single type of product was advantageous for multiple reasons. First, the product attributes on which purchasing decisions are made were directly comparable across purchasing outcomes. Since all products had the same functional attributes (i.e., size, weight, color, application, etc.), the effect of differences in price, environmental certifications, and fiber content should be more pronounced. Furthermore, studying purchases of a single type of product reduces the variability in how buyers evaluate and compare different sustainability related attributes. For copy paper products, the primary sustainability related attributes are environmental certifications and fiber content (i.e., recycled vs. virgin). Finally, limiting the study to a single type of product allowed for "apple to apple" comparisons between purchasing decisions. That is, since all of the products included in the analysis were direct substitutes of one another, a decision to purchase one was effectively a decision not to purchase another. In this way, the sampling design was guided by the principle of compatibility by aligning the sample identification process with the specific behavior being studied.

Sampling Design

An initial analysis of purchasing data was conducted to determine the approximate size of the research population. Organizational purchasing data for orders of office and janitorial supplies from FY 2018-2019 were obtained, representing approximately 19,000 unique items. Filters using keywords were then applied to the item descriptions of the approximately 19,000 items to identify paper product. After multiple rounds and variations of filters were applied to the purchasing data, the list of identified paper products included 719 unique items. Using keywords associated with copy paper as filters, this same process was then repeated on the 719 paper product items, with the results then being further filtered to identify standard copy paper items. Once completed, the list of standard copy paper products included 58 unique item numbers. It was found that only 24 of these items accounted for more than 98% of the total spend on standard copy paper products.

The 24 standard copy paper product items served as the basis for initially identifying and estimating the size of the research population during the planning phase of the study. To estimate the size of that population, a representative from Purchasing Services pulled all purchase orders from the 2019 calendar year containing any of those 24 item numbers, then exported and anonymized the Penn State user ID associated with each purchase order. Analysis of the resulting purchase order data indicated there were approximately 3500 orders involving the 24 item numbers, placed by 924 unique buyers. Thus, the initially estimated size of the research population was 900-950 members.

The final research population was based on a slightly modified list of 26 copy paper products purchased in FY 2019-2020. Purchasing history for these products was obtained from Purchasing Services, covering an approximately 12 month period prior to the survey's administration in June 2020, roughly representing the 2019-2020 FY. Purchasing data included the order date, order number, product item number, quantity purchased, and the user ID (ex., ABC123) of the employee who submitted the order. The data represented approximately 3000 unique purchase orders, each including at least one of the 26 copy paper products. Only university employees who submitted purchase orders totaling at least ten reams (or one case) of copy paper during the research period were selected to participate in the study, resulting in a final research population of 873 cases.

Of particular interest to the study were employees in administrative support roles, as these employees are most often responsible for minor procurement of office supplies. To verify the composition of the research population, a random sample of 60 cases were selected for job title identification using the organization's electronic directory. Of the 60 cases identified, 53 (88%) had job titles associated with administrative responsibilities (ex., administrative assistant, office manager, financial assistant, administrative support coordinator, assistant director, etc.), suggesting the sampling procedure would effectively identify the target population.

Measures and Questionnaire Design

Due to rapidly changing research protocols during the COVID-19 pandemic in early 2020, traditional elicitation phase activities could not be carried out. In TPB studies, the elicitation phase ideally involves focus groups and/or direct interviews to identify commonly held salient beliefs associated with the behavior being studied since such salient beliefs are assumed to be the antecedents of the core TPB constructs. Considering the well-defined context (i.e., intentions of university employees to purchase recycled copy paper) and homogenous population, however, eliciting responses was unlikely to produce unique insights. Instead, behavioral beliefs and sources of normative pressure were identified through literature review and consideration of contextual factors. The final survey instrument was pretested by administering the questionnaire to a small group of participants (n = 5), including members of the research population and subject matter experts, to ensure functionality of the instrument and contextual appropriateness of the terminology used.

All items were measured using the same 7-point Likert-type scale with anchors of Strongly Agree to Strongly Disagree. While such design can potentially introduce limitations with regard to item structure and wording, the consistency in the measurement scale simplified the design of the questionnaire, greatly reducing visual complexity and its overall length. This is particularly important for TPB studies in which the core TPB variables are composed of multiple pairs of indicator variables, contributing to long surveys and the likelihood of lower participation/completion rates. This method of item scaling was based the organizational TPB research of Greaves and colleagues (2013). Descriptions of the items and scaling procedures are provided below. To explain how the

final measures used in study were obtained, some preliminary item analysis is also presented as part of the methodology.

Subjective norm was calculated as a latent variable reflecting both normative beliefs and motivations to comply with the associated referent groups. Since the research is focused on purchasing behavior in a professional capacity (as opposed to purchasing for personal use), referent groups specific to the organizational context were selected as these are of most interest to the research and likely to be among the most salient for employees.

Specifically, normative belief strengths were measured by asking participants if they agreed/disagreed that each of the following groups would approve of their purchasing recycled copy paper: my supervisor (IN1), my coworkers (IN2), students (IN3), faculty (IN4), and university leadership (IN5). Similarly, participants were also asked about their motivation to comply with each of these groups (ex. "when it comes to purchasing copy paper, I want to do what _____ thinks I should do") (MC1-MC5). Taking motivation to comply into account effectively weights the behavioral beliefs of important referents while discounting those of unimportant referents. Finally, a direct measure item for normative pressure was also included ("most people who are important to me think I should purchase recycled copy paper") (SND) as a means of confirming the saliency of the identified referent groups and the validity of the latent subjective norm variable.

Following the recommendations of Fishbein & Ajzen (2009), normative belief strength items were scored on a bipolar scale (-3 to 3) while motivation to comply items were scored on a unipolar scale (1-7). The reason for doing this is that the scores for each pair of items were then multiplied to produce an overall score (ex., IN1xMC1=SN1) reflecting the strength and direction of perceived pressure from each referent group (SN1-SN5), potentially ranging from -21 to +21. Table 5.1 below presents descriptive statistics for the normative belief (IN), motivation to comply (MC), and INxMC product measures for each of the referent groups, as well as correlations of the INxMC product measures with the direct measure of subjective norm.

Table 5.1 Descriptive statistics for subjective norm measures

Referent Group	Normative Belief (IN) [a]		Motivation to Comply (MC) [b]		INxMC (SN) [c]		Correlation
	x	(SD)	*x*	(SD)	*x*	(SD)	INxMC with SND
My supervisor	1.92	1.04	5.00	1.30	9.74	6.20	0.36 ***
My coworkers	1.62	1.12	3.79	1.41	6.38	5.48	0.47 ***
Students	0.95	1.12	3.16	1.42	3.35	4.95	0.23 **
Faculty	1.13	1.21	3.72	1.37	4.60	5.52	0.32 ***
University leadership	1.79	1.04	5.51	1.24	10.15	6.63	0.34 ***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[a] Scored on a bipolar scale of -3 to +3; [b] Scored on a unipolar scale of 1 to 7; [c] Possible range of -21 to +21, actual range was -12 to +21

As can be seen in Table 5.1 above, respondents on average identified their supervisors (x = 1.92) as being most supportive of purchasing recycled paper, followed by university leadership (x = 1.79) and coworkers (x = 1.62). Their motivation to comply with university leadership (x = 5.51) was substantially stronger than with coworkers (x = 3.79). Considering both measures in conjunction with one another, the INxMC product represents a measure of belief strength weighted by the motivation to comply with those beliefs. From this, it can be inferred that university leadership is the primary source of normative pressure to purchase recycled copy paper, followed by supervisors (x = 10.15 and 9.74, respectively). Interestingly though, it was the weighted belief measure for coworkers that correlated (0.48) most strongly with the direct measure of subjective norm (SND), suggesting coworkers may be the most salient among the identified referent groups for university employees.

Finally, there is some debate in the literature about the practical value provided by separately measuring motivations to comply for different referent groups, with some prominent studies finding the additional measures do little to nothing to improve the prediction of subjective norms (eg., Montaño, et. al., 1997; Sayeed et al., 2005). It was found in this study that the direct measure of subjective norms (SND) correlated slightly more strongly with the composite measure of the INxMC products (.47, p <.000) than with the composite measure of normative beliefs alone (.45, p <.000).

Like the measures of subjective norm, attitude items (IA1-IA7) were also composite measures, in this case composed of item pairs measuring behavioral beliefs and evaluations. The beliefs and evaluations addressed issues commonly associated with

recycled copy paper. Specifically, behavioral beliefs were measured by asking participants if they agreed/disagreed that purchasing recycled copy paper: helps my unit/department be more sustainable (BB1), leads to paper jams and other printer malfunctions (BB2), helps prevent deforestation (BB3), increases the operating expenses of my unit/department (BB4), helps to conserve our natural resources, (BB5), hurts communities that rely on the forest products industry for jobs and economic growth (BB6), and can support local business (BB7). Items BB2, BB4, and BB6 were reverse coded. The final item (BB7) was contextually specific as a key supplier of recycled copy paper is located in the same region as the university. Behavioral belief items were scored on bipolar scale ranging from -3 to +3.

Whereas behavioral beliefs items are intended to measure the subjective probability that a behavior leads to a particular outcome (ex., purchasing recycled copy paper leads to paper jams), behavioral evaluation items are intended to measure positive or negative perceptions of the outcome. This approach of measuring outcome beliefs paired with outcome evaluations is based in the expectancy-value model of attitude formation (Fishbein, 1963). Behavioral evaluation (BE1-BE7) items asked respondents if they agreed/disagreed with statements assessing the value of each outcome (ex., "deforestation is a serious problem"; "it is important to help my unit/department be more sustainable") and were scored on a unipolar scale ranging from 1 to 7. Product scores of behavioral belief and evaluation items were calculated for each outcome (ex., BB1xBE1 = ATT1) as indicators of the instrumental attitude latent variable (ATT1-ATT7).

In line with recognized best practices for TPB studies, direct measures of attitude were also included (Fishbein & Ajzen, 2009; Oluka, et al., 2014). These measures (AD1-AD4) focused on instrumental aspects of the behavior (i.e., good, important, useful, etc.) rather than experiential aspects (i.e., pleasant, exciting, fun, etc.). Since the actual process of purchasing recycled copy paper is effectively the same for all members of the research population, items measuring experiential aspects would likely not have produced sufficient variation in responses. Direct measures of attitude asked participants if they agreed/disagreed with the following statements: purchasing recycled copy paper is a good idea (AD1), it is important to purchase recycled copy paper (AD2), purchasing recycled copy paper does more harm than good (reverse-coded; AD3), and purchasing recycled

copy paper is worthwhile (AD4). The four direct measure items were scored on a unipolar scale ranging from 1-7 and averaged to create a composite score of attitude (α = 0.73) to measure correlations with the identified behavioral outcomes. Table 5.2 below presents descriptive statistics for the behavioral belief (BB), behavioral evaluation (BE), and BBxBE product measures for each of the identified outcomes, as well as correlations of the BBxBE product measures with the composite attitude score composed of the direct measures (AD).

Table 5.2 Descriptive statistics for attitude measures

Purchasing Recycled Copy Paper Outcome	**Behavioral Belief (BB)** [a]		**Behavioral Evaluation (BE)** [b]		**BBxBE (ATT)** [c]		**Correlation**
	x	**(SD)**	***x***	**(SD)**	***x***	**(SD)**	BBxBE with AD
Helps my unit/department be more sustainable	2.12	0.88	6.31	0.75	13.77	6.41	0.67 ***
Leads to paper jams or other malfunctions in our printer(s)	0.82	1.47	6.18	1.08	4.92	9.34	0.51 ***
Helps prevent deforestation	1.43	1.16	5.88	1.13	9.14	7.67	0.46 ***
Increases the operating expenses of my unit/department	0.11	1.33	6.46	0.75	0.77	8.83	0.20 **
Helps to conserve our natural resources	2.42	0.69	6.74	0.52	16.56	5.16	0.64 ***
Hurts communities that rely on the forest products industry for jobs and economic growth	0.61	1.20	4.45	1.22	2.55	5.46	0.19 **
Can support local business	0.90	1.19	6.18	0.92	5.81	7.78	0.34 ***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[a] Scored on a bipolar scale of -3 to +3; [b] Scored on a unipolar scale of 1 to 7; [c] Possible range of -21 to +21, actual range was -21 to +21

As can be seen in Table 5.2 above, respondents on average agreed most that helping to conserve natural resources ($x = 2.42$) and helping their department be more sustainable ($x = 2.12$) were outcomes of purchasing recycled paper. It is worth noting again that items BB2 (leads to paper jams; $x = 0.82$), BB4 (increases expenses; $x = 0.11$), and BB6 (hurts communities; $x = 0.61$) were reverse coded. As such, results for these items in Table 5.2 indicate that respondents, on average, neither agreed/disagreed or slightly disagreed that these are outcomes of purchasing recycled paper. Similarly, there was only slight agreement on average that purchasing recycled paper can support local business ($x = 0.90$).

The behavioral strength measures (ATT1-ATT7) represented both the subjective probability that the outcome would occur as well as the overall evaluation of that outcome, measured as the product of the paired responses. These results suggest that the strongest behavioral beliefs, and so those theorized to most influence attitudes, were on average associated with the outcomes of conserving natural resources (ATT5; $x = 16.56$), helping my department be more sustainable (ATT1; $x = 13.77$), and helping prevent deforestation (ATT3; $x = 9.14$). The other identified outcomes of purchasing recycled paper are less likely to influence attitudes about the behavior, either positively or negatively.

