ON THE ROAD TO SUSTAINABILITY:
FROM VISION TO ACTION IN THE SUSTAINABILITY TRANSITION

By

Richard Garland Grogan

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ABSTRACT

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This dissertation examines change towards sustainability in three types of organizations: corporations, small and medium-sized enterprises (SMEs), and universities. Following the introduction, each of these organizational types is treated in a separate manuscript, with a conclusion that integrates the manuscripts and poses new questions about the role of organizational change in meeting sustainability goals.

The introduction surveys the evolution of organizational change research, including its applicability to sustainability. The rich theoretical literature on organizational change reveals four themes germane to these manuscripts: (1) typologies of change, (2) drivers of change, (3) degree of change, and (4) pace of change. The most relevant typologies are social cognition, and cultural (Kezar, 2001); the drivers (triggers) of change are identified as broad in scope, yet all related to the same end goal of sustainability; the degrees of change are best explained within Dunphy and Stace's (1993) typology as "incremental adjustments" and "modular transformations," but these efforts fall short of "fundamental" changes; finally, the pace of change is identified as possibly too slow to meet sustainability stressors.

The first manuscript is an investigation of corporate sustainability reporting over the past decade (1999-2009), during which the number of corporations reporting on sustainability indicators has grown exponentially. Using quantitative content analysis, this study examines commonly reported core environmental indicators as specified by the Global Reporting Initiative (GRI). The concept of improvement is measured among these commonly reported indicators, and

in the years 2006-2009, the majority of companies showed improvement in energy consumption, water usage, carbon emissions, and Nitrogen Oxide (NOx) emissions. Further, the manuscript links changes in sustainability indicators over time with changes in financial indicators, strengthening the "business case" for sustainability.

The second manuscript examines decision-making in SMEs in the fuel industry (service stations and small oil companies). In-depth interviews with service station owners, oil company owners, and others in the fuel industry in Michigan are used to examine decisions about whether to install biofuel (ethanol and/or biodiesel) infrastructure as part of the overall product mix. Results indicate that decision biases resulting from representativeness, availability, and overconfidence in part characterize decisions by these organizations.

Manuscript three explores the evolution of sustainability within an environmental stewardship initiative at a large midwestern university through a series of in-depth interviews with faculty, staff, and student employees. The success of the broader initiative is examined through the theoretical framework of Lipsky's (1971 & 1980) street-level bureaucracy model, which is applied and extended from governmental agencies to the university setting. The study concludes that members of the University's street-level bureaucracy embody the primary characteristics of Lipsky's model, suggesting wider applicability.

The final manuscript concludes the dissertation with a discussion of the degree, pace, and direction of sustainability change among the three preceding manuscripts. It is argued that each of the change processes explored in this research fail to achieve "fundamental" change, and thus the difficult process of fundamental change should be elevated to, in the language of David Orr's (2002) four challenges of sustainability, a fifth challenge on which other sustainability challenges depend.

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KEY TO ABBREVIATIONS

AASHE	Association for the Advancement of Sustainability in Higher Education
AASHE STARS	(AASHE) Sustainability Tracking, Assessment and Rating System
AFDC	(U.S. Department of Energy's) Alternative Fuels and Advanced Vehicles Data Center
A4S	The Prince's Accounting for Sustainability Project
B5	Blend of 95 percent diesel fuel and 5 percent biodiesel
BOD	Biochemical Oxygen Demand
B20	Blend of 80 percent diesel fuel and 20 percent biodiesel
CCX	Chicago Climate Exchange
CEO	Chief Executive Officer
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFP	Corporate Financial Performance
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO2	Carbon Dioxide
CSP	Corporate Social Performance
CSR	Corporate Social Responsibility
DOE	(U.S.) Department of Energy
E85	Blend of 85 percent ethanol and 15 percent gasoline
EIA	(U.S.) Energy Information Administration
ESG	Environmental, Social and Governance
GDP	Gross Domestic Product
GGE	Gasoline Gallon Equivalent
GHG	Greenhouse Gas
GM	General Motors
GRI	Global Reporting Initiative
HAP	Hazardous Air Pollutant
IPCC	Intergovernmental Panel on Climate Change
LPG	Liquefied Petroleum Gas
NACS	The Association for Convenience and Petroleum Retailing
NBB	National Biodiesel Board
NGO	Non-governmental Organization
NOx	Nitrogen Oxide
P/E	Price-Earnings Ratio
PFC	Perfluorocarbons
RFA	Renewable Fuels Association
ROE	Return on Equity
ROI	Return on Investment
SARA	Superfund Amendments and Reauthorization Act

SEC	(U.S.) Securities and Exchange Commission
SF6	Sulfur Hexafluoride
SME	Small and Medium-Sized Enterprise
SO2	Sulfur Dioxide
SPSS	Statistical Package for the Social Sciences
SUV	Sport Utility Vehicle
TPV	Third-Party Value
USDA	U.S. Department of Agriculture
VOC	Volatile Organic Compound
WBCSD	World Business Council for Sustainable Development

INTRODUCTION

There is little consensus around the meaning of the term "sustainability" in academic literature (e.g., Mebratu, 1998; SMEP, 2008), which makes applying it empirically challenging. However, there are common themes and principles that emerge in attempts to define sustainability. One such principle is interdependence (e.g., Leiserowitz, Kates & Parris, 2006; World Summit on Sustainable Development, 2002), which suggests that all living creatures and natural resources on the planet are dependent upon each other. Naess (2002) articulates this in part through the idea of "deep ecology," in which (among eight principles) he argues for an intrinsic value of our biosphere, as juxtaposed with an anthropocentric view.

Interdependence, as illustrated above, necessarily transcends "the environment" to also include our social and economic systems. In this vein, sustainability is often considered as having three components: social (or, as Agyeman, Bullard & Evans (2002), Elkington (1999) and others argue, "social justice"), environmental, and economic (e.g., World Summit on Sustainable Development, 2002). These three components are important for understanding sustainability in organizations, as they underpin the "triple bottom line," popularized by Elkington (1999). The triple bottom line refers to the need to consider an organization's "social" and "environmental" bottom lines as opposed to a myopic focus on the economic bottom line.

Another important component of understanding sustainability in organizations is rooted in the concept of *sustainable development*; that is, the push for growth of organizations, an idea most evident in corporations (the subject of the first manuscript in this dissertation), which are bound by charter to maximize shareholder value (akin to growing profits). Though the concepts

of development and sustainability may be at odds to many, the pursuit of growth while also seeking to adhere to sustainability principles is the essence of sustainability in organizations.

Definitions of sustainable development abound, including Kates et al. (2001): "Meeting fundamental human needs while preserving the life-support systems of planet Earth is the essence of sustainable development…"; Clark & Dickson (2003): "…the challenge of sustainable development is the reconciliation of society's development goals with the planet's environmental limits over the long term" (p. 8059); and perhaps the most famous sustainability definition, from the World Commission on Environment and Development's 1987 report (popularly known as the Brundtland Commission), "Our Common Future": "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Each of these definitions allows for significant flexibility in defining terms such as "needs," "long-term," and especially "society's development goals."

However, despite the inability to reach agreement on a single holistic concept of sustainability, elements of sustainability, or attempts at moving along the continuum of a sustainability transition (as conceptualized by organizations), are widely evident. In organizations, these elements are manifested at multiple levels. Pearce and Robinson (1988) offer a useful framework for examining organizational levels. They theorize three such levels: corporate, business, and functional. Decisions made at each of these levels can impact organizations in different ways. For example, decisions made at the "functional" or "street" level, utilize the bureaucratic concept of "discretion" (Lipsky, 1980); decisions made at the "corporate" or "strategic" level have a much broader scope, and can impact organizations on a longer time horizon.