The final core predictor in traditional TPB models is, of course, behavioral control. Measures of perceived control often address separately the capacity to perform a behavior (ex., "If I wanted to, I could easily _____" or "I have the ability to _____") and the autonomy to perform a behavior (ex., "Whether or not I _____ is completely up to me" or "I have control over whether or not I _____").

In the case of the current study, it was not expected that members of the research population would face substantial challenges or obstacles to purchasing recycled paper. In the organizational context of the study, the process for purchasing recycled copy paper is nearly identical to that of virgin fiber copy paper. Access, availability, cost, and time to delivery are also effectively the same for both types of paper, with little differentiation among buyers. In general, the resources needed to purchase standard copy paper products are the same, regardless of fiber type.

Since the study is concerned with purchasing decisions related to minor procurement, measures of perceived control addressed autonomy within the purchasing function. Specifically, a single-item measure of task discretion from the European Quality of Life Survey (OECD, 2017) was slightly modified to create a measure of purchasing task discretion. The item, which asked respondents if they agreed/disagreed with the statement, "with regard to making purchasing decisions, I have a great deal of influence in deciding how to do my work" (PTD), was scored on a scale ranging from 1 to 7. Although the generalized wording of the item does not follow the principle of compatibility with regard to the behavioral criterion (i.e., purchasing recycled copy

paper), it is intended to reflect the decentralized nature of purchasing authority for minor procurement activities (see Kraljic, 1983).

Environmental involvement was measured with four items, scored on a unipolar scale from 1 to 7: “I am concerned about the environment” (EI1), “the condition of the environment affects the quality of my life” (EI2), “I am willing to make sacrifices to protect the environment” (EI3), and “my actions impact the environment” (EI4) (Schulwerk & Lefkoff-Hagius, 1995; Wei, et. al., 2017). Finally, behavioral intention was measured with three items based on standard TPB measures and scored on a unipolar scale from 1 to 7: “when purchasing copy paper, I intend to select products made with recycled content” (BI1), “I am willing to purchase copy paper that contains recycled material” (BI2), and “I plan to choose products that are made from recycled material when purchasing copy paper” (BI3).

Administration of the Survey Instrument

The questionnaire was administered online using Qualtrics. An invitation to participate in the study was emailed in July, 2020 to the university assigned (i.e., work email) address of research population members ($N = 873$). Recruitment information stated the study was for research purposes only and that participation was completely voluntary. It was also stated that the decision to participate or not to participate would only be known to members of the study team, and that all responses were confidential and would only be reported in aggregate form. Consent information was presented; voluntary consent was implied by participating in the survey. The survey remained active for a period of two weeks, during which two additional reminder emails were sent to nonrespondents. Among participants who provided full responses, the average time to complete the survey was about 11.5 minutes; 90% of respondents completed the survey in about 19 minutes or less.

In total, 263 participants provided useable data, representing an effective response rate of 30.8% and falling just short of the ideal sample size of 267 necessary for a 95% confidence interval with margin of 5%. It should be noted, however, that to meet the statistical requirements of structural equation modeling (SEM) without needing to address cases of missing data, the analyses and results that follow are based on the complete responses of 226 participants.

Demographic characteristics on which respondents and nonrespondents are compared to determine representativeness of the sample were not readily available for the broader research population. However, purchasing history was used to compare the two groups in terms of average recycled content for copy paper purchases. Average recycled content (RC) for each employee was calculated as the proportion of total copy paper purchases by weight attributed to recycled fiber. Rather than using a dichotomous variable (i.e., purchased recycled paper/did not purchase recycled paper), the calculated RC index score better reflects the range in recycled content that exists among products (typically 0%, 30%, 50%, and 100%) and so the variation in purchasing decisions. Figure 5.5 below provides a visual comparison of the sample population and broader research population on the basis of RC score, broken down into four categories of RC level.

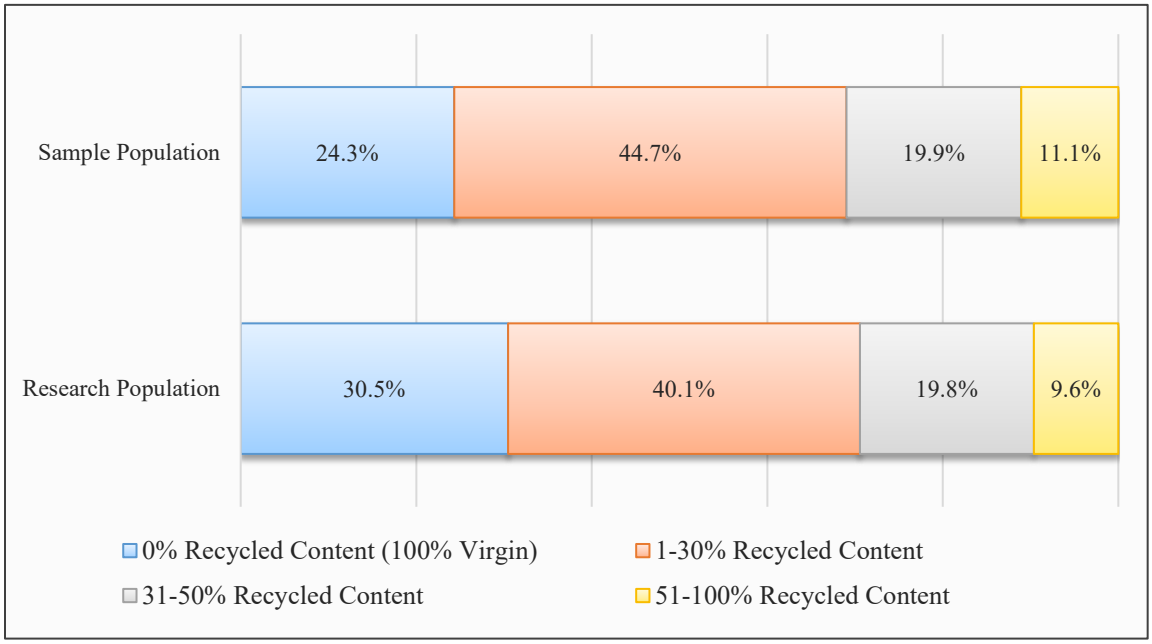

Figure 5.5 Comparison of sample population and research population, by average RC of purchases

The visual comparison in Figure 5.5 above shows the proportion of cases purchasing only 100% virgin paper was smaller for the sample population (24.3%) than the broader research population (30.5%), while the proportion averaging up to 30% RC was larger (44.7% versus 40.1%, respectively). This could suggest that some level of self-selection bias occurred among study participants. The average RC score among participants was $x = 0.308$ (30.8% RC) and $x = 0.288$ (28.8% RC) among the research population, a

statistically significant, albeit small, difference at a 95% level of confidence ($p < .000$). These results, combined with those in Figure 5.5 above, suggest that employees who only purchase virgin fiber copy paper are slightly underrepresented in the sample while those who, on average, purchase up to 30% RC paper are slightly overrepresented.

Of the study participants, 65% ($n = 171$) had job titles of administrative support assistant or administrative support coordinator, 10% ($n = 26$) had job titles of accounting assistant, financial assistant, or financial coordinator, and 5% ($n = 12$) had titles of research technologist. The remaining 20% consisted of a wide variety of titles in various other job families, such as marketing and communications, facilities management, campus operations, and student services. Notably, it is estimated that over 90% of participants were female (gender was deduced from university directory records based on respondent name and in some cases also photo). Although this proportion is quite high, it was not unexpected. Within colleges of the university, females account for 70% of staff employees (PSU, 2021), with proportions specifically in administrative support roles almost certainly higher.

Data Analysis and Results

Testing the Measurement Model

Before testing the hypothesized causal relationships proposed in the research model, psychometric properties of the constructs and their components were investigated through item analysis, confirmatory factor analysis (CFA), and reliability analysis. To prove normal univariate distribution, skewness and kurtosis was measured for all items relating to the constructs in the research model (see Figure 5.3). The potential for self-selection bias and the relative homogeneity of the research population can increase the likelihood for departures from normality in response data for particular items. Values between ±1.0 for each of these measures are considered excellent for most psychometric purposes while values between ±2.0 are generally considered acceptable (see George & Mallory, 2019; Gravetter, et. al., 2020). Skewness and kurtosis measured within ±1.0 for 15 items and within ±2.0 for an additional four items. One item from the Environmental Involvement construct (EI4) had a kurtosis value of 3.3, exceeding the recommended range and thus was removed from further analysis.

Confirmatory factor analysis (CFA) was then conducted to verify the measurement quality of the latent constructs used in the structural equation model and determine whether the item-factor structure of the proposed model supports the theorized constructs. A measurement model containing the four latent constructs of the research model and the 18 remaining indicator variables was created to calculate the factor loadings of the indicators on the associated latent constructs (Figure 5.6).

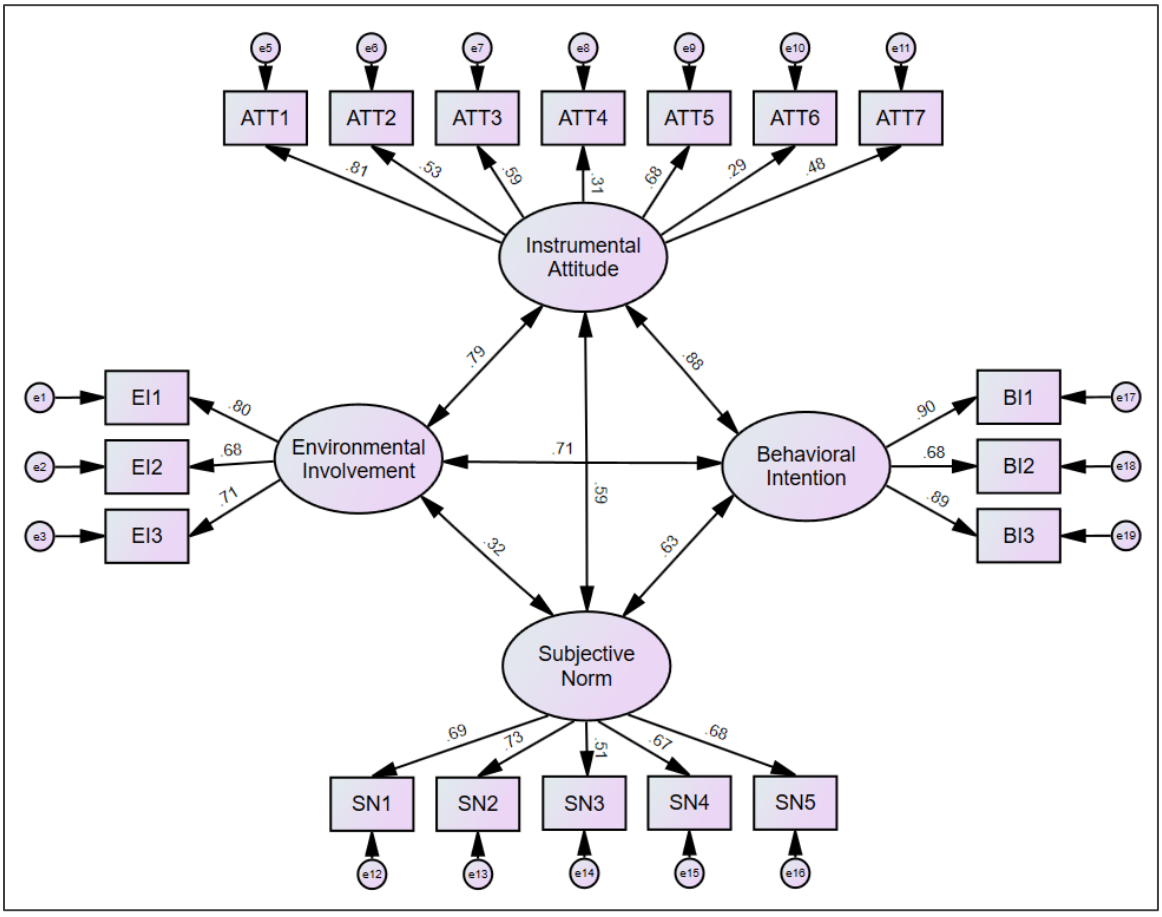

Figure 5.6 CFA results for full model containing all variables

All factor loadings in the initial measurement model were statistically significant. However, in order to determine the adequacy of each measured variable as an indicator of its latent construct, standardized loading estimates must also be considered. A general rule of thumb in CFA is that standardized loading estimates be at least 0.5 for consideration in the model and ideally 0.7 or higher (Hair, et. al., 2009). As can be seen in Figure 5.6 above, numerous indicators of the Instrumental Attitude construct have

standardized estimates below the 0.5 level (ATT4, ATT6, ATT7). The relatively low factor loadings suggest these measured variables are not strongly related to the latent construct of Instrumental Attitude and were therefore removed from the model.

The final consideration regarding the factor loadings is the communality or variance extracted for each measured variable. High factor loadings among all measured variables of a latent construct indicate they share a large proportion of common variance, supporting convergent validity of the construct. While factor loadings of at least 0.5 may be acceptable, convergent validity is best established when the average variance extracted (AVE) among all indicators of a particular latent construct exceeds 0.5, indicating the variance explained by the latent factor structure exceeds that of unexplained error variance among the indicators. The AVE can be calculated as the average of the squared factor loadings. For example, the AVE of Instrumental Attitude with the four remaining indicators (ATT1, ATT2, ATT3, and ATT5) is 0.44, suggesting the unexplained error variance exceeds that explained by the latent construct. By removing ATT2 from the model, AVE of the Instrumental Attitude construct increased to 0.52, indicating convergent validity of the construct and its measures. Following the same process, SN3 of the Subjective Norm construct was also identified for removal.

The resulting measurement model of variables to be included in the structural model is presented in Figure 5.7. The model fit indices suggest this measurement model fits the observed data well; x^2 (59) = 134.63, $p < .000$, CFI = 0.95, RMSEA = 0.08, SRMR = 0.06. These test statistics satisfy the index fit criteria recommended by Hu and Bentler (1999). It should be noted the significance of the chi-square statistic is expected when models are measured using small sample sizes (i.e., $N \leq 250$) (Hair, et. al., 2009). When this is the case, goodness-of-fit criteria emphasize combinational rules involving Comparative Fit Index (CFI), standardized root mean squared residual (SRMR), and root mean squared error of approximation (RMSEA).

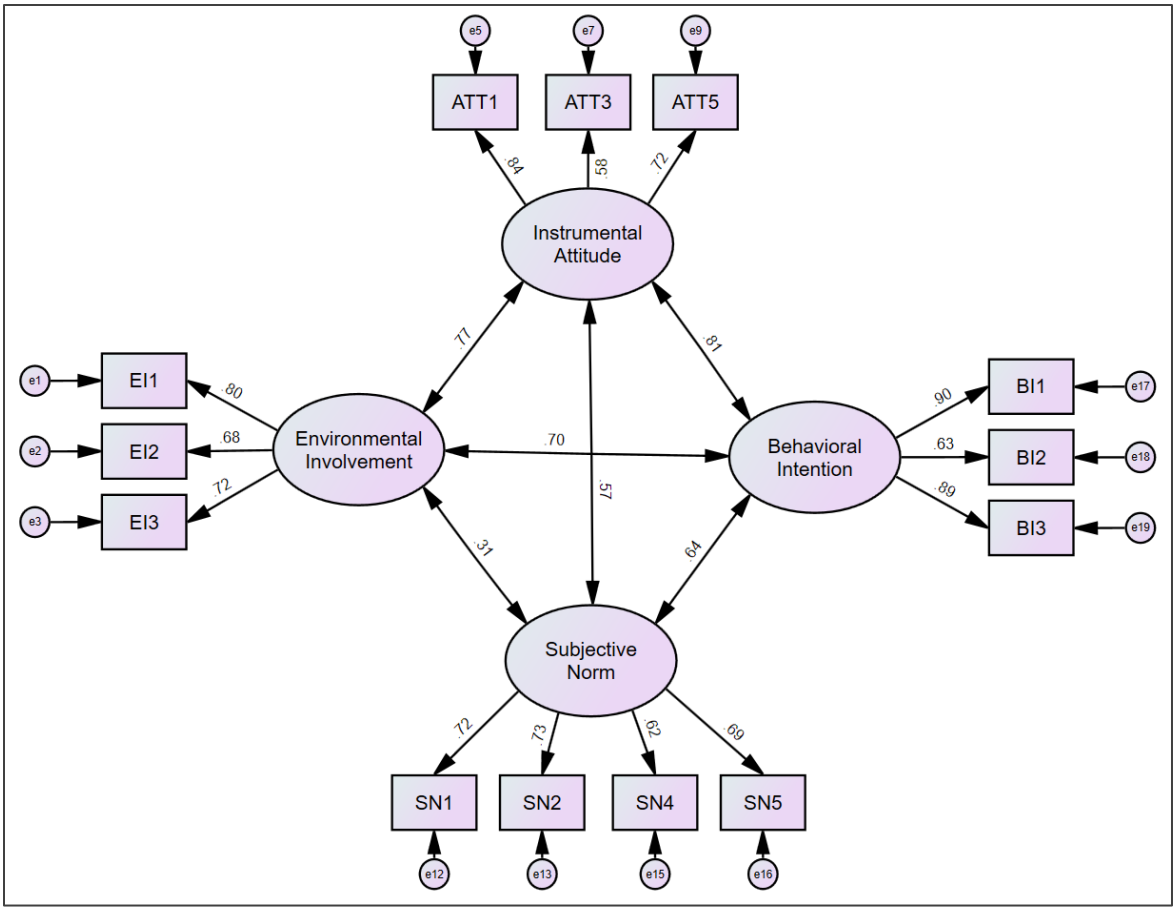

Figure 5.7 CFA results of measurement model

Finally, reliability analysis of the measured variables indicate high levels of consistency for each of the latent constructs in Figure 5.7. Internal consistency reliability was measured by computing the coefficient alpha for each construct. A Cronbach's α of 0.7 or greater is widely considered an acceptable measure of internal consistency (Hair, et. al., 2009; Nunnally, 1978). The computed Cronbach's α statistics were as follows: Environmental Involvement, α = 0.76; Instrumental Attitude, α = 0.73; Subjective Norm, α = 0.78; and Behavioral Intention, α = 0.85.

Testing the Structural Model

After establishing adequate fit of the measurement model, a structural model was specified representing the hypothesized dependence relationships among the variables. In SEM, the structural model is created by adding constraints to the non-specified relationships of the measurement model (Hair, et. al., 2009). In other words, instead of

measuring correlational relationships among all variables, the structural model specifies the direct paths of dependence relationships that are hypothesized to exist. Specifying directional relationships between variables allows for multiple pathways through the model to be measured relative to one another.

Path analysis was conducted using AMOS 27 to estimate the hypothesized relationships between environmental involvement, the TPB constructs, and intention to purchase recycled paper. The estimated structural equation model with standardized coefficients is presented in Figure 5.8 below. The goodness-of-fit indices indicate an adequate fit of the model to the underlying data (CFI = 0.94, RMSEA = 0.08, SRMR = 0.06). Using the combinational rules proposed by Hu and Bentler (1999) for a model of this type, the RMSEA and SRMR indices both met the recommended cutoffs while the CFI parameter was just below the recommended level of 0.95. The chi-square statistic for the model was x^2 (68) = 155.65, $p < .000$. Again, significance of the chi-square statistic is expected for complex models (i.e., models having greater than 12 observed variables) with less than 250 observations (Hair, et. al., 2009). The structural model explained 81% of the variance ($R^2 = 0.81$) in employee intentions to purchase recycled copy paper.

It should also be noted that the degrees of freedom (df) of the significance test for the structural model increased relative to that of the measurement model. This was primarily due to the inclusion of the purchasing task discretion variable, which was not included in the measurement model because it is not a latent variable. Additionally, upon further investigation of the structural model, it was deemed appropriate to allow the error terms of SN1 and SN2 to correlate since many employees may not perceive normative pressure of faculty as being distinct from normative pressure of coworkers (i.e., they are not mutually exclusive).

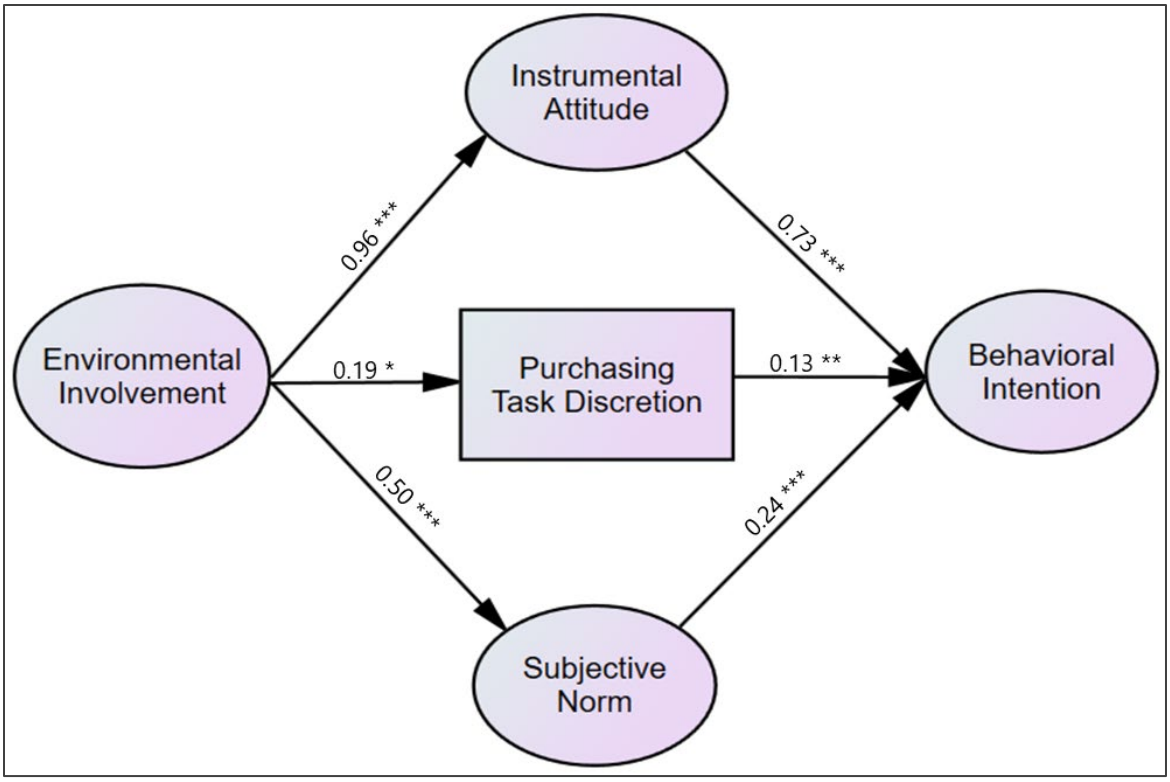

Figure 5.8 Estimated structural equation model of employee intention to purchased recycled copy paper

The path coefficients between environmental involvement (EI), instrumental attitude (IA), purchasing task discretion (PTD), subjective norm (SN), and behavioral intention (BI) can be used to evaluate support for the hypothesized relationships by assessing their size, statistical significance, and direction. Each path coefficient was statistically significant and in the hypothesized direction ($\beta_{H2A} = 0.96$, $p < .001$; $\beta_{H2B} = 0.19$, $p < .05$; $\beta_{H2C} = 0.50$, $p < .001$; $\beta_{H1A} = 0.73$, $p < .001$; $\beta_{H1B} = 0.13$, $p < .01$; $\beta_{H1C} = 0.24$, $p < .001$), lending support for H_{1A}- H_{1C} and H_{2A}- H_{2C}. That is to say, an employee's instrumental attitude (a product of behavioral beliefs and behavioral evaluations), perceived task discretion, and subjective norm (a product of injunctive norms and motivations to comply with them) are all positively influenced by his/her environmental involvement. Furthermore, an employee's intention to purchase recycled copy paper is positively influenced by his/her instrumental attitude, perceived task discretion, and subjective norm.

In terms of direct effects, it can be seen from the relative size of the standardized path coefficients that instrumental attitude ($\beta = 0.73$) has the largest impact on behavioral

intention in this context, with purchasing task discretion (β = 0.13) having the smallest impact. These results are in line with the theoretical understanding of TPB, which generally accepts that attitude toward a behavior is a much strong predictor of intention than is perceived control over the behavior since the simple ability to perform a behavior does not imply intention to do so (Fishbein & Ajzen, 2009). Likewise the direct effect of environmental involvement is largest on instrumental attitude (β = 0.96) and smallest on purchasing task discretion (β = 0.19).

To test H_3-H_4, which addressed the multiple mediation between environmental involvement and behavioral intentions, path analyses compared both indirect and direct effects. A partially mediated model that measured the direct effect of environmental involvement on behavioral intentions in addition to the indirect effects through the TPB measures was tested and compared to the fully mediated model of Figure 5.8 above. To calculate the indirect effect of EI on BI via the collective TPB constructs, the indirect effects for each path from EI to BI were first calculated. Indirect effects are calculated as the product of all path coefficients (i.e., direct effects) between two related variables. The total indirect effect of EI on BI then is the sum of these compound paths. Table 6.3 below presents the unstandardized path coefficients and associated confidence intervals. Direct and indirect effects were calculated using a bootstrapping method with bias-corrected confidence intervals at 95% (Crowson, 2021).

Table 5.3 Unstandardized path coefficients for direct and indirect effects

Path	Effect (*B*)	95% CI
EI → IA	9.486 *	(7.03, 14.71)
IA → BI	0.128 **	(0.10, 0.17)
EI → BI (indirect effect via IA)	1.211 *	(0.85, 1.89)
EI → PTD	0.503 *	(0.01, 1.10)
PTD → BI	0.085 **	(0.02, 0.15)
EI → BI (indirect effect via PTD)	0.043 *	(0.01, 0.10)
EI → SN	4.667 **	(2.35, 7.79)
SN → BI	0.045 **	(0.02, 0.08)
EI → BI (indirect effect via SN)	0.211 **	(0.10, 0.45)
EI → BI (total indirect effect)	1.465 *	(1.10, 2.22)

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Recall that hypothesis 4 stated that the positive impact of employee environmental involvement on intentions to purchase recycled paper was mediated collectively by the core TPB measures (IA, PTD, SN). The total indirect effect of EI on BI accounts for the compound paths through IA, PTD, and SN. As shown in Table 5.3 above, the indirect effect of 1.465 (β = 0.843) is significant ($p < 0.05$) with CI range above zero, supporting the hypothesis that the TPB measures (IA, PTD, SN) collectively mediate the EI→BI relationship. Furthermore, under the partial mediation model in which the effect of EI on BI is measured directly as well as indirectly through the TPD measures, the coefficient (β = -0.254) representing the direct effect of EI on BI is nonsignificant ($p = 0.849$).