These decisions, collectively, can contribute to what is often called the "sustainability transition," or some derivative thereof (e.g., McMichael & Smith, 2000; Orr, 2002; Parris & Kates, 2003; Siegel, 2006). This transition is generally characterized as a shift in consciousness among the global citizenry and how these citizens think about the structure of society, the economy, and the environment; among business scholars this shift in consciousness applies to businesses that recognize that they must engage many different types of stakeholders (as opposed to just investors), and pursue environmentally-friendly and community- (defined broadly) friendly practices to continue to succeed (e.g., Elkington, 1999; Freeman, 1984).

Implicit in the concept of a sustainability transition is some measure of change, that is, transitioning to a more "sustainable" way of doing things from a *modus operandi* that is less so. However, change is problematic on two levels: First, change implies an endpoint or goal – change *to what*; second, changing an organization, either from within or externally, is a formidable challenge.

The organizational change literature is substantial [Kezar (2001) notes that there are "hundreds" of organizational change theories], and spans a continuum from scholarly work to what Checkland calls "airport" paperbacks (Checkland, 1981) of questionable theoretical origin. Much organizational change research can be categorized in two ways: (1) understanding the process of organizational change, and (2) prescriptively addressing how managers and other stakeholders can create change; the prescriptive element is often presented as "leadership" (e.g., Heifetz, Grashow & Linsky, 2009). Though useful in some applications, prescriptive change literature risks glossing over important differences between specific organizational change processes (Bolman & Deal, 1991), and the psychological attributes underlying the behavior of people and organizations during change processes (Dawson, 2003).

The field of organizational change can be viewed through a variety of disciplinary lenses because of the scope of what can be included in the term "organization;" among these disciplines are psychology, decision science, business strategy, supply chain management, and sociology. One could just as easily find a citing by Foucault (e.g., Mills, 2003) as by the newest Chief Executive Officer (CEO) of BP, whose post-Gulf spill change efforts will no doubt be the subject of numerous Harvard Business case studies in the near future.

The size and scope of the field, however, is partly a reflection of how important it is, particularly for the work of change for sustainability, or change towards sustainability. The collection of manuscripts in this dissertation is titled "On the Road to Sustainability," and if we agree as a society that change towards sustainability is needed (as a growing body of evidence and organizations who study these issues suggest) organizations are a necessary component of that change program.

Specific to this collection of manuscripts, the three types of organizations highlighted here – corporations, SMEs, and universities – represent three powerful types of organizations. A quick survey of statistics indicates that in 2002, of the 100 largest global "economic entities" (which includes countries), nearly 30 were corporations (UNCTAD, 2002). SMEs comprise 90 percent of the world's businesses (GRI, 2008), and universities are both hubs of research on this topic (and thus help to define the research agenda), and are responsible for educating those who will inherit the reins of existing businesses, as well as those who will start new ones.

There are collections of people and organizations who espouse to lead the way towards sustainability; Bjorn Stigson, for example, heads the World Business Council for Sustainable Development (WBCSD), which is a collection of large corporations seeking to implement change, and to argue for the regulatory framework that will allow them to do so. Outside of

regulation, businesses are also voluntarily participating in frameworks, such as the GRI, to measure and communicate their sustainability activities; universities are also participating in sustainability measurement, most recently through the GRI's educational complement, the Association for the Advancement of Sustainability in Higher Education's Sustainability Tracking, Assessment and Rating System (AASHE STARS).

These efforts are noble, though there is also room for a cynical take on the creation of sustainability associations and reporting frameworks, which is that they are a method of delaying change rather than actually doing it; this accusation is certainly possible, because one conclusion that the organizational change literature can agree on is that change is incredibly hard, and is hard on organizations (e.g., Holbeche, 2006; Mills, 2003; Pennings, 1985). Fundamental change – the most disruptive and transformative – is especially difficult, which explains why up to 95 percent of changes in organizations, regardless of their initial intent, fail to achieve this level (Burnes, 1996). Academic and non-academic work is littered with examples of change processes that failed, or failed to reach the crescendo of fundamental change (e.g., Heifetz et al., 2009; Mills, 2003).

One reason it is so difficult to change is that organizations are collections of individuals, and often change is internalized by these individuals as loss (Heifetz et al., 2009). From decision science, we know that people behave differently when they encounter loss than when they face the prospect of gains (e.g., Kahneman, 1979). As such, the subversive behaviors that employees undertake to avoid change (i.e., loss) have been both catalogued (e.g., Dawson, 2003) and incorporated into the field of "leadership" or "adaptive leadership" (Heifetz et al., 2009) in an attempt to teach managers how to cope with feelings of loss.

Manuscripts

The three manuscripts that comprise this dissertation are best framed and connected within the context of organizational change. Specifically, the manuscripts are linked by four components of organizational change research: (1) categorization within the social cognition (Kezar, 2001) and cultural (Kezar, 2001; Dawson, 2003) change theory typologies, (2) the influence of multiple triggers (both external and internal) of change towards the same end, (3) a similar degree of change with respect to sustainability, and (4) a similar pace (rate) of change, again with respect to sustainability. Each of these components is discussed briefly below in the context of the literature, and as they relate to the manuscripts.

Organizational Change

Component One: Typologies of Change

Because of the number of theories and perspectives in the field of organizational change, a few scholars have attempted to categorize the theories according to typologies to enhance understanding for both executives and for the field itself; notable examples include Van de Ven and Poole (1995), Kezar (2001), and Dawson (2003). Kezar (2001) divides the theories into six groupings, which is more useful than some higher-level groupings [one review, Beer and Nohria (2000), grouped all organizational change theories into just two categories] because it allows a finer level of differentiation between later theories, particularly in the categories of social cognition and cultural models.

Elements of these six perspectives on organizational change can be seen throughout the literature (e.g., Bolman & Deal, 1991; Dawson, 1994; Dawson 2003; Jaffee, 2001; Reed, 1989) through the work of scholars who trace their co-evolution in concert with a growing understanding of organizations themselves. That is, what was once considered a very rational,

intentional, and logical implementation of change objectives eventually came to be understood as boundedly rational, and ultimately as political and culturally laden processes (Dawson, 2003).

This mirrors the development of the understanding of change at the strategic level; after all, often it is the organization's leadership that either drives change (e.g., Dunphy, Griffiths & Benn, 2002), or encourages it from a grassroots level (e.g., Lipsky, 1980). It was Mintzberg (1978) who refuted the notion that change was intentional and proceeded logically from a strategic decision, and Barnes Jr. (1984) and Schwenk (1984) who incorporated elements of judgmental heuristics and biases at all organizational levels into the understanding of the implementation of change. Perhaps Argyris put it most succinctly, noting simply that people rarely behave "rationally" and thus the organizations that they create embody this (Argyris, 1985).

Kezar's (2001) six categories of change theories are: evolutionary theories, teleological theories, political (dialectical) theories, life cycle theories, social cognition theories and cultural theories. Evolutionary and teleological theories (Dawson, 2003; Kezar, 2001; Van de Ven & Poole, 1995) typically de-emphasize individuals' roles in organizations, treating the organization instead as one monolithic entity. By contrast, political theories (also termed "dialectical") build from the work of Simon (1997), who emphasized the psychological environment of organizations as a mechanism for controlling the boundaries of decisions, and as such placed the emphasis for change back on individuals, or more commonly on factions of individuals advocating for one element or perspective of change (Dawson, 2003; Kezar, 2001; Van de Ven & Poole, 1995).