Looking at the indirect effects of EI on BI separately through each of the PTD measures, the significance and confidence intervals of each support the multiple mediation hypotheses (H_{3A}- H_{3C}). Analyzing the standardized coefficients of the indirect effects, however, provides a useful explanation of the mediated relationships. The indirect effect of EI on BI through instrumental attitude (β = 0.697) is much stronger than the indirect effects through both purchasing task discretion (β = 0.025) and subjective norm (β = 0.121). The collective mediation addressed in H_4 then primarily, though not entirely, occurs through instrumental attitude.

Discussion

Theoretical Contribution

Studies on procurement in organizations and supply chain management tend to focus on procurement professionals at the manager and executive levels (e.g., Swaim et al., 2016; Philippart, 2016; Goebel et al., 2018; Sánchez-Rodríguez & Martínez-Lorente, 2004; Walker et al., 2008), since these individuals are more likely to be involved in developing purchasing strategies, setting purchasing goals, and managing supplier relationships. Not surprisingly then, the majority of research in sustainable supply chain management, as well as corporate social responsibility, is conducted at either the institutional or organizational levels of analysis.

Thus, one contribution to both the SSCM and CSR literatures of the current research is the individual level of analysis used. The lack of micro level research has been pointed to as a weakness of the SSCM field. Investigations of the human aspects of SSCM, such

as the role of decision-making processes, interactions, perceptions, and behaviors in the implementation of SSCM programs, have been identified as a promising area of contribution to the SSCM field (Touboulic & Walker, 2015).

This is not unlike the role of individual employees in organizational CSR practices. In one review of CSR literature, the authors called for CSR researchers to place greater emphasis on micro level investigations, noting that "although CSR takes place at the organizational level of analysis, individual actors are those who actually strategize, make decisions, and execute CSR initiatives" (Aguinis & Glavas, 2012, p. 953). Likewise, in another review of how organizational behavior is being applied to the study of CSR, the authors noted that "although it is on behalf of corporations that acts of CSR are planned and completed, it is truly individuals who advocate for, comply with, and participate in CSR" (Rupp & Mallory, 2015, p. 212).

Finally, this research helps to bridge the gap between the consumer and organizational behavior fields. The opportunity to draw on concepts from both fields (i.e., TPB, consumer involvement, task autonomy) comes from the focus on minor procurement decisions of administrative support staff. For minor procurement in decentralized purchasing contexts, employees typically have greater discretion for making purchasing decisions relative to contexts involving major procurement. Minor items, for example, typically do not need to meet complex specifications to ensure quality or compatibility with current processes. Likewise, non-product related items have little or no exposure to customers, and so present relatively low risk to a company's image or brand. For reasons such as these, minor procurement decisions often don't involve the participation of other organizational members (Mosgaard et al., 2013). Additionally, since minor procurement has little impact on firm profits and is not of strategic importance, efforts spent on managing it are minimized, including the development and communication of formal policies that guide it (Haake & Seuring, 2009). Even where EPP and other green purchasing programs do exist, organizational leaders may be less motivated to monitor compliance, opting instead to focus resources on areas of procurement deemed strategically important. The absence of strong internal and external drivers to purchase certain products creates flexibility for employees to make purchasing

decisions based on their own attitudes and beliefs, thus to some extent allowing them to behave more like end-consumers than organizational buyers.

Practical Implications

The information gained from this study can help guide development of organizational purchasing policies and practices. For example, understanding what factors influence employee decisions to purchase non-preferred products over preferred products can help both procurement and sustainability professionals identify solutions to more effectively encourage purchasing of preferred products. Likewise, practitioners in other HEIs with similarly decentralized purchasing systems would benefit from knowing key factors associated with employee purchasing decisions in that context, as this could inform the design of interventions intended to modify behavior.

In the context of large organizations with decentralized purchasing systems, it makes sense that individual employees with administrative purchasing responsibilities be included in the scope of SSCM. Otherwise efforts made by organizational leaders to implement SSCM practices could fall short, since actual purchasing decisions are still being made by many employees operating beyond the prescribed parameters of those practices. For instance, procurement managers in an HEI may require apparel suppliers to complete an extensive vetting process to determine whether the upstream supply chain meets ethical standards. However, a staff level employee conducting an apparel sale for members of a department within that HEI could select the least expensive supplier without ethical considerations of the supply chain. In this case, the integrity of the SSCM practice could fairly be called into question.

Paper products is one such area that should be critically evaluated by most HEIs due to the sheer volume in which they are consumed by universities and the substantial differences in environmental impact that can exist among effectively identical products. Furthermore, in contexts of HEIs with decentralized purchasing systems, it is crucial to understand the antecedents of purchasing decisions involving paper products in order to develop effective green purchasing strategies.

For instance, results from this study suggest the behavioral beliefs most influential to purchasing decisions for recycled copy paper are associated with reducing deforestation and other environmental impacts. The link between recycled paper products and impact

reductions, however, is not a given. Greenhouse gas emissions, for instance, are generally no greater at pulp mills using virgin fiber than at those using recycled fiber (NCASI, 2013). Less market demand for forest products, in part due to overall reductions in paper consumption and increased use of recycled fiber, has also been linked to development and conversion of forestland to other uses (NCASI, 2013; TCF, 2021). Furthermore, in the particular case of printing paper, it has been argued that products with high proportions of post-consumer recycled content can actually have far greater fiber input requirements than equivalent products with lower levels of recycled content (Bowyer, et al., 2020).

Limitations and Future Research

The inability to conduct elicitation interviews is a key limitation to the study. Although the defined context allowed for the identification of likely behavioral beliefs and normative referents without elicitation interviews, the process could have nonetheless informed development of a more effective TPB questionnaire. Inclusion of an elicitation phase is considered best practice in TPB research (Fishbein & Ajzen, 2011; Oluka, et al., 2014). The case study design of the research also presents a limitation, making it difficult to generalize results to organizational contexts outside of higher education or even to smaller institutions with more centralized purchasing systems.

Another methodological consideration is how the behavioral target (i.e., purchasing recycled copy paper) was conceptualized. Intention to purchase recycled copy paper was effectively treated as a dichotomous outcome (will purchase/will not purchase), preventing the measure to account for variation across the range of recycled content levels. Behavioral antecedents to purchasing 100% RC paper may differ from those to purchasing 30% RC paper, in which case the current study was not able to determine those differences. Related to this, another limitation is that the study measured only behavioral intention but not actual behavior. Although TPB assumes behavior generally follows intention, the relationship is not constant. Analyzing copy paper purchasing data of study participants for a period of time immediately following the survey administration would provide a measure of behavioral outcomes, completing the TPB model. This could also provide the opportunity to test for differences in behavioral antecedents by RC level of paper purchases.

DISCUSSION & CONCLUSIONS

Discussion

Part 1

This research consisted of two related but distinct projects, each investigating different aspects of organizational fiber consumption. The first part of the research was a descriptive study offering a critical evaluation of sustainability metrics related to fiber consumption and corporate attempts at quantifying environmental impacts in the form of footprint-type measures. The current metrics that are most commonly used to evaluate sustainability are simple measures of consumption that focus on the overall quantity of fiber products purchased or consumed, certifications the products carry, and the proportion of recycled content in those products. These metrics are of limited value for assessing sustainability performance though, as they are only measures of consumption rather than the environmental impact it causes. In the absence of a more meaningful method, most organizations will continue to be guided by seemingly logical, and potentially incorrect, assumptions of how to best improve sustainability performance (ex. use less paper, use only recycled paper). Other companies may attempt developing their own method for quantifying impact, most likely in response to stakeholder pressure or as part of a broader strategy to improve overall performance. The critique presented in Chapter 2 examined vividly opposing examples, provided by Apple and British Airways, of organizational attempts to calculate forest footprint metrics and the ultimate impact those efforts had on improving the sustainability performance of their operations.

It should be apparent from the descriptive research of Part One that organizations need a better way to assess sustainability performance related to consumption of forest products. A goal of the study was to illustrate that need by examining the limitations of current assessment methods and describing the broad reliance that organizations have on those methods despite their deficiencies. It should also be apparent from this research that, for most organizations, calculating a valid measure of environmental impact associated with fiber consumption is a very difficult task. While system-level methods can be used for assessing input requirements in very broad contexts (ex., material flow

analyses), such methods are not sensitive to the particular mix of fiber products consumed by any one organization. Product-level methods can be used for assessing impact in highly defined contexts (ex., life cycle assessment), but such methods are not feasible for organizations that consume a variety of different fiber products.

The challenge of calculating a forest footprint at an organizational-level is exemplified by the failure of this research to complete what was initially identified as a key objective during the planning stage, which was to calculate the forest footprint of Penn State University. Due to the complexity of fiber supply chains and the wide variations that can exist in raw materials and processing, reliably estimating forest impacts in terms of acres or wood volume would require manufacturers to disclose product specific information about sourcing and processing of raw materials as well as manufacturing processes for finished products. Until such a disclosure process becomes standard practice for producers, quantifying impact in this manner will likely remain prohibitively difficult.

Part 2

The second part of the research was rooted in behavioral science and investigated human factors that influence fiber consumption in organizations. The study sought to explain the roles of behavioral attitudes and social norms in employee purchasing decisions. Unlike most studies that investigate organizational procurement, however, this study was unique in its focus on purchasing decisions of administrative staff employees for office supplies. Procurement of noncritical items, also called minor procurement, receives less attention from researchers than areas of major procurement that are more strategically important to a firm's overall performance. Nonetheless, minor procurement is important to study since those items can account for upwards of half of total procurement by value in service providing companies. Minor procurement is also important to study because it is often decentralized, meaning it is a task that may need completed by many organizational members independently. For organizations trying to improve their sustainability performance through implementing green purchasing policies, decentralized purchasing systems for minor procurement activities can present a substantial challenge. As such, it is important to understand how purchasing decisions are made in these contexts.

The current study combined survey data with institutional data to examine purchasing decisions related to recycled copy paper at Penn State University. Using a theoretical framework based on the theory of planned behavior (TPB), the study applied an extended and modified TPB model to measure the influence of consumer involvement with the environment, behavioral attitudes and social norms related purchasing copy paper, and task discretion on employee intentions to purchase recycled products. The context of the study combined with the model applied to it is an important source of contribution for the research. The focus on minor procurement and staff-level employees presented appropriate opportunity to study consumer behaviors in the context of organizational purchasing.

As expected, results from the study suggested employees with high levels of environmental involvement (EI) placed greater priority on perceived environmental attributes of recycled copy paper, whereas employees with lower levels of involvement were more likely to consider non-environmentally related attributes such as cost and economic impacts. Interestingly, only a small proportion of survey participants agreed that recycled copy paper leads to paper jams and printer malfunctions. The strongest belief motivations though were sustainability-focused, such as beliefs that purchasing RC copy paper would help prevent deforestation, conserve natural resources, and help departments/units be more sustainable.

Another interesting, though not entirely unexpected, finding was the positive relationship between environmental involvement (EI) of employees and their perceived levels of social norms and task discretion. While the relationship between EI and beliefs about recycled copy paper seems intuitive, the effects of EI on social norms and task autonomy are less so. In psychology, a person's level of involvement or engagement with an issue is thought of as a foundation on which attitudes can be formed. From a theoretical perspective, an individual highly engaged in environmental issues may be more inclined to perceive external support for or agreement with their believes, even in areas not directly related to the environment. For instance, an employee who strongly believes in the environmental merits of green products or feels knowledgeable about them may feel more empowered to make purchasing decisions in general.

With regard to social norms, the findings from Part Two of the research are most applicable to universities. Results from the study indicate that, for administrative employees at Penn State, the most influential source of social pressure regarding minor purchasing decisions may be university leadership. This could suggest that the communications strategies employed by university leadership regarding sustainability and purchasing at Penn State have been effective in their reach. An alternative outcome could have been that, due to the minor cost and limited impact of copy paper purchasing, employees might have been more sensitive to the opinions of coworkers rather than organizational leaders. This did not appear to be the case in this study.

Limitations & Future Research

The greatest limitation to the employee purchasing study is the case study that was used. The research design makes it difficult to generalize results to organizational contexts outside of higher education or even to smaller institutions with more centralized purchasing systems. Another limitation of the study is the lack of elicitation interviews. Although the defined context allowed for the identification of likely behavioral beliefs and normative referents without elicitation interviews, the process could have nonetheless informed development of a more effective TPB questionnaire. The conceptualization of the behavioral target (i.e., purchasing recycled copy paper) should also receive further consideration. Intention to purchase recycled copy paper was effectively treated as a dichotomous outcome (will purchase/will not purchase), preventing the measure to account for variation across the range of recycled content levels. Behavioral antecedents to purchasing 100% RC paper may differ from those to purchasing 30% RC paper, in which case the current study was not able to determine those differences. Related to this, another limitation is that the study measured only behavioral intention but not actual behavior. Although TPB assumes behavior generally follows intention, the relationship is not constant. Analyzing copy paper purchasing data of study participants for a period of time immediately following the survey administration would provide a measure of behavioral outcomes, completing the TPB model. This could also provide the opportunity to test for differences in behavioral antecedents by RC level of paper purchases.

Due to the complexity of fiber supply chains and the many factors that need consideration, from forest biology and harvesting operations through pulp production and product manufacturing, it is recommended that any further efforts to develop sustainability metrics related to the consumption of forest products, including paper, should involve engagement with the forest products industry. Widespread adoption of any new sustainability metric would be difficult without industry buy-in. More importantly though, industry input would help ensure the validity and feasibility of any proposed methodology for quantifying impact. Industry involvement could also encourage support for development of a uniform environmental product declaration program similar to the Paper Profile but designed to compliment any new sustainability metrics.