Yet another category is life cycle theories (Levy & Merry, 1986; Van de Ven & Poole, 1995), which describe change at various points in the natural development and evolution of an

organization, not unlike the framework for the "diffusion of innovations" envisioned by Everett Rogers (2003).

Of the six categories of change outlined by Kezar (2001), social cognition and cultural theories are most relevant to the manuscripts in this dissertation. Social cognition theories of change were the fist venture away from the *organization as monolith* perspective of change; that is, there are multiple visions of what change should look like (or what the outcome of that change ought to be) within an organization, and these visions translate to multiple "truths," all of which impacts implementation (Bolman & Deal, 1991; Kezar, 2001; Morgan, 1986; Weick, 1995). However, the social cognition perspective tends to de-emphasize environmental "triggers;" the environment of change is not necessarily as important as how individuals in an organization interpret these triggers – be they internal or external (Harris, 1996).

Cultural change theories follow the lead of social cognition theories, again placing an emphasis on individuals, but including the importance of factions of individuals in change processes, as in political theories (Dawson, 2003; Kezar, 2001). Because of the complexity of the culture of an organization, cultural theories offer some explanation of why change takes so long to implement, and why it is rare to achieve lasting, fundamental change (Collins, 1998; Kezar, 2001). Cultural theories emphasize the symbols of an organization – paying homage to the importance of myth and folklore (Dawson, 2003), and again place an importance on individuals' reluctance to change, in part because of loss aversion (Heifetz, et al., 2009).

Social cognition and cultural change theories are the most relevant to the manuscripts in this dissertation because they recognize: (1) that change is difficult, and fundamental change is rarely achieved, which is a primary finding of the manuscripts, (2) that change takes a long time, and cannot be directed in a rational, linear way, as is also reflected in the manuscripts, and (3)

that change is filtered through an organization of individuals, who bring their own biases to bear in assessing and implementing change initiatives. These may not sound like revolutionary characteristics, but the formalization of these ideas is the result of a long progression of organizational research, and it is notable that these characteristics are supported again in the work completed for this dissertation.

Finally, it should also be noted that using elements of two types of change theories (here, social cognition and cultural) to interpret empirical change processes is not without precedent; scholars such as Bolman and Deal (1991) advocate for the use of multiple theories or "lenses" in order to understand change more broadly, and via more constituencies within an organization.

Component Two: Triggers

Another component of organizational change that unifies these three manuscripts is the source of organizational change, or what the literature refers to as "triggers" (e.g., Dawson, 2003; Dunphy et al., 2002; Senior, 2002) These triggers can be both external and internal, and are analogous to drivers of change.

Dawson's (2003) review of triggers yields several that are appropriate to sustainability in organizations, including governmental policy shifts, technology changes, and an increasingly globalized operating environment that has steadily increased the number of stakeholders to which organizations are held accountable (Dunphy et al., 2002). Triggers rarely operate alone; as Senior (2002) points out, it is unlikely that a single trigger is enough to compel organizations to change; rather, change is the result of multiple triggers. Further, as Bolman and Deal (1991) theorize, no two organizations change in the same way, thus, different triggers can apply to different organizational change processes.

In the first manuscript, research on corporate sustainability efforts recognizes that the triggers are global in scope, and for corporations include the desire for positive public relations, and a growing recognition of the substantive financial impacts of climate change on business operations (e.g., Dunphy et al., 2002; Holliday, Schmidheiny & Watts, 2002).

On a smaller scale, in the second manuscript, SMEs in Michigan that added biofuel infrastructure were compelled to change through a combination of national, state, and local triggers, including government incentives, and the demographic composition of their communities (SMEs in farming communities enthusiastically support biofuels).

Finally, the university profiled in the third manuscript faced its own set of triggers including external accountability via the Chicago Climate Exchange (CCX), and internal policy-making and attempts to change the culture of the university.

What unites the manuscripts with respect to triggers is not necessarily the triggers themselves, but rather that multiple triggers are operating simultaneously to create change, and that a variety of triggers are influencing the same end – a change with respect to sustainability. Though one trigger is rarely enough to compel change (Senior, 2002), the differentiation of meaning within the concept of sustainability is evidenced here in part through the differing number of triggers that influence its manifestation.

Component Three: Degree of Change

Degree of change is framed within the understanding that change is perpetual, even in organizations that appear to be sitting idle. Weick and Quinn (1999) describe change as either "episodic" or "continuous," noting that continuous change is smooth and ongoing; the sum of smaller changes ultimately yields fundamental change. Weick and Quinn (1999) argue that organizations that do not continuously adapt lose touch with their environment [Senior (2002)

calls this process "strategic drift"] such that they are eventually forced into more uncomfortable episodic change, which is much more noticeable and disruptive. A core concept in this vein is that organizations should not have to undergo fundamental change processes if they continuously adapt; the need for fundamental change is considered a response to an organization's failure to adapt (Holbeche, 2006).

Change can also be demarcated as "first order" or "second order" change (e.g., Kezar, 2001), whereby first order processes are characterized by small adjustments, while avoiding "core" changes in the organization. By contrast, second order is fundamental, with change encompassing an organization's values and mission; this is akin to a change in the organization's culture (e.g., Dunphy et al., 2002).

Dunphy and Stace (1993) utilize a typology of the degree of change, which is useful in analyzing how degree of change relates to the collection of manuscripts in this dissertation; in the typology, there are four degrees of change: "fine tuning," "incremental adjustment," "modular transformation," and "corporate transformation," with fine tuning as the least intensive form of change (similar to first order changes), and corporate transformation analogous to second order (fundamental) change.

Using the language of the typology just outlined, change for sustainability in this dissertation is concentrated at levels two and three, that is, incremental adjustment and modular transformation. At these levels, new products are added or removed from a product mix, and organizational adjustments are made that include redefining the responsibilities of departments, or re-envisioning the functions of some departments.

With regard to the first manuscript[1], corporations have in some cases added departments in which sustainability initiatives are housed, and have modified practices to improve environmental or social performance, which in some cases is reflected in their sustainability indicators; thus, some corporations (at least those reporting) appear to have undergone modular transformation. In the second manuscript, SMEs have arguably changed less than their corporate colleagues; they have simply added new products alongside older products, a process analogous to incremental adjustment. Finally, the university profiled has re-organized a major department (campus sustainability office) and made key changes to improve environmental performance, another modular transformation. As will be discussed in more depth in the concluding section of this dissertation, there was no evidence to support fundamental (or second-order) change in the organizations in these studies.

Component Four: Pace of Change

Pace of change refers to how fast an organization changes. Pace can be problematic to analyze and measure; considering the concept of continuous change above, a company that is continually adapting and changing is technically never finished with the change process, so it is difficult to discern when and where change initiatives begin and end (Weick & Quinn, 1999). Further, fundamental changes are particularly difficult to measure (Snow & Hambrick, 1980), in

[1] A limitation of content analysis, the method used to analyze corporate sustainability reports in manuscript one, is the inability to understand just how fundamental change has been. Thus, the statements concerning the degree of change in corporations made in this introduction are based only on the content of the reports themselves (and previous academic literature), and the evidence they provide about corporations' sustainability initiatives.

part due to the same methodological challenges that plague sustainability measurement, including definitional, contextual, and comparability problems. For example, there are unclear expectations for the amount of change required for an effort to be considered "fundamental," especially given that what is fundamental for one organization might only be "fine tuning" for another. Additionally, though some data is available from ethnographic-style change studies (e.g., Mills, 2003), comparability is a problem due to ever-shifting contexts, environments, and organizational differences.

Because of the issues outlined above, the manuscripts in this dissertation work from the assumption that a benchmark research strategy is a logical method to investigate the pace of change in organizations; that is, determining a series of baseline measurements based on empirical data to assess whether organizations are changing towards sustainability fast enough to meet or outpace the manifestation of sustainability challenges in environmental, financial, and social systems.

Despite international efforts to establish directionality and benchmarks (such as the Kyoto Protocol, or the 2009 UN Climate Change Conference in Copenhagen), there is no sustainability "deadline" to which all global organizations must adhere, and science can at best give us estimates of climate change markers. Thus, these manuscripts contribute to an understanding of the pace of change by adding to the literature new insights into the significant amount of time it takes change processes to unfold (even incremental adjustments and modular transformations) and simultaneously establishing the types of benchmarks mentioned above that can serve as markers in an analysis of whether the pace of change is fast enough (and, as noted below, substantial enough).

The university examined in manuscript three has been working on change since 2005 and still lacks integration of sustainability initiatives as a core value, as evidenced through its continued struggle to effect "culture change" and the absence of sustainability as a core value among the university's published Core Values. Regarding manuscript two, though the number of service stations that offer biofuels increased 48 percent from 2007 to 2010 (DOE, 2010; EIA, 2007), they still comprise only two percent of service stations overall (Census Bureau, 2009; DOE, 2009; DOE, 2010). Finally, in the first manuscript, companies only consistently showed improvement on four environmental indicators (out of 17) based on absolute measures of sustainability within the past decade, suggesting that change may actually be moving away from sustainability (as currently theorized) in the corporate category, not towards it.

Summary

To summarize, the three manuscripts that comprise this dissertation are connected through four components of organizational change: (1) typologies of change, (2) drivers of change, (3) degree of change, and (4) pace of change. The typologies of change create a context for understanding the change process. With the context established, the drivers of change help to explain what compels an organization to change towards sustainability. Components three and four, degree of change and pace of change, provide the language and framework necessary to take the next steps in this type of research, by assessing how much change is needed and how quickly it is needed to meet sustainability objectives.

The findings of this dissertation, when applied through a change lens, provide a benchmark for how at least three types of organizations are changing with respect to sustainability, and I believe that a benchmark is the first step towards crystallizing an agreed-upon direction for change. Yet, the organizations investigated here do not exhibit fundamental

changes, or, depending on the time scale used, a rapid pace of change. This is not to say that these changes are not meaningful; I believe that any of these changes are difficult to undertake, financially and culturally. However, the crux of the issue of sustainability and change is ultimately whether the changes are substantial enough (*degree of change*) and quick enough (*pace of change*), to meet environmental, financial, and social requirements for the planet and "society." This issue will be discussed in more depth in the concluding section of this dissertation, after readers have explored the three manuscripts, and thus have a greater understanding of the types of organizations being analyzed, and the changes they are undergoing.

Introduction to the Manuscripts

The manuscripts following this introduction investigate three types of organizations, and are arranged sequentially based on the scope of the organization being analyzed, from large to small. The first manuscript analyzes large corporations, the average revenue of which is approximately $42 billion; the second investigates much smaller businesses (SMEs), though collectively they represent over 5,000 service stations in Michigan; and the third manuscript investigates a single university, in a case study of change in that organization's "street level" bureaucracy. Each manuscript is introduced briefly below.

Manuscript one[2] examines corporate sustainability reporting, a growing phenomenon over the past decade, and a field that is rapidly converging on a shared sustainability standard for reporting, the GRI. The study examines reports over the past decade (1999-2009) for evidence of change in the form of improvement in absolute (as opposed to normalized) sustainability

[2] Portions of the analysis of this manuscript were presented as a poster, by the same title, at the Global Reporting Initiative's biennial conference in Amsterdam, 2010.

indicators, a topic that has not yet been thoroughly addressed in the reporting literature. Further, the study seeks to extend the concept of the "business case" for sustainability, by linking improvement in sustainability indicators to financial outcomes. Results suggest that GRI indicators related to carbon emissions, water use, NOx emissions, Sulfur Dioxide (SO2) emissions, Volatile Organic Compound (VOC) emissions, and waste generation are the most commonly reported indicators, and that in the years 2006-2009, the majority of companies showed improvement in energy consumption, water usage reductions, carbon emission reductions, and NOx emission reductions. Additionally, new evidence in support of the business case for sustainability (a financial benefit to undertaking sustainability initiatives) is presented.

Manuscript two is focused on the fuel industry, working from the assumption that at one time biofuels were considered a path to more sustainable transportation infrastructure. The study utilizes in-depth interviews with service station owners and others in the fuel industry in the state of Michigan, and finds that despite the excitement around biofuels, relatively few stations offer them. Decisions by service station owners to include biofuels have resulted in questionable Returns on Investment (ROI), and it is apparent that well-established decision biases such as representativeness, availability, and overconfidence crept into the biofuel infrastructure decision processes of participants. As such, continuing down the same policy path of offering partial incentives for infrastructure may not be the optimal solution for encouraging mass adoption of alternative fuel vehicles, whatever those may be in the future.

Finally, manuscript three[3] explores the evolution of sustainability change through an environmental stewardship initiative at a large midwestern university. The initiative is investigated through a series of in-depth interviews with faculty, staff, and student employees. The success of the initiative is examined through the theoretical framework of Lipsky's (1971 & 1980) street-level bureaucracy model, which is applied and extended from governmental agencies to the university setting.

While each of the three manuscripts can stand alone as separate studies, they are linked by themes of organizational change as outlined in this introduction, and thus work together to aid in understanding how change is occurring in organizations with respect to sustainability. While future research topics are addressed in each manuscript individually, it is also worth noting that only continued research in each of these areas will allow us to gain a sense of where we are headed, and whether we are truly on the road to sustainability, or on the road to something very different.

[3] A slightly truncated version of this manuscript was published in *Thresholds in Education Journal*, Spring/Summer 2009: Grogan, R. (2009). We All Have a Part to Play: Making Street Level Bureaucracy Work at the University Level. *Thresholds in Education Journal, 35*(1&2), 16-22.

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CHAPTER 1: CORPORATE SUSTAINABILITY REPORTING: COMMON INDICATORS AND IMPROVEMENT OVER TIME, WITH IMPLICATIONS FOR COMPARABILITY AND THE BUSINESS CASE FOR SUSTAINABILITY

Introduction

Corporate reporting has traditionally consisted of financial information, provided in a standardized format within the guidelines of the U.S. Securities and Exchange Commission (SEC), or one of several country or region-specific regulatory agencies. However, over the past 20 years, a separate stream of reporting has emerged, which focuses on the measurement of non-financial activities. These reports go by a number of different names, including "Corporate Social Responsibility" (CSR), "Environmental, Social and Governance" (ESG), and increasingly, "Sustainability Reporting" (all non-financial reports will be referred to in this manuscript as "sustainability reports").