Conclusions

Preserving the ecological health of the world's forests is imperative not just for mitigating the effects of climate change but also for ensuring the availability of renewable materials people depend on. The methods currently used by organizations for assessing sustainability performance related to consumption of fiber products, however, have proven inadequate. The information that most organizations currently rely on to manage sustainability of paper consumption is restricted to the presence of third-party certification labels (i.e., FSC, SFI, PEFC, etc.), proportion of recycled content, and overall measures of paper use. This information is of limited use for determining impact of paper consumption. The disconnect between measuring consumption and its associated impact is leading more companies to investigate their own paper supply chains. The dramatically different methods developed by Apple and British Airways for quantifying their forest footprints underscore the need for developing a formal, standardized methodology for measuring impact of fiber consumption.

Ultimately, the value an organization creates from calculating its forest footprint will be derived from the information it gathers in the process. The footprint is one part, albeit an important one, of a comprehensive understanding of organizational fiber consumption. It should not be intended to replace the sustainability practices that organizations commonly use today to manage paper use, but rather to compliment existing measures by

providing new insight. By identifying key areas of consumption and subsequently investigating each to determine material composition, processing methods, and fiber sources, organizations can develop a more thorough understanding of their own operations and the impact they have on forests.

Beyond measuring impact, organizations must also understand the factors that drive consumption in order to manage sustainability performance over time. Many organizations develop green purchasing policies in an effort to manage aspects of consumption, but often find it challenging to achieve substantial improvements in purchasing outcomes following implementation. This is particularly true for large HEIs with decentralized purchasing systems in which authority for minor procurement (ex., purchasing office supplies) is widely distributed among many employees. Achieving sustainability goals in these contexts may require compliance of hundreds or even thousands of employees across many locations.

Understanding how individual differences and contextual factors influence employee purchasing decisions for noncritical items is important for improving the sustainability of organizations and their supply chains. This study adds to the limited body of literature addressing sustainable purchasing behaviors of administrative staff members in organizational contexts.

APPENDIX A

Assessing Organizational Fiber Consumption at Penn State: A Proposed Methodology and Initial Analysis

Introduction

This section introduces a basic methodology proposed for assessing the fiber footprint of Penn State University. A preliminary analysis of fiber purchasing data is presented to demonstrate how the data can be collected, cleaned, coded, and analyzed. This section also includes an initial subset of 22 identified items that represent over 90% of the spend on paper products at the University during the fiscal years 2015-2016 to 2018-2019. Finally, the proposed methodology for developing the University's fiber profile is outlined.

Research Overview and Methodology Outline

Multiple sources of secondary data would be needed to calculate the University's fiber footprint in RWEs and develop a profile of institutional fiber consumption. The first step in the process would be to evaluate the various sources of institutional purchasing data at Penn State and assess the application of each to the study. After primary sources of purchasing data were established, the next step would be to identify a product mix that captures a large proportion of fiber spend while being of reasonable size and complexity to be feasible for analysis. Once the product mix representing the University's fiber consumption is identified, additional information for each product would be obtained from publicly available technical data sheets and informal requests for information (RFI) submitted to product manufacturers. The information obtained from manufacturers could then be used to apply published conversion factors and process yield measurements to the purchasing volumes of each product and ultimately calculate the University's fiber footprint.

Secondary Sources of Purchasing Data

The first step in calculating an organization's fiber footprint would be to analyze its consumption of paper products. In order to focus on fiber consumption related to University operations and within the scope of institutional control, the preliminary analysis presented her utilized secondary data representing institutional purchases from the 2014 though 2018 fiscal years. The primary source of these purchasing data would be

the Department of Purchasing Services, with additional data potentially provided by the Departments of Housing and Food Services and Multimedia and Print Services.

eBuy

Analysis of data from Purchasing Services would primarily be focused on transactions completed through the University's electronic purchasing catalog, referred to at Penn State as eBuy. This type of system, which is also known as a punchout catalog, allows users (i.e., University employees) to browse offerings and purchase products from a selection of approved vendors through use of a centralized online purchasing process. According to a recent study, there were 3,216 unique users at Penn State who completed at least one purchase through the eBuy system in 2017 (Sheth, 2018). There are currently 38 approved vendors in the eBuy program, in categories such as electronics, MRO/facilities, furniture, laboratory equipment, medical supplies, etc.

Among the approved vendors in the eBuy system, Penn State General Stores (GS) is responsible for the vast majority of transactions involving paper products. General Stores is a University operated, on-campus supplier of a wide variety of office and janitorial products. It is also the only approved vendor of office and janitorial supplies listed in the eBuy system. However, GS does not maintain its own dedicated electronic catalog. Instead, users wishing to purchase office or janitorial supplies from GS are directed to an Office Depot electronic catalog, which essentially hosts items from the GS catalog alongside the many non-GS products sold by and shipped from Office Depot warehouses. As a result of this partnership, transaction data associated with GS will include both direct purchases from GS as well as indirect purchases of non-GS items from Office Depot.

In addition to the eBuy system, there are three other methods of University purchasing that should be mentioned. These remaining purchasing methods, for reasons described below, are unlikely to involve a significant share of the University's paper procurement and thus will not be prominently featured in the proposed study. The first alternative method is a non-catalog purchase order, which allows buyers with a justified need to obtain goods or services beyond those listed in a supplier's approved catalog. Non-catalog purchase orders are the preferred method for purchases exceeding $5000 and often involve a competitive bidding process, as is required for all purchases exceeding

$10,000. This purchasing method is generally limited to high-value, low-volume, and/or non-recurring transactions. According to Sheth, non-catalog purchase orders accounted for 30% of total spend in FY 2017 but represented just 3% of total orders (2018), demonstrating its intended application of paying high-value invoices. Despite the significant proportion of total spend accounted for by non-catalog purchase orders, this payment method is the least likely to involve significant quantities of paper products due to its intended application and closely monitored use.

Preliminary Analysis of Purchasing Data

A preliminary analysis of purchasing data was conducted to evaluate the general size and complexity of the University's fiber consumption. Purchasing data of all General Stores and Office Depot orders for the fiscal years of 2015-2016 through 2018-2019 were obtained from Purchasing. This dataset contained eBuy orders for approximately 38,000 unique items. The total spend represented by these items over the four-year period was $29.1 million. Filters using keywords were then applied to the item descriptions of the items to identify paper products of interest to the proposed research. Examples of words used to filter items include paper, tissue, napkin, towel, corrugated, package, box, folder, note, book, ream, cup, plate, bowl, roll, shipping, sleeve, board, toilet, carton, Kraft, facial, recycled, pads, covers, etc. A dichotomous "Fiber Product" variable was then created to identify items confirmed as paper products. After applying each filter, the remaining items were reviewed individually and, using the "Fiber Product" variable, marked as "1" if a paper product and "0" if not. For instance, applying the keyword "ream" as a filter produced an item list containing both copy paper products as well as coffee creamer products. In this case, the creamer products were identified with a "0" and the copy paper products with a "1".

After multiple rounds and variations of filters applied to the purchasing data, the list of identified paper products included 903 unique items, totaling approximately $6.3 million. Spend on paper products purchased from the General Stores/Office Depot electronic catalog averaged $1,584,720 per year from FY 2015-16 through 2018-19. Of the 903 unique paper product items represented in the four fiscal years of purchasing data, it was found that only 22 products account for over 90% of the total spend on paper

products ($5,715,726 of $6,291,510). Figure A.1 below shows a breakdown of the spend on these 22 products, by product category. provide details for each product in the subset, by product category.

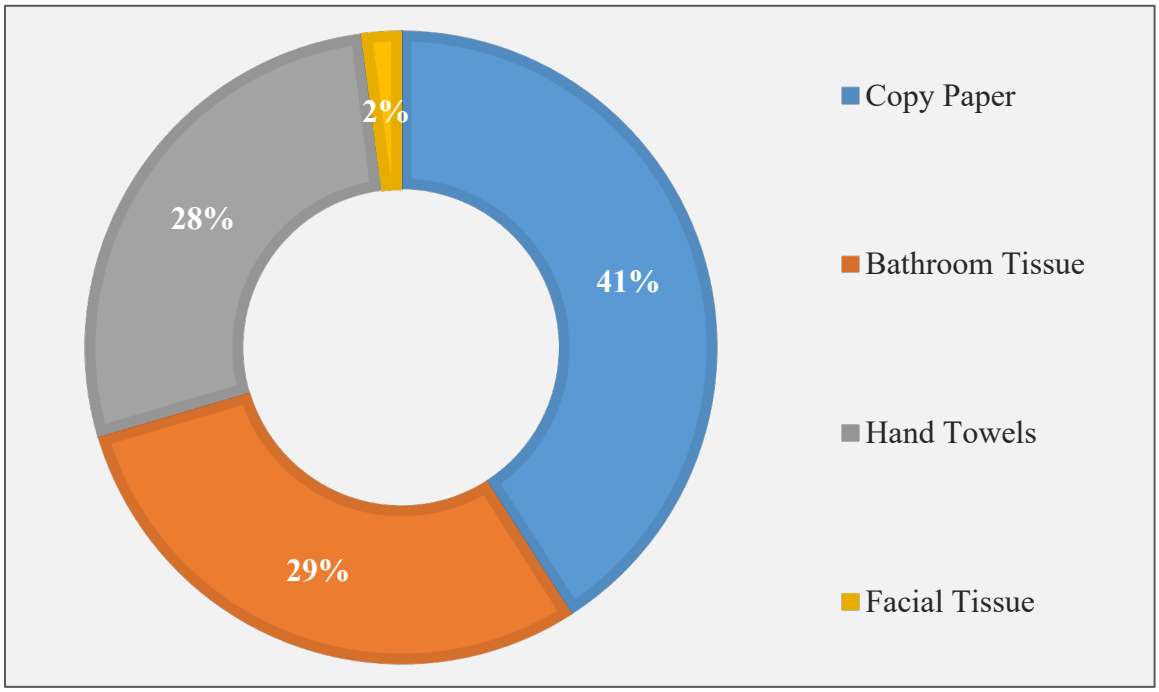

Figure A.1 Proportion of spend on 22 top products, by category

Since a small number of items account for a vast majority of spend on paper products, analysis of the University's fiber profile and calculated footprint will be based on this small subset of items. Depending on the final parameters decided upon for the proposed study, minor changes could occur in the number and composition of items in the subset, and the proportion of total spend represented by the subset.

Table A.1 Copy paper products accounting for greatest spend, FY 2015-16 to FY 2018-19

Manufacturer	Short Description	Associated Item Numbers [a]	Total RC [b]	Certifications	Total Spend
American Eagle	Multi-Use 50% Recycled Copy Paper 8.5X11	Z11GOGREENSK, Z11GREENCCSK, Z11GOGREENCT	50	FSC	[redacted]
American Eagle	Multi-Use 100% Recycled Copy Paper 8.5X11	Z11PSU100CT, Z11PSU100SK	100	FSC	[redacted]
American Eagle	Multi-Use 30% Recycled Copy Paper 8.5X11	Z11PSU30CT, Z11PSU30SK	30	FSC	[redacted]
American Eagle	Paper, 100% Recycled, White, 11X17	Z1111X17PS	100	FSC	[redacted]
Boise	Boise X-9 Multi-Use Copy Paper, Letter Paper Size, 20 lb., Bright White, 500 Sheets/Ream, Case 10 Reams	P1OX9001-CTN, 196517	0	SFI	[redacted]
Boise	Boise ASPEN Multipurpose Paper, 30, Letter Paper Size, 20 lb., 30% Recycled, FSC Certified, 500 Sheets/Ream, Case 10 Reams	116946, P1054901-CTN	30	FSC, Green Seal	[redacted]
Domtar	Xerox Vitality Multipurpose Printer Paper, Letter Size, 92 Brightness, 20 lb., FSC Certified, 500 Sheets/Ream, Case 10 Reams	P13R02047, 275474, P13R2047-CTN	0	FSC	[redacted]
				Category Total Spend	$2,339,249,28

[a] Item numbers used in General Stores/Office Depot electronic purchasing catalog
[b] Total recovered content, may include pre- and post-consumer materials

Table A.2 Bathroom tissue products accounting for greatest spend, FY 2015-16 to FY 2018-19

Manufacturer	Short Description	Associated Item Numbers [a]	Total RC [b]	Certifications	Total Spend
Kimberly Clark	Toilet Jumbo Roll 1 Ply 722340	Z11614810	>20	FSC, EPA, ECOLOGO	[redacted]
Kimberly Clark	Toilet Cottonel 2 Ply 1771301	Z11614820	25	FSC, EPA	[redacted]
Kimberly Clark	Toilet Tissue, 1 Ply 0510240	Z11614800	>20	FSC, EPA, ECOLOGO	[redacted]
Kimberly Clark	Toilet Scott 2 Ply 0730402	Z11680642	25	FSC, EPA	[redacted]
Kimberly Clark	Toilet Jumbo Roll 2 Ply 0780540	Z11614830	>20	FSC, EPA, ECOLOGO	[redacted]
Kimberly Clark	Toilet Scott 2 Ply 0446005	Z11680507	100	FSC, EPA, ECOLOGO	[redacted]
Georgia Pacific	Compact by GP Pro Coreless 2-Ply Bathroom Tissue, 1,500 Sheets Per Roll, Case Of 18 Rolls	W319378CT	100	EPA, ECOLOGO, Green Seal	[redacted]
				Category Total Spend	$1,686,770.39

[a] Item numbers used in General Stores/Office Depot electronic purchasing catalog
[b] Total recovered content, may include pre- and post-consumer materials