While companies (or occasionally other types of organizations, such as nonprofits or government agencies) are not required to report non-financial indicators, there is evidence that the SEC in the U.S. is heading in that direction; recent actions include requiring disclosures concerning business risks from climate change (Lehmann, 2009), and consideration of standardized sustainability indicators for future reporting schemes (SEC, 2009). Among those that already report non-financial indicators, the most widely accepted framework is the GRI.

Within the growing body of research on sustainability reports, several questions remain, three of which are addressed by this study: progress with respect to sustainability among reporting companies, the "business case" for sustainability, and report comparability. To address these topic areas, a sample of 330 sustainability reports was collected and analyzed, from U.S.

headquartered companies who reported multiple times (at least twice) over the past decade (1999-2009).

A content analysis was conducted of quantitative environmental indicators from these reports to determine, on an absolute level (as opposed to a normalized basis), whether companies improved or declined in their sustainability performance during / between reporting years. These change variables were analyzed for their impacts on financial indicators to determine relationships that might suggest a business case for sustainability (i.e., that changes in sustainability indicators correspond with changes in financial outcomes). The issue of comparability of sustainability reports is discussed throughout the manuscript as a limitation to this type of research.

Descriptive results show that GRI indicators related to carbon emissions, water use, NOx emissions, SO2 emissions, VOC emissions, and waste generation are the most commonly reported indicators over the past decade. Regarding the business case for sustainability, the study adds to the literature supporting the business case; results show that increasing carbon emissions results in lower revenue.

Finally, the conclusion addresses potential concerns with the concept of improvement as used here, as well as future challenges related to reporting. It should be noted that this study relies on the assumption, drawn from stakeholder theory (Freeman, 1984), that corporations will volunteer sustainability information *even if it shows a decline* in performance over time.

Given a lack of standardization of reporting, or accountability to governing bodies for sustainability results, companies can choose to omit potentially negative information from reports[4].

This study is exploratory; the author is not aware of other studies that have analyzed sustainability indicators with respect to improvement. As such, many of the results will require additional research to verify and extend the questions addressed in this manuscript. Future research is discussed in detail in the conclusion.

Background & Current Challenges

Background

Sustainability reporting must be considered in the context of sustainable development, a concept which implies that corporations can hold both growth (development) and sustainability as complementary values. This idea is theoretically challenging, in that corporations are bound to seek profits for their shareholders by their charters, and thus must continue to grow. Yet at least some theoretical concepts of sustainability [such as "strong sustainability" (e.g., Lawn, 2006; Brekke, 1997), which severely restricts substitutability of natural capital and makes unrestrained growth difficult] would seem to be at odds with a paradigm encouraging growth, certainly unrestrained growth. Still, organizations are operationalizing elements of sustainability by

4 A tangential concept is legitimacy theory, which details the social contract between a firm and society, such that a firm that seeks to improve or adjust its legitimacy claim in society may use a report as a mechanism to do so (O'Donovan, 2002).

increasingly introducing quantifiable sustainability practices and disclosing them publicly in sustainability reports.

Sustainability reporting, or at least thinking beyond the financial "bottom line" of a company, can be traced back to the concept of externalities, introduced by Pigou (1920) and, later, Coase (1960). Social responsibility at the corporate level can be traced to the 1960s (Salzmann, Ionescu-Somers, & Steger, 2005). As early as the 1940s however, there are accounts of a broader commitment to *stake*holders, implying an audience beyond *share*holders (Norman & MacDonald, 2004). In the 1980s, the concept of stakeholder involvement in corporate strategic decisions appeared through the work of scholars such as Edward Freeman, whose 1984 work *Strategic Management: A Stakeholder Approach*, is commonly cited as early evidence of what would eventually be called "social" sustainability in corporations.

To make these theoretical concepts explicit, alternative (compared to strictly financial) reporting began to emerge in the form of environmental indicators. These were eventually combined with social indicators to create "sustainability reports." The process of sustainability reporting generally follows a set of guidelines or a framework of indicators within which a company measures and reports its sustainability-related activities.

The basis of the indicators included in the earliest sustainability reports was in financial accounting, in what was termed "triple bottom line accounting" or "sustainable accounting." Sustainable accounting is credited to Elkington (1999), who developed the concept during the 1990s. Together with other scholars, the concept of sustainable accounting has evolved from its first iteration, which employed traditional methods of accounting to make damage to the environment from business activities financially explicit, to later work, which defines two

additional "bottom lines," social and environmental, beyond the economic or financial bottom line (Lamberton, 2005).

Multiple reporting frameworks have emerged since this earlier work to provide the growing interest in measuring corporate sustainability with a format for systematically measuring and reporting it. Perrini and Tencati (2006) found that over 100 such frameworks and reporting schemes have existed at one time or another for this purpose. The frameworks that still exist today exhibit a range of comprehensiveness, from the triple-bottom line-rich GRI, to the London Benchmarking Group's tool that helps companies evaluate contributions from a single philanthropic project, such as a day of volunteerism to remove trash from a local river, or a company-wide fundraising drive to benefit a charitable organization (LBG, 2009). Additionally, some companies create and use their own proprietary frameworks.

One framework has emerged as the clear frontrunner: the GRI. In the absence of a formal standard for sustainability reporting, the GRI has become the de facto standard; a recent KPMG study found that nearly 80 percent of sustainability reporting companies use the GRI (KPMG International, 2008), and in early SEC deliberations on potential sustainability reporting standards, the SEC formally recognized that the GRI is rapidly becoming the standard worldwide (SEC, 2009). Harnessing this momentum, GRI director Ernst Ligteringen unveiled a charge at the GRI's 2010 conference in Amsterdam to all of the world's companies – corporations and SMEs – to report using the GRI by 2015, or explain publicly why they choose not to (GRI, 2010).

The GRI was piloted by 20 organizations in 1999, and by 2008, 715 international organizations participated in reporting using the GRI's G3 guidelines (GRI, 2008). The G3 guidelines represent the third iteration of guidelines, with each revision reflecting changes driven

by a stakeholder input process (GRI, 2009; KPMG International, 2008). The GRI specifies indicators ranging from quantitative, such as the amount of energy or materials used in a specific industrial process, to qualitative, such as the narrative details of employee training programs (GRI, 2008).

Current Challenges in Reporting Research

A review of research on corporate sustainability reporting over the past decade reveals several remaining challenges, three of which are addressed by this study: progress with respect to sustainability among reporting companies, the "business case" for sustainability, and report comparability. Each of these areas is briefly addressed in the context of the literature below.

First, there are suspicions about whether *real* progress is being made with respect to sustainability, or whether the reports are merely a marketing tactic; the popular term "greenwashing" is one manifestation of this controversy. Though many companies have a dedicated sustainability or social responsibility department or office, some companies house these operations within marketing, public relations, or public affairs offices, thus contributing to the marketing-driven perception.

A review by Kolk (2004) revealed that while categories of sustainability indicators proliferated in the 1990s, there has been little evidence to support an increase in the "sustainable" activities included in those reports. In part because of this, a few scholars have called sustainability reporting little more than a marketing and public relations vehicle (e.g., Cerin, 2002; Dunphy, Griffiths & Benn, 2002; Marshall & Brown, 2003; O'Donovan, 2002; Perrini & Tencati, 2006).