Table A.3 Hand towel products accounting for greatest spend, FY 2015-16 to FY 2018-19

Manufacturer	Short Description	Associated Item Numbers [a]	Total RC [b]	Certifications	Total Spend
Kimberly Clark	Towel Scott Hand 1 Ply 0100010	Z11614907	60	FSC, EPA, ECOLOGO	[redacted]
Kimberly Clark	Towel Scott Multifold 0180450	Z11614900	60	FSC, EPA, ECOLOGO	[redacted]
Kimberly Clark	Towel Roll Hand 1 Ply 0108003	Z11614905	60	FSC, EPA, ECOLOGO	[redacted]
Essity	Peakserve Hand Towel 105065	Z11614508	0	FSC Mix	[redacted]
Georgia Pacific	Pacific Blue Basic by GP PRO Multifold Paper Towels, 100% Recycled, Brown, 250 Towels Per Pack, Case Of 16 Packs	W523304	100	FSC, EPA, Green Seal	[redacted]
				Category Total Spend	$1,573,702.31

[a] Item numbers used in General Stores/Office Depot electronic purchasing catalog
[b] Total recovered content, may include pre- and post-consumer materials

Table A.4 Facial tissue products accounting for greatest spend, FY 2015-16 to FY 2018-19

Manufacturer	Short Description	Associated Item Numbers [a]	Total RC [b]	Certifications	Total Spend
Kimberly Clark	Tissue, Kleenex Btq 2 Ply 2127095	Z11614688	0	FSC	[redacted]
Kimberly Clark	Tissue, Kleenex 2 Ply 2160660	Z11614685	0	FSC	[redacted]
Kimberly Clark	Kleenex 2-Ply Facial Tissue, Boutique Box, 95 Tissues Per Box, Pack Of 6 Boxes	W521271	0	FSC	[redacted]
				Category Total Spend	$116,003.75

[a] Item numbers used in General Stores/Office Depot electronic purchasing catalog
[b] Total recovered content, may include pre- and post-consumer materials

Proposed Methodology for Developing Fiber Profile and Calculating Footprint

The final subset, expected to consist of 20-25 products, would then be analyzed and form the basis of the University's fiber profile. Multiple methods and sources will be used to obtain the pertinent information for developing the fiber profile and calculating the footprint measure. These sources, which include specification sheets, requests for information (RFI), and scientific publications, are described below.

Although the majority of products in the subset carry an FSC chain-of-custody certification, it has not yet been determined how useful that certification information will prove. A single FSC certificate can be assigned to a group of mills geographically dispersed across a wide region. For example, the certificate "SGSNA-COC-005460" belongs to Kimberly-Clark for household and sanitary products processed at 8 different locations, including South Carolina, California, Pennsylvania, Connecticut, Ontario, Oklahoma, and Wisconsin[11]. Each mill location is designated a different letter at the end of the certificate number (e.g., SGSNA-COC-005460-A, SGSNA-COC-005460-B, SGSNA-COC-005460-C, etc.) but that identifier is not required to be included in the certificate number that is attached to each invoice. If location specific information cannot be obtained through the FSC certificate database, requesting it directly from manufacturers/suppliers will be the most feasible method.

Product Specification Sheets

Product specification sheets, technical data sheets, and sell sheets that are publicly available on manufacturer/distributer websites are the most easily accessible source of information. Although often basic, the information contained in these documents is still useful. Key to both the fiber profile and footprint calculations is the fiber composition of each product. Where applicable, specification sheets typically include the average proportion of recovered (i.e., non-virgin) fiber in the product as well as the average

[11] See: https://info.fsc.org/details.php?id=a0240000005tFz1AAE&type=certificate&certificate_subcode=b

proportion of post-consumer recycled fiber. From this, the proportion of fiber from virgin sources can be deduced and applied to footprint calculations. These proportional measures of fiber composition are also necessary for calculating a weighted average of the composition of the University's fiber consumption.

Specification sheets also typically include certifications carried by the product related to fiber sourcing (e.g., FSC, SFI, PEFC, ATFS, EPA, ECOLOGO, Green Seal, etc.). Again, weighted averages could be calculated to indicate the proportions of the University's fiber consumption carrying the various certifications. In the case that proportional measures of recovered and/or recycled fiber are not available, the specific certifications issued to the product may be used to at least determine the minimum contents of these fiber sources.

Finally, product specification sheets will generally include product weight per unit and/or the shipping weight. Although not ideal, this information can be used as an alternative to the standard measure of basis weight in the case that the technical basis weight measure cannot otherwise be obtained. A measure of weight, whether exact or estimated, is a necessary component for calculating each product's contribution to the University's fiber footprint.

Requests for Information (RFI)

In collaboration with the Department of Purchasing Services, requests for information (RFI) could be issued directly to manufacturers to obtain basic information about products and processes that is otherwise not publicly available. A request for information is a document that organizations commonly issue to potential suppliers in an effort to obtain information about suppliers' ability to meet the organization's procurement needs. An RFI is typically used early in the buying process to evaluate the range of viable solutions and providers. These documents differ in purpose and form from requests for proposals (RFP) and requests for quotations (RFQ). Although RFI's are most often issued before purchasing decisions are made, they can also be used by used by organizations seeking greater transparency from current suppliers.

One potential concern is that these manufacturers would not be required to complete and return the RFI's. Since Penn State University represents a sizeable account in terms of annual purchases for these companies, however, it is expected they would be willing to

comply. In an effort to avoid discouraging their participation, the RFI's should seek information related to supply chains and operations only in broad terms, as this type of information could be proprietary or of strategic value. The information that could be requested and descriptions of how that information would be used are provided below. This information would be requested for each individual product in the final subset.

1. What is the mass per unit area (i.e., grammage) of the product? Please provide in units of grams per square meter (g/m^2) according to TAPPI standard T 410.

Grammage of paper products is a standard measure that will be the basis from which all conversions are made. This information is necessary to calculate the total weight of the product consumed annually at the University, and subsequently the total weight of the fiber components. Grammage is preferable to the non-metric "basis weight" measures common in the US, since it can be applied consistently to all sheet products regardless of size and type (measures of basis weight are typically used to represent various quantities of uncut products, rather than products in finished dimensions). Grammage in g/m^2 is also the testing standard used by TAPPI (Technical Association of the Pulp and Paper Industry).

2. Which of the following mill locations manufacture this product?

Mill locations associated with the FSC chain of custody certificate for the product would be listed. Online industry databases could be used to determine whether each paper mill is an integrated pulp/paper mill or, if not, where the closest pulp mill owned by the same company is located. This information, combined with responses to item 5, could be used to identify the regional fiber basket supplying materials to the mill.

3. Approximately what proportion of the product's grammage does lignocellulosic fiber account for (including virgin, recovered, recycled, etc.)? Or, conversely, approximately what proportion of the product's weight do fillers/additives account for?

In order to quantify fiber consumption, it is necessary to distinguish the fiber components of the products from the non-fiber components (i.e., additives/filler material). With regard to copy paper, these non-fiber materials can account for up to 26% of the product's weight (Laufmann & Hubschmid, 2013).

4. Of the virgin fiber used to make the product, what proportions come from the following sources?

   Softwood tree species _____
   Hardwood tree species_____
   Other (such as agricultural sources) _____

Due to differences in composition of lignocellulosic fiber, namely lignin content, pulping yields can differ significantly between hardwood and softwood tree species. This information can be used in conjunction with responses to questions 2 and 5 regarding regional sources to identify a representative mix of tree species likely used in each product. Species-specific pulp yield data can then be used to estimate fiber input requirements per output unit.

5. From what regions is the virgin fiber used in the product primarily sourced from? Approximately what proportion of the virgin fiber component does each region account for? (see maps below for reference)

United States Regions		*%*
R1	Northern Region	
R2	Rocky Mt Region	
R3	Southwestern Region	
R4	Intermountain Region	
R5	Pacific Southwest Region	
R6	Pacific Northwest Region	
R8	Southern Region	
R9	Eastern Region	
R10	Alaska Region	
United States Total		

Other (please explain)	*%*

Canadian Provinces & Territories	*%*
British Columbia	
Alberta	
Saskatchewan	
Manitoba	
Ontario	
Quebec	
New Brunswick	
Prince Edward Island	
Nova Scotia	
Newfoundland and Labrador	
Yukon	
Northwest Territories	
Nunavut	
Canada Total	

Identifying broad regions as fiber sources is less than ideal. Source identification at the mill or even state levels would be much more effective. The more narrowly defined geographical boundaries would increase validity of RWE calculations since the forest productivity data obtained from the Forest Inventory Analysis database would be more representative of the actual fiber basket. However, suppliers may prefer not to disclose fiber sources at the state level, and so, regional levels could be used to avoid discouraging suppliers from completing and returning the RFIs.

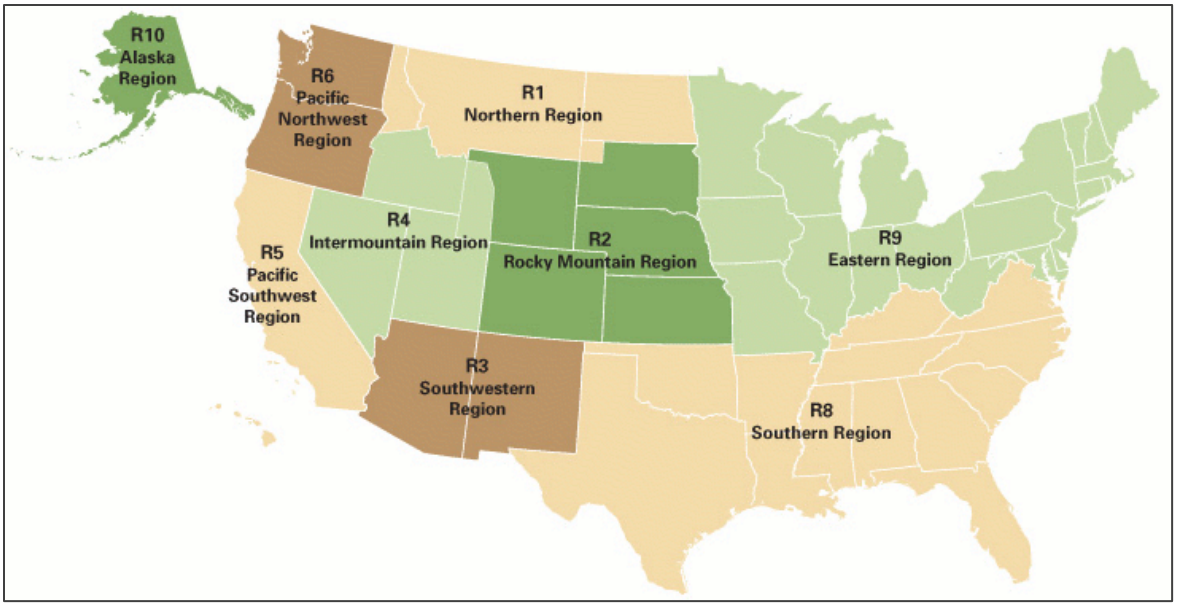

Figure A.2 Map of United States Forest Service Regions
Source: USDA, Forest Service (2020)

Figure A.3 Map of Canadian Provinces
Source: University of Alberta (2020)

6. Broadly speaking, which type of pulping process is used to produce the virgin fiber component of the product?

   ☐ Mechanical (ex. stone/pressure groundwood, thermomechanical,etc.)

   ☐ Chemi-mechanical (i.e., mechanical pulp with chemical pretreatment)

   ☐ Semi-chemical (ex., neutral sulfite semi-chemical)

   ☐ Chemical, Kraft (i.e., sulfate)

   ☐ Chemical, Sulfite

The pulp yields, or the amount of pulp produced from a given amount of wood, of these different processes can vary dramatically, from around 45% for bleached chemical pulps to upwards of 95% for mechanical pulps. Using pulp yield data from published sources, this information will be used to estimate the volume of virgin fiber needed to produce the pulp used for manufacturing each product.

Scientific Publications & Secondary Data

The information obtained from the RFIs will be used in conjunction with known conversion factors, process yields, and forest measurement data. For instance, based on geographical information from questions two and five of the RFI, the Forest Inventory Analysis (FIA) database from the US Forest Service can be used to determine the hardwood and softwood species mixes that contribute most to fiber production in the forests of the identified region. Once the mix of species that are most likely used in each product is identified, pulping properties of those species can then be used to calculate production yields. Pulping properties and process yields will be likely come from two books: “Handbook of Pulping and Papermaking” (Biermann, 1996) and “Forest Products Measurements and Conversion Factors” (Briggs, 1994). An abbreviated example, from the former source, of the data to be used is provided in Figure 4.6 below.

Species	Scientific name	Aver. fiber length (mm)	Dens. lb/ft³	Spec. Grav.	Pulp yield, %[1] Kraft	Sulfite
Baldcypress	*Taxodium distichum*	6.00	26	0.42	48	46
Cedar:						
Atlantic white	*Chamaecyparis thyoides*	2.10	19	0.30	45	
Eastern redcedar	*Juniperus virginiana*	2.80	27	0.43	45	
Incense	*Libocedrus decurrens*	2.00	22	0.35	45	40
Port-Orford	*Chamaecyparis lawsoniana*	2.60	25	0.40	45	45
Western redcedar	*Thuja plicata*	3.80	19	0.30	40	43
Douglas-fir, coastal	*Pseudotsuga menziesii*	4.50	28	0.45	48	48
Fir:						
Balsam	*Abies balsamea*	3.50	21	0.34	50	47
California red	*A. magnifica*	3.25	23	0.37	48	48
Grand	*A. grandis*	5.00	23	0.37	48	49
Noble	*A. procera*	4.00	22	0.35	47	48
Pacific silver	*A. amabilis*	3.55	22	0.35	49	49
Subalpine	*A. lasiocarpa*	3.15	21	0.34	48	48
White	*A. concolor*	3.50	22	0.35	48	48

[1]Screened yield for nonbleachable kraft (for bleachable subtract 2-3%) and bleachable sulfite.