This study addresses the issue of sustainability progress by determining whether companies, at least on an absolute scale, improved or declined in their sustainability performance

across the GRI's environmental sustainability indicators over a 10-year period. It is important to measure improvement specifically because understanding changes over time provides a benchmark for progress. This research is only now becoming possible, at least with reports as the unit of analysis, because an increasing number of reports are being released every year.

It should be acknowledged that "improvement" is a subjective term, and that what is improvement to one person or organization is very different from improvement to another. While examining quantitative indicators exclusively makes improvement more objective than qualitative aspects of sustainability, it is still a concept open to interpretation. Because of this, in the spirit of transparency, the author's improvement judgments for each of the indicators included in the analysis are provided in **Appendix A: Table 5**. Also, improvement for this study is viewed in absolute terms, as opposed to normalized terms; thus, improvement is focused on emissions and resource use as a global, cumulative calculus.

Second, researchers continue to debate the "business case" for sustainability. The business case is a link between "corporate social performance" (CSP) and "corporate financial performance" (CFP) (as they are termed in the literature) (e.g., Brammer & Millington, 2008; Callan & Thomas, 2009; Godfrey, Merrill & Hansen, 2009), such that "better" performance on CSR indicators would yield "better" performance on financial (CFP) indicators.

Generally, studies show a positive relationship between CSP and CFP, such that more sustainable behaviors are connected to stronger financial performance, though strong disagreements still exist in the literature (e.g., Callan & Thomas, 2009; Margolis & Walsh, 2001). The bulk of these studies establish a correlation by linking specific events or other corporate actions to fluctuations in stock price (e.g., Godfrey et al., 2009; Hillman & Keim,

2001; Peterson, 1989; Waddock & Graves, 1997). The use of stock price itself, however, is also controversial, as will be addressed in the methods section below.

This study addresses the business case in two ways: first, the study builds on previous literature by linking CSP and CFP using traditional financial indicators (revenue and stock price) in an attempt to continue to build the business case; second, a new term called third-party value is used as a dependent variable in an attempt to push towards more precise measures of the financial indicators that are specifically influenced by sustainability.

Finally, regarding comparability, even though the GRI is rapidly becoming the de facto standard for sustainability reporting (thus allaying early fears in the literature concerning inter-framework comparability), comparability issues remain among companies using the same framework (intra-framework comparability) due to flexibility in the measurement and application of indicators. Many indicators within reports are "…in non-financial terms..." or appear "…as qualitative policy descriptions" (Slater & Gilbert, 2004, p. 45). Thus, many of the actual contents of sustainability reports may take the form of vignettes or stories about corporate activities, which do not allow for comparisons across companies or industries; one study identified a sustainability report that exceeded 500 pages, primarily due to the inclusion of lengthy (and non-comparable) case studies (GRI, 2008b). A report analyzed for this study reached to over 330 pages (Newmont Mining, 2007).

Further, the GRI guidelines propose a set of core indicators, along with several additional ones; thus, two companies that use the same guidelines could produce two very different looking reports (GRI, 2008). In referencing this issue, an early study found: "…the majority of companies do not follow any particular practice. Consequently, there is great variety in the content of what is reported" (Cerin, 2002, p. 61).

Indeed, results from this study reveal that comparability is hampered by three factors among companies who use the GRI: inconsistent methods of measuring indicators such as carbon emissions; inter-company differences in the perceived applicability of core indicators (which are designed to *enhance* comparability); and inconsistencies in the scope of activities included in measurements (for example: Should companies include wholly owned subsidiaries' emissions?; Should companies account for the emissions of their products after they are produced – such as emissions from gasoline or diesel use by oil refinery customers?). Though comparability is not addressed in this study in the form of a dedicated research question, issues of comparability are discussed throughout the manuscript because they are integral to data analysis, implications of this work, and future research opportunities.

Research Questions & Hypotheses

The study uses the following research questions to investigate the research challenges highlighted above. Hypotheses are based on findings in previous research.

RQ-1: Of companies that have produced multiple sustainability reports, what are the most commonly reported indicators among them?

RQ-1a: By how much have these commonly reported indicators improved / declined?

Hypothesis 1: Commonly reported indicators will improve over time.

RQ-2: How is financial value impacted by change in sustainability indicators?

Hypothesis 2: Building on the majority of findings in prior research, an increase in CSP activity will predict an increase in financial value.

Method

This study utilizes quantitative content analysis (e.g., Riffe, Lacy & Fico, 2005), though there is considerable space for in-depth qualitative analyses of this data set in future research. Quantitative indicators are the focus of this study because it is exploratory, and given reported inconsistencies in the literature (e.g., Slater & Gilbert, 2004), it was unclear to what extent qualitative indicators could be categorized for analysis of "improvement" over time. Further, consistent with the findings of Moneva & Cuellar (2009), quantitative indicators have a greater potential to impact third-party value than qualitative indicators, again due to potential inconsistencies in the latter.

This section first describes the data collection and identification processes, which resulted in the creation of a database that the author believes to be unique in the field of corporate sustainability indicators research. This is followed by a discussion of the coding process, and the challenges encountered in collecting these data.

Data Identification & Collection

Multiple sources were used to collect these data. Collectively, the data populate a new database that consists of the names of companies that have produced sustainability reports, the years they have reported (within the years 1999-2009), the associated environmentally focused quantitative indicators contained within the reports, and a series of financial indicators (discussed below).

Though products such as KLD STATS detail some of the same indicators as are outlined in corporate sustainability reports, these products do not detail which companies have produced multiple reports over multiple years. Meetings with colleagues and librarians at Michigan State University, and additional research and networking internationally, revealed no comprehensive

databases of corporate reports organized by company and by year. There is one known global source of this information, though it is unknown whether it is categorized as outlined above, given that the organization holds this information as proprietary (Corporate Register Employee, personal communication, March 2, 2010).

Given these challenges, the author created a new database of global organizations that have reported over the past decade (1999-2009). This timeframe was chosen because 1999 was the first year companies reported using the GRI, which is a relevant milestone for the field. Also, 2009 was the last year for which there was a significant volume of reports available at the time the study was conducted (winter/spring, 2010).

The GRI's website includes a chart of company reports per year (it is not cumulative; if company X reports in 2000 and in 2001, the chart does not indicate that); and this became the foundation of the new database. The new database shows that 1,811 organizations, headquartered across 68 countries, reported at least once between 1999 and 2009. Of the 1,811 companies, 853 reported more than once, and of those, 78 were U.S. headquartered companies. These U.S. headquartered companies are the focus of this study for two reasons: first, the author is most familiar with U.S. based organizations, having studied them extensively and worked in three such organizations; second, U.S. companies are relatively "new" to sustainability reporting when compared with peer organizations in Europe, and thus U.S. companies provide an interesting case study and point of comparison for future studies.

Upon completion of the initial database, financial indicators were added for each of the companies in the sample. These include revenue, stock price, and P/E (price-earnings) ratio; number of employees was also added for use as a control variable in the analysis. Given the longitudinal nature of this study, both stock price and revenue were converted to "real" stock

price and revenue, per the Consumer Price Index (CPI) prior to analysis. These financial data were collected from five primary sources: the Orbis database product, Google Finance, Yahoo Finance, annual reports, and 10-K filings (annual reports and 10-K filings are available from company websites and the website of the SEC's Edgar database).

Report Collection

Reports were collected and analyzed in both hardcopy and electronic format, depending on availability. Many reports are available from specially designated sections of company websites; these are commonly called "sustainability," or "corporate responsibility" pages. Additionally, reports can sometimes be found within the "investors" section of company web pages alongside a company's 10-K filings, annual reports, and other financial documents. There are also online clearinghouses of corporate sustainability reports. The clearinghouses used for this study were Corporate Register, and Social Funds.

Finding the earliest reports in the sampling frame presented the greatest challenge. Using contact information located in sustainability reports, emails were sent to corporate sustainability directors, and via generic "contact us" pages, and were followed up with phone calls. When they could be located, these early reports were mailed in hardcopy.

After collection, a final check was performed to ensure that the reports were in fact GRI-compliant, or had used GRI guidelines in their preparation. It became apparent early on that some reports in the GRI's list were not, in fact, GRI-compliant, thus necessitating this final check. If reports were on the list, but were not GRI-compliant, they were not included in the final sample.

Sample

As mentioned above, the sampling frame is 1999-2009, during which time there were 78 U.S. headquartered organizations that reported multiple times. Three of these organizations were not included in the final sample because only one sustainability report was available, and thus, improvement could not be assessed.

The final sample of 75 companies produced a total of 330 reports, which were collected for analysis. The reports ranged in length from 14 pages (Strategic Sustainability Consulting, 2009), to 332 pages (Newmont Mining, 2007). The companies in the sample span 24 industry sectors, and range in annual revenue from $142,000 - $477 billion, though the majority of companies are large entities, as average revenue is just over $42 billion. The smallest reporter has just 3 employees, while the largest company employs 465,000; the average number of employees for U.S. headquartered reporters in this sample is 91,356.

A significant portion of the study consisted of learning which indicators are reported, and whether they improve; as such, results showing this trend data include the entire 330-report sample. Business case results, because the analysis requires public financial data, use a somewhat smaller sample of for-profit companies; this sample consists of 64 companies and 292 reports.

Report Coding

Each of the 330 reports was coded for core environmental (EN) indicators specified by the GRI's G3 guidelines. Only core indicators were analyzed because, according to the GRI, every company should be able to report on core indicators, and thus these offer the best chance of comparability. The GRI separates indicators into "core" and "additional" categories. In theory, every company should be able to produce a report using the core indicators, with the opportunity

for companies to achieve a higher "Adherence Level" (the highest adherence level is A+; directionality is commensurate with a standard grading scale) by also measuring and including additional indicators.

The G3 guidelines are the third release of guidelines by the GRI, making analysis of previous versions potentially problematic; however, the GRI provides a conversion document via its website to allow users to interpret indicators released under previous versions in the language of the G3 guidelines. This study utilized this document to ensure the consistent coding of indicators across guideline updates.

To collect the data, a coding sheet was developed (**Appendix B**) that includes all of the core G3 environmental indicators. The sheets were left blank on the reverse side to allow room to record variation in reporting within each indicator (see data challenges section below). Due to the amount of variation, the code sheet was complemented by a spreadsheet into which each new variant was entered; additionally, as new variants were discovered, a retroactive analysis was conducted to ensure that this variant had not been missed in previously analyzed reports.

The reports were analyzed between January 2010 and April 2010. Due to the timeframe, some 2009 reports were not yet available. For these reports, individual companies were contacted (per the sampling methods above) and asked to provide the reports when available, even if they were in a pre-production phase. If these reports did not arrive by April 2010, they were excluded from the sample. Analysis was limited to eight reports per day to avoid coding fatigue, which can result in missed data points, or diminished thoroughness (Riffe, et al., 2005). At the end of each coding day, data were entered into a master spreadsheet.

Data Challenges & Corrections

There were four primary data challenges that influenced the coding and analysis, each of which is detailed below. First, companies interpret and report each of the core indicators liberally; there are 17 quantitative, core environmental indicators in the G3 guidelines, yet companies in this sample reported these indicators as 181 different variations (for example, listing a wide range of air or water pollutants; see **Appendix A: Table 5** for a complete list of all of the variations).

Second, these indicators were not designed as survey items, nor were they created for later analysis using quantitative data techniques; the absence of intentional research design resulted in multiple additional challenges, among them the "double-barreled" configuration of some individual indicators. An example is indicator EN20: "NOx, SO2 and other significant air emissions by type and weight" (GRI, 2008). NOx and SO2 comprise two data points (as do "type and weight"), while "other significant air emissions" resulted in 23 additional variants of emissions, including VOCs and Methane.

A third challenge was the normalization of data. Some companies choose not to report data points in absolute terms, opting instead to report on a normalized basis, such as Carbon Dioxide (CO2) emissions per $1,000 in revenue. A typical example is the Anheuser-Busch 2002 report, which detailed indicators on a *per $1 million in net sales* scale (Anheuser-Busch, 2002). Where possible, in this report and across the sample, indicators were converted from normalized terms to absolute terms. The units of normalization, such as sales volume or other financial data,

were accessed in annual reports and from company websites. If the calculation was not clearly replicable after these steps[5], the indicator was excluded from the data.

A final notable challenge resulted from units of measurement. The GRI has specific unit of measurement guidelines for reporting data per category; energy usage, for example, is reported in gigajoules, water usage is reported in cubic meters, and most emissions are reported in metric tons. However, many companies choose to report data consistent with their own internal data collection systems, resulting in vast inconsistency across companies. For this study, all of the data was converted from proprietary units to the GRI-specified unit of analysis for each indicator prior to analysis.

Analysis & Measures

After completing the data entry from the code sheets, the data were transferred to the statistical package for social sciences (SPSS) for processing. First, descriptive statistics were calculated to determine commonly reported indicators (**RQ-1**). Next, change variables were computed for each year and for the entire span of years captured for each company, to determine improvement or decline in specific indicators (**RQ-1a**). Improvement (or decline) was calculated through a dummy variable, in which a one or a zero was assigned to improvement or decline, respectively, from year to year; if a company reduced its absolute CO2 emissions, for example,

[5] If the indicator was normalized based on "total net sales," for example, and that exact number was not available in the financial data (and called the same thing), the indicator was excluded from the database. This standard was created to enhance replicability.

from 2000-2001, they would receive a 1. Alternatively, if their emissions increased over that time period, they received a 0[6].

Analysis conducted for **RQ-2** used the change variables computed for **RQ-1a** as a series of independent variables in a linear regression analysis. This analysis was designed to test for effects of these change variables on changes in dependent financial value variables. Regression equations for each analysis are specified below, following a brief discussion of dependent and independent variables.

Dependent Variables

Financial value has been the subject of much controversy in the literature (e.g., Brammer & Millington, 2008; Callan & Thomas, 2009). There is a substantial history of testing the predictive ability of sustainability indicators on stock price, where stock price serves as a proxy for a company's financial value (e.g., Godfrey et al., 2009; Hillman & Keim, 2001; Peterson, 1989; Waddock & Graves, 1997). However, this method has met with criticism, particularly among those who feel that stock price is not sufficient to account for the financial value created by sustainability activities. These latter scholars feel that other financial data, such as Return on Equity (ROE) (Waddock & Graves, 1997) or even advertising spending (Konar & Cohen, 2001), should be included in the financial value term.

This study builds upon and extends the financial value debate by using stock price and revenue as dependent variables, but also building a case for the use of "third-party value" (TPV). This new variable is rooted in Freeman's (1984) stakeholder theory. An analysis of financial

[6] Please see Appendix A for a list of improvement / decline judgments for each of the 181 variations.

value using the principles of stakeholder theory, which specifies that corporations will act in a socially responsible way in order to account for and service their stakeholders, requires a more inclusive perspective on financial value, such that stock price (which is considered primarily by investing stakeholders) is not enough. That is, corporations have stakeholders beyond investors, such as peer companies and consumers, for whom a company's progress on sustainability issues is increasingly salient (Environics, 1999).