Figure A.4 Screenshot of "Table 2-5. Basic pulping properties of U.S. softwoods."
Source: Biermann, 1996, p. 42

APPENDIX B

Data Dictionary

Environmental Involvement

(Scored on a scale of 1 to 7: Strongly Disagree = 1, Strongly Agree = 7)

EI1	I am concerned about the environment.
EI2	The condition of the environment affects the quality of my life.
EI3	I am willing to make sacrifices to protect the environment.
EI4	My actions impact the environment.

Behavioral Attitude – Direct Measures

(Scored on a scale of 1 to 7: Strongly Disagree = 1, Strongly Agree = 7)

AD1	Purchasing recycled copy paper is a good idea.	
AD2	It is foolish to purchase recycled copy paper.	
AD3	It is important to purchase recycled copy paper.	
AD4	Purchasing recycled copy paper does more harm than good.	* *Reverse coded*
AD5	Purchasing recycled copy paper is worthwhile.	

Behavioral Beliefs, Outcomes – Indirect Measures

(Scored on a scale of -3 to +3: Strongly Disagree = -3, Strongly Agree = +3)

BB1	Purchasing recycled copy paper helps my unit/department be more sustainable.	
BB2	Purchasing recycled copy paper for use in my unit/department leads to paper jams or other malfunctions in our printer(s).	* *Reverse coded*
BB3	Purchasing recycled copy paper helps prevent deforestation.	
BB4	Purchasing recycled copy paper increases the operating expenses of my unit/department.	* *Reverse coded*
BB5	Purchasing recycled copy paper helps to conserve our natural resources.	
BB6	Purchasing recycled copy paper hurts communities that rely on the forest products industry for jobs and economic growth.	* *Reverse coded*
BB7	Purchasing recycled copy paper can support local business.	

Behavioral Beliefs, Evaluations – Indirect Measures

(Scored on a scale of 1 to 7: Strongly Disagree = 1, Strongly Agree = 7)

BE1	It is important to help my unit/department be more sustainable.
BE2	Paper jams and other printer malfunctions are bad.
BE3	Deforestation is a serious problem.
BE4	Minimizing expenses related to office supplies is important.
BE5	Conserving natural resources is desirable.
BE6	It is wise to support communities that rely on the forest products industry for economic growth.
BE7	It is important to support local business.

Normative Beliefs – Direct Measures

(Scored on a scale of 1 to 7: Strongly Disagree = 1, Strongly Agree = 7)

SND	Most people who are important to me think I should purchase recycled copy paper.
DN1	Most University employees in roles that are similar to mine purchase recycled copy paper.

Subjective Norm, Injunctive – Indirect Measures

(Scored on a scale of -3 to +3: Strongly Disagree = -3, Strongly Agree = +3)

IN1	My supervisor would approve of me purchasing recycled copy paper.
IN2	My coworkers would approve of me purchasing recycled copy paper.
IN3	Students would approve of me purchasing recycled copy paper.
IN4	Faculty would approve of me purchasing recycled copy paper.
IN5	University leadership would approve of me purchasing recycled copy paper.

Subjective Norm, Motivation to Comply – Indirect Measures

(Scored on a scale of 1 to 7: Strongly Disagree = 1, Strongly Agree = 7)

MC1	When it comes to purchasing copy paper, I want to do what my supervisor thinks I should do.
MC2	When it comes to purchasing copy paper, I want to do what my coworkers think I should do.
MC3	When it comes to purchasing copy paper, I want to do what students think I should do.
MC4	When it comes to purchasing copy paper, I want to do what faculty think I should do.
MC5	When it comes to purchasing copy paper, I want to do what University leadership think I should do.

Behavioral Control

(Scored on a scale of 1 to 7: Strongly Disagree = 1, Strongly Agree = 7)

BCC1	It is easy for me to purchase recycled copy paper.
BCA1	Whether or not I purchase copy paper with recycled content is entirely up to me.
PTD	With regard to making purchasing decisions, I have a great deal of influence in deciding how to do my work.

Behavioral Intention

(Scored on a scale of 1 to 7: Strongly Disagree = 1, Strongly Agree = 7)

BI1	When purchasing copy paper, I intend to select products made with recycled content.
BI2	I am willing to purchase copy paper that contains recycled material.
BI3	I plan to choose products that are made from recycled material when purchasing copy paper.

Attitude Toward Green Purchases

(Scored on a scale of 1 to 7: Strongly Disagree = 1, Strongly Agree = 7)

AGP1	I like the idea of purchasing green.
AGP2	Purchasing green products is not important.
AGP3	I have a favorable attitude toward purchasing a green version of a product.
AGP4	Purchasing green products is generally not worthwhile.
AGP5	It is wise to purchase green products.

Perceived Organizational Support Toward the Environment

(Scored on a scale of 1 to 7: Strongly Disagree = 1, Strongly Agree = 7)

OSE1	I feel that I am able to behave as sustainably as I want to while at work.
OSE2	The University does not care about whether I behave in a sustainable manner or not.
OSE4	I do not feel that I make a positive environmental impact through work at Penn State.
OSE5	My actions toward sustainability are appreciated by the University.

Organizational Identity

(Scored on a scale of 1 to 7: Strongly Disagree = 1, Strongly Agree = 7)

OI1	When someone criticizes Penn State University, it feels like a personal insult.
OI2	I am very interested in what others think about Penn State University.
OI3	When I talk about my organization, I usually say ‘we’ rather than ‘they’.
OI5	When someone praises this organization, it feels like a personal compliment.
OI6	If a story in the media criticized Penn State University, I would feel embarrassed.

Political Ideology

(Scored on a scale of 1 to 7: Extremely Liberal = 1 ; Moderate, Middle of the Road = 4 ; Extremely Conservative = 7)

PI	How would you describe your political views?

Employment Tenure

(Scored on a slide scale from 0 to 30+)

ET1	Approximately how many years have you been employed at Penn State University?
ET2	Approximately how many years have you been in your current role?

Open-ended

OE1	If you have any thoughts or comments you'd like to share about paper purchasing and/or paper consumption at Penn State University, please use the text box below:

Following items presented only to those who did not purchase AE products in previous year:

American Eagle Paper – Part 1

(Scored on a scale from 1 to 4: Not familiar at all = 1 ; Very familiar = 4)
Included photos of AE copy paper products: AE30, AE50, and AE100

AE1	How familiar are you with the American Eagle Paper Mills company?
AE2	How familiar are you with the Eagle Office brand of copy paper made by American Eagle Paper Mills (shown above)?

American Eagle Paper – Part 2

(Scored on a scale from 1 to 4: No, never = 1 ; Yes, many times = 4 ; 0 = I don't know)
Included photos of AE copy paper products: AE30, AE50, and AE100

AE3	Have you ever <u>purchased</u> any Eagle Office brand products like the ones shown above?
AE4	Have you ever <u>used</u> any Eagle Office brand products like the ones shown above?

American Eagle Paper – Part 3

(Scored on a scale from 1 to 5: No, definitely not = 1 ; Not sure = 3 ; Yes, definitely = 4)
Included photos of AE copy paper products: AE30, AE50, and AE100

AE5	Do you know how to locate and purchase Eagle Office brand paper in the Penn State General Stores online catalog?

APPENDIX C

Full Survey Questionnaire

Survey Introduction Page

"What's in Your Paper? Fiber Consumption of a University and the Purchasing Decisions that Drive it"

The purpose of this study is to better understand factors that influence paper purchasing decisions at Penn State University.

- You will be asked to complete a brief survey. The survey questions will pertain to purchasing decisions for copy paper products and general perceptions of sustainability at Penn State University. You may skip any questions you prefer not to answer. Most participants will be able to complete the survey in about 8-9 minutes.
- Participating in this research study is an opportunity for employees with purchasing responsibilities to receive broader recognition for their role in University operations. Furthermore, this study will contribute to our collective understanding of the factors that drive organizational purchasing decisions and guide development of purchasing policies that reduce environmental impact while maintaining operational effectiveness.
- If you have questions or concerns about this research study, please contact Nathaniel Elser (principal investigator) at (814) 865-9485 or nce5000@psu.edu. You may also contact Dr. Judd Michael (co-investigator) at (814) 863-2976 or jhm104@psu.edu.
- This study has been approved by IRB. Please review the consent information for participating in this research at the following link: Informed Consent to Participate in Research

By proceeding to the survey, you imply your voluntary consent to participate in the study.

Thank you for supporting this research

Items in Blocks 1-5 utilized 7-point Likert-type response scales ranging from "Strongly agree" to "Strongly disagree". Items are presented in the same order as presented in the online questionnaire.

Block 1

Please consider the following statements and select the response you feel is most true for you

1. Purchasing recycled copy paper is a good idea.
2. Conserving natural resources is desirable.
3. I am very interested in what others think about Penn State University.
4. My actions impact the environment.
5. Most people who are important to me think I should purchase recycled copy paper.
6. I do not feel that I make a positive environmental impact through my work at Penn State.
7. With regard to making purchasing decisions, I have a great deal of influence in deciding how to do my work.
8. It is wise to purchase "green" products.
9. Minimizing expenses related to office supplies is important.
10. When it comes to purchasing copy paper, I want to do what University leadership think I should do.

Block 2

Please consider the following statements and select the response you feel is most true for you

1. Purchasing recycled copy paper helps to conserve our natural resources.
2. My actions toward sustainability are appreciated by the University.
3. Purchasing recycled copy paper does more harm than good.
4. When it comes to purchasing copy paper, I want to do what my coworkers think I should do.
5. It is important to help my unit/department be more sustainable.
6. Whether or not I purchase copy paper with recycled content is entirely up to me.
7. I am willing to make sacrifices to protect the environment.
8. Most University employees in roles that are similar to mine purchase recycled copy paper.
9. Purchasing recycled copy paper increases the operating expenses of my unit/department.
10. Purchasing "green" products is generally not worthwhile.
11. It is important to support local business.

Block 3

Please consider the following statements and select the response you feel is most true for you

1. Paper jams and other printer malfunctions are bad.
2. I have a favorable attitude toward purchasing a "green" version of a product.
3. University leadership would approve of me purchasing recycled copy paper.
4. It is important to purchase recycled copy paper.
5. The University does not care about whether I behave in a sustainable manner or not.
6. When it comes to purchasing copy paper, I want to do what my supervisor thinks I should do.
7. I am willing to purchase copy paper that contains recycled material.
8. When someone criticizes Penn State University, it feels like a personal insult.
9. Purchasing recycled copy paper helps my unit/department be more sustainable.
10. I am concerned about the environment.
11. Purchasing recycled copy paper hurts communities that rely on the forest products industry for jobs and economic growth.

Block 4

Please consider the following statements and select the response you feel is most true for you

1. Purchasing "green" products is not important.
2. My supervisor would approve of me purchasing recycled copy paper.
3. I feel that I am able to behave as sustainably as I want to while at work.
4. When it comes to purchasing copy paper, I want to do what students think I should do.
5. Purchasing recycled copy paper for use in my unit/department leads to paper jams or other malfunctions in our printer(s).
6. Deforestation is a serious problem.
7. Purchasing recycled copy paper is worthwhile.
8. When I talk about Penn State to others, I usually say ‘we’ rather than ‘they’.
9. I plan to choose products that are made from recycled material when purchasing copy paper.
10. Faculty would approve of me purchasing recycled copy paper.
11. Purchasing recycled copy paper can support local business.

Block 5

Please consider the following statements and select the response you feel is most true for you

1. The condition of the environment affects the quality of my life.
2. When purchasing copy paper, I intend to select products made with recycled content.
3. My coworkers would approve of me purchasing recycled copy paper.
4. If a story in the media criticized Penn State University, I would feel embarrassed.
5. Purchasing recycled copy paper helps prevent deforestation.
6. When it comes to purchasing copy paper, I want to do what faculty think I should do.
7. It is easy for me to purchase recycled copy paper.
8. Students would approve of me purchasing recycled copy paper.
9. When someone praises Penn State University, it feels like a personal compliment.
10. I like the idea of purchasing "green".
11. It is wise to support communities that rely on the forest products industry for economic growth.

Block 6

American Eagle Paper Items; presented only to respondents who did not purchase AE products in previous year (see data dictionary in Appendix A for more information)

Block 7

1. If you have any thoughts or comments you'd like to share about paper purchasing and/or paper consumption at Penn State University, please use the text box below:
   (Open-ended item)

APPENDIX D

Survey Recruitment Communications

Penn State Purchasing Study

Nathaniel Elser <PSU_PaperPurchasingStudy@qualtrics-survey.com> Wed, Jul 1, 2020 at 12:45 PM
Reply-To: Nathaniel Elser <nce5000@psu.edu>
To: (recipient's @psu.edu email address here)

Survey of Paper Purchasing Practices at Penn State University

Hello,
My name is Nathan Elser. I am a PhD student in the Department of Agricultural and Biological Engineering at University Park. As part of my dissertation research, I am conducting a study on employee purchasing behaviors at Penn State University. Specifically, I am interested in learning about factors that influence purchasing decisions for copy paper products.