The commonly reported P/E ratio is used to represent TPV in this study as a first step towards including a broader stakeholder base in financial indicators. P/E ratio is a financial indicator consisting of a ratio of "price" to "earnings," calculated by dividing a company's market value of its shares of stock by earnings per share. Thus, this ratio incorporates investor (third-party) sentiment concerning a company's overall performance, and an element of sound governance as manifested through earnings; it spans how a company is judged by investors, but also by consumers. For this study, P/E ratios, which can be calculated at any one point in time, were calculated at year-end (either fiscal or calendar, depending on a given company's reporting cycle) to stay consistent with reporting cycles of sustainability indicators.

Independent Variables

Improvement or decline in sustainability indicators, as calculated for **RQ-1a**, populate the right-hand side of the regression equation. Including these variables in a linear regression analysis allows for testing their ability to predict change in TPV and other financial dependent variables.

Regression Equations

Despite the large sample size of reports, variation in reporting of the 17 core environmental indicators spread the number of data points across 181 variations, which left two variables [EN3 (Direct energy consumption by primary energy source) and EN16 (Total direct and indirect greenhouse gas emissions)] with enough data points for use as independent variables in the regression equations. Further, a large cluster of the sample was concentrated in the later years of the sample (2006-2009), and thus data from these years is used in the regression analysis. Regression equations are specified below for each financial value outcome: stock price, revenue, and TPV.

Stock Price

$$\Delta Y_{i(t2-t1)} = ß_0 + ß_n X_{n(t2-t1)} + ß_k X_{k(t2-t1)} + e_i$$

Where ΔY_i is the change in stock price between t_1 and t_2, $ß_n$ is a coefficient representing the change in Y_i for each value of X_n, X_n is dummy variable indicating whether a company improved between t_1 and t_2, $ß_k X_k$ is a term capturing the organizational control variables (number of employees, P/E ratio, revenue) and change between t_1 and t_2, and e_i is an error term.

Revenue

$$\Delta Y_{i(t2-t1)} = ß_0 + ß_n X_{n(t2-t1)} + ß_k X_{k(t2-t1)} + e_i$$

Where ΔY_i is the change in revenue between t_1 and t_2, $ß_n$ is a coefficient representing the change in Y_i for each value of X_n, X_n is dummy variable indicating whether a company

improved between t_1 and t_2 , $ß_k X_k$ is a term capturing the organizational control variables (P/E ratio, stock price, number of employees) and change between t_1 and t_2, and e_i is an error term.

Third-Party Value

$$\Delta Y_{i(t2-t1)} = ß_0 + ß_n X_{n(t2-t1)} + ß_k X_{k(t2-t1)} + e_i$$

Where ΔY_i is the change in TPV between t_1 and t_2 , $ß_n$ is a coefficient representing the change in Y_i for each value of X_n , X_n is dummy variable indicating whether a company improved between t_1 and t_2 , $ß_k X_k$ is a term capturing the organizational control variables (revenue, stock price, number of employees) and change between t_1 and t_2, and e_i is an error term.

Results

Descriptive results are provided first, as part of a discussion of commonly reported indicators (**RQ-1**) over the sampling frame (1999-2009). Next, improvement and decline for each of the commonly reported indicators is presented (**RQ-1a**), and finally the regression analysis is discussed in the context of potential linkages between financial and sustainability outcomes (**RQ-2**).

RQ-1: Of companies that have produced multiple sustainability reports, what are the most commonly reported indicators among them?

Each of the 17 core environmental sustainability indicators are shown in **Table 1** below, with higher percentages indicating more commonly reported indicators. These results represent

the entire sample of multi-report organizations (75 U.S.-headquartered companies), including public and private companies and nonprofit organizations. Note that the 181 variations of core environmental indicators were re-combined to the original 17 for presentation in this table.

Table 1
Commonly Reported GRI Core Environmental Indicators 1999-2009: U.S. (HQ) Companies (G3 Terminology & Order)

Indicator	Percentage Reporting
Aspect: Materials	
EN1: Materials used by weight or volume	22.20%
EN2: Percentage of materials used that are recycled input materials	10.00%
Aspect: Energy	
EN3: Direct energy consumption by primary energy source	78.70%
EN4: Indirect energy consumption by primary source	11.90%
Aspect: Water	
EN8: Total water withdrawal by source	69.00%
Aspect: Biodiversity	
EN11: Location and size of land owned, leased, managed in, or adjacent to, protected areas of high biodiversity value outside protected areas	32.20%
EN12: Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas	38.60%
Aspect: Emissions, Effluents, and Waste	
EN16: Total direct and indirect greenhouse gas emissions by weight	89.40%
EN17: Other relevant indirect greenhouse gas emissions by weight	11.60%
EN19: Emissions of ozone-depleting substances by weight	13.40%
EN20: NOx, SO2 and other significant air emissions by type and weight	55.60%
EN21: Total water discharge by quality and destination	20.40%
EN22: Total weight of waste by type and disposal method	68.40%
EN23: Total number and volume of significant spills	23.70%
Aspect: Products & Services	
EN26: Initiatives to mitigate environmental impacts of products and services, and extent of mitigation	66.30%

Table 1 (cont'd)	
EN27: Percentage of products sold and their packaging materials that are reclaimed by category	24.00%
Aspect: Compliance	
EN28: Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with environmental laws and regulations	37.10%
	n=330

From the table, it is clear that the most commonly reported indicators (more than 50 percent reporting across the 10-year time horizon) are: EN3 (Direct energy consumption by primary energy source) (78.70 percent), EN8 (Total water withdrawal by source) (69.00 percent), EN16 (Total direct and indirect greenhouse gas emissions by weight) (89.40 percent), EN20 (NOx, SO2 and other significant air emissions by type and weight) (55.60 percent), and EN22 (Total weight of waste by type and disposal method) (68.40 percent).

Though EN26 (Initiatives to mitigate environmental impacts of products and services, and extent of mitigation) was also reported over 50 percent of the time, analysis showed that this indicator was primarily reported as qualitative (it is written as quantitative indicator by GRI) and thus it was not included in the coding other than to indicate presence / absence.

RQ-1a: By how much have these common measures improved / declined?

The percentage of companies that improved their sustainability performance for each of the commonly reported core indicators is shown in **Table 2** below. Since indicators EN20 (NOx, SO2 and other significant air emissions by type and weight) and EN22 (Total weight of waste by type and disposal method) are written as "double-barreled," the most commonly reported variations of these indicators are included in **Table 2**.

Table 2
Percentage of Companies Improving by Year & Commonly Reported Indicators (years 2006-2007 - 2008-2009)

	2006-2007		2007-2008		2008-2009	
Indicator	n	%	n	%	n	%
EN3: Direct energy consumption by primary energy source	19	57.9	24	62.5	11	72.7
EN8: Total water withdrawal by source	29	37.9	38	57.9	16	62.5
EN16: Total direct and indirect greenhouse gas emissions	43	48.8	50	64.0	21	81.0
EN20: NOx	15	73.3	19	78.9	5	80.0
EN20: SO2	14	78.6	18	61.1	5	80.0
EN20: VOC	16	81.3	13	92.3	5	60.0
EN22: Hazardous