Did you know? Penn State University consumes over ***150,000 reams*** of copy paper in a typical year.

Areas of "minor" procurement, such as purchasing office supplies, are often not given high priority in the overall procurement strategies of large organizations. With this research, I hope to better understand how these decisions are often made and highlight the important role of employees who are tasked with making them.

Only Penn State employees who have placed purchase orders for copy paper in the past year have been invited to participate in this study. To participate, you will only need to complete a short online questionnaire (see link below). Most participants will be able to complete the questionnaire in **about 8-9 minutes.**

This study is for research purposes only and participation is completely voluntary. Your decision to participate or not to participate will only be known to members of the study team (myself and my faculty advisor, Dr. Judd Michael). All responses are confidential and will only be reported in aggregate form.

Please consider contributing to this study by completing the questionnaire before **Tuesday, July 14th**.

Your responses will be automatically saved and you may return to the survey using the same link if need be. Additional information about the study can also be found by following the link.

Follow this link to the Survey:
Take the Survey

Or copy and paste the URL below into your internet browser:
(full custom link displayed here)

Thank you for your support,
Nathaniel C. Elser
PhD Candidate, Biorenewable Systems

Department of Agricultural & Biological Engineering (ABE)
205 Agricultural Engineering Building
The Pennsylvania State University, University Park, PA 16802

Questions about the study can be directed to:

Nathaniel Elser		Dr. Judd Michael
nce5000@psu.edu	*or*	jhm104@psu.edu
(814) 865-9485		(814) 836-2976

Penn State Purchasing Study

Nathaniel Elser <PSU_PaperPurchasingStudy@qualtrics-survey.com> Wed, Jul 8, 2020 at 9:30 AM
Reply-To: Nathaniel Elser <nce5000@psu.edu>
To: (recipient's @psu.edu email address here)

Survey of Paper Purchasing Practices at Penn State University

Hello again,
Last week you should have received an email from me with an invitation to participate in a study on purchasing decisions at Penn State University (the body of that email is copied below). I'm emailing again to provide a friendly reminder to please consider contributing to this study by completing the short online questionnaire. If you have already done so, thank you! If not, please find the survey link below. Based on the responses received so far, the average amount time needed to complete the survey is **9.3 minutes**.

For more information about the study, please see the original invitation (copied below) or simply follow the survey link. The survey will close on **Tuesday, July 14th**.

Follow this link to the Survey:
Take the Survey

Or copy and paste the URL below into your internet browser:
(full custom link displayed here)

Thank you,
Nathaniel C. Elser
PhD Candidate, Biorenewable Systems
Department of Agricultural & Biological Engineering (ABE)
205 Agricultural Engineering Building
The Pennsylvania State University, University Park, PA 16802

Original Invitation, Sent July 1st:

Hello,
My name is Nathan Elser. I am a PhD student in the Department of Agricultural and Biological Engineering at University Park. As part of my dissertation research, I am conducting a study on employee purchasing behaviors at Penn State University. Specifically, I am interested in learning about factors that influence purchasing decisions for copy paper products.

Did you know? Penn State University consumes over ***150,000 reams*** of copy paper in a typical year.

Areas of "minor" procurement, such as purchasing office supplies, are often not given high priority in the overall procurement strategies of large organizations. With this research, I hope to better understand how these decisions are often made and highlight the important role of employees who are tasked with making them.

Only Penn State employees who have placed purchase orders for copy paper in the past year have been invited to participate in this study. To participate, you will only need to complete a short online questionnaire. Most participants will be able to complete the questionnaire in **about 8-9 minutes.**

This study is for research purposes only and participation is completely voluntary. Your decision to participate or not to participate will only be known to members of the study team (myself and my faculty advisor, Dr. Judd Michael). All responses are confidential and will only be reported in aggregate form.
Please consider contributing to this study by completing the questionnaire before **Tuesday, July 14th**.

Your responses will be automatically saved and you may return to the survey using the same link if need be. Additional information about the study can also be found by following the link.

Thank you for your support,
Nathaniel C. Elser
PhD Candidate, Biorenewable Systems
Department of Agricultural & Biological Engineering (ABE)
205 Agricultural Engineering Building
The Pennsylvania State University, University Park, PA 16802

Questions about the study can be directed to:

Nathaniel Elser		Dr. Judd Michael
nce5000@psu.edu	*or*	jhm104@psu.edu
(814) 865-9485		(814) 836-2976

Follow the link to opt out of future emails:
Click here to unsubscribe

Penn State Purchasing Study (Final Request)

Nathaniel Elser <PSU_PaperPurchasingStudy@qualtrics-survey.com> Mon, Jul 13, 2020 at 12:11 PM
Reply-To: Nathaniel Elser <nce5000@psu.edu>
To: (recipient's @psu.edu email address here)

Survey of Paper Purchasing Practices at Penn State University

-- Final Request --

Are you feeling anxious about everything you read in the news? Stressed over last-minute tax filing? Emotionally exhausted from following endless debates online among your Facebook friends?

Skip the online debates and discouraging headlines. Instead, let me offer you a 9.3 minute escape.

On July 1st and July 8th, I contacted nearly 900 Penn State employees to request their participation in a study on purchasing decisions at the University. As of today, approximately 21% have completed the survey. While I am very grateful for those responses, I am still short of the number I'll need in order for this study to prove worthwhile. As such, I am asking you *one last time* to please consider contributing your opinions and experience to this study by completing the short questionnaire before **midnight tomorrow** (Tuesday, July 14th). If you started but did not complete the survey, you may also resume your response using the link below.

It's a survey, about copy paper. Boring? Yes, maybe a little. But after you complete it, you can feel good knowing you've helped guide future purchasing policies at Penn State and beyond (and not to mention, helped me get closer to graduating). What better way to spend 9.3 minutes of your time online?

Please, follow this link to the survey:
Take the Survey

Or copy and paste the URL below into your internet browser:
(full custom link displayed here)

For more information about the study, simply follow the survey link.

Thank you for supporting this research!

Nathaniel C. Elser
PhD Candidate, Biorenewable Systems
Department of Agricultural & Biological Engineering (ABE)
205 Agricultural Engineering Building
The Pennsylvania State University, University Park, PA 16802

Questions about the study can be directed to:

Nathaniel Elser		Dr. Judd Michael
nce5000@psu.edu	*or*	jhm104@psu.edu
(814) 865-9485		(814) 836-2976

APPENDIX E

Consent Form (HRP–589)

CONSENT FOR RESEARCH

The Pennsylvania State University

Title of Project: *What's in Your Paper? Fiber Consumption of a University and the Purchasing Decisions that Drive it*

Principal Investigator: *Nathaniel Elser*
Telephone Number: *(814) 865-9485*

Faculty Advisor: *Judd Michael, PhD*
Telephone Number: *(814) 863-2976*

We are asking you to be in a research study. This form gives you information about the research.

Whether or not you take part is up to you. You can choose not to take part. You can agree to take part and later change your mind. Your decision will not be held against you and there will be no penalty or loss of benefits to which you are entitled.

Please ask questions about anything that is unclear to you and take your time to make your choice.

1. **Why is this research study being done?**
   The purpose of this study is to better understand factors that influence paper purchasing decisions at Penn State University.
2. **What will happen in this research study?**
   Participants in the study will complete a brief survey online. The survey questions will pertain to purchasing decisions for copy paper products and general perceptions of sustainability at Penn State University. Participants are free to skip any questions they prefer not to answer. Most participants will be able to complete the survey in less than 8 minutes.
3. **What are the risks and possible discomforts from being in this research study?**
   There is a risk of loss of confidentiality if your information is obtained by someone other than the investigators. Absolute confidentiality cannot be guaranteed; however, the loss of confidentiality is very unlikely since precautions will be taken to prevent it from happening. The confidentiality of information will be maintained as required by applicable law and to the degree permitted by the technology used.
4. **What are the possible benefits from being in this research study?**
   Participating in this research study is an opportunity for administrative support employees to receive broader recognition for their role in University operations. Furthermore, this study will contribute to our collective understanding of the factors that drive organizational purchasing decisions and guide development of purchasing policies that reduce environmental impact while maintaining operational effectiveness.
5. **What other options are available instead of being in this research study?**
   You may decide not to participate in this research study.
6. **How long will you take part in this research study?**
   If you agree to take part, it will take you about 8 minutes to complete the online questionnaire.

7. How will your privacy and confidentiality be protected if you decide to take part in this research study?

7a. What happens to the information collected for the research?

Efforts will be made to limit the use and sharing of personal information to people who have a need to review this information. Reasonable efforts will be made to keep personal information private. However, absolute confidentiality cannot be guaranteed.

- Participant email addresses will be linked to survey responses. Only the principal investigator and their faculty advisor will have access to the survey data, which will be stored in a password protected file. When the survey period closes on (date appx. 2 weeks after survey opening), email addresses will be removed and the survey data will be maintained in an anonymized format.
- The principal investigator and/or their faculty advisor may use information collected in this project for future projects involving other researchers. Any information that could identify you would not be shared.
- In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.
- Research records can be provided by court order, or in response to a subpoena or a legal request for documents.

We will do our best to keep your participation in this research study confidential to the extent permitted by law. However, it is possible that other people may find out about your participation in this research study. For example, the following people/groups may check and copy records about this research.

- The Office for Human Research Protections in the U. S. Department of Health and Human Services
- The Institutional Review Board (a committee that reviews and approves research studies) and Penn State's Office for Research Protections.

7b. What will happen to my research information and/or samples after the study is completed?

All survey data will be maintained electronically in password protected files stored in Penn State IT systems. Only the principal investigator and his advisor will have access to the data. To provide opportunities for publishing findings or conducting follow-up research, data will be stored for five years following completion of the study.

The survey data may be used in future research studies only if one of the original investigators remains directly involved. In this case, we may share your responses with other investigators without your additional informed consent. Before sharing survey data, however, we will anonymize the records by removing all identifying information.

8. Will you be paid or receive credit to take part in this research study?

You will not receive any payment or compensation for being in this research study.

10. Who is paying for this research study?

Funds from the Penn State College of Agricultural Sciences Department of Agricultural and Biological Engineering will be used to support this research.

11. What are your rights if you take part in this research study?

Participating in this study is voluntary.

- You do not need to participate in this study

- If you choose to participate in this study, you have the right to stop at any time.
- If you decide not to participate in this study or if you decide to stop at a later date, there will be no penalty or loss of benefits to which you are entitled.

If you submit responses to the online survey and later decide you no longer want to be part of the study, all information you provided will be permanently removed from the study records.

12. If you have questions or concerns about this research study, whom should you call?

Please call the head of the research study (principal investigator), Nathaniel Elser at (814) 865-9485 if you:

- Have questions, complaints or concerns about the research.
- Believe you may have been harmed by being in the research study.

You may also contact the Office for Research Protections at (814) 865-1775, IRB-ORP@psu.edu if you:

- Have questions regarding your rights as a person in a research study.
- Have concerns, complaints, or general questions about the research.
- You may also call this number if you cannot reach the research team or wish to offer input or to talk to someone else about any concerns related to the research.

INFORMED CONSENT TO TAKE PART IN RESEARCH

By proceeding to the survey, you imply your voluntary consent to participate in the research. Please keep or print a copy of this form for your records.

APPENDIX F

IRB Approval

PennState

Office for Research Protections
Vice President for Research
The Pennsylvania State University
205 The 330 Building
University Park, PA 16802

814-865-1775
Fax: 814-865-8699
orp@psu.edu
research.psu.edu/orp

APPROVAL OF SUBMISSION

Date: June 10, 2020

From: (IRB Coordinator)

To: Nathaniel Elser

Type of Submission:	Initial Study
Short Title:	Green Purchasing Decisions in a HEI
Full Title of Study:	What's in Your Paper? Fiber Consumption of a University and the Purchasing Decisions that Drive it
Principal Investigator:	Nathaniel Elser
Study ID:	STUDY00014968
Submission ID:	STUDY00014968
Funding:	Not Applicable
IND,IDE, or HDE:	Not Applicable
Documents Approved:	• Consent Form, Interview (HRP-589).pdf (0.01), Category: Consent Form • Consent Form, Questionnaire (HRP-589).pdf (0.01), Category: Consent Form • Eliciting Salient Beliefs - Interview Questions (14968 - Elser).pdf (0.01), Category: Data Collection Instrument • Email Recruitment Script.pdf (0.01), Category: Recruitment Materials • HRP-591 - Protocol for Human Subject Research - Fiber Purchasing Decisions in a HEI (ELSER).pdf (0.04), Category: IRB Protocol • OIS Approval of Qualtrics Survey Use.pdf (0.01), Category: Other • Paper Purchasing - TPB Questionnaire Items (14968 - Elser).pdf (0.01), Category: Data Collection Instrument • Use of Purchasing Data - Approval Letter (Study 14968) _signed.pdf (0.01), Category: Other
Review Level:	Expedited

On 6/10/2020, the IRB approved the above-referenced Initial Study. This approval is effective for one year from date of approval. You will be required to submit an annual administrative review form through CATS IRB. You will receive reminders prior to the administrative review form due date.

If an administrative review form is not submitted within one year of approval, the study will be closed administratively.

Attached are stamped approved consent documents. Use copies of these documents to document consent.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within CATS IRB (http://irb.psu.edu). These requirements include, but are not limited to:

- Documenting consent
- Posting a consent form to a federal website, if applicable
- Requesting modification(s)
- Closing a study
- Reporting new information about a study
- Registering an applicable clinical trial
- Maintaining research records

This correspondence should be maintained with your records.

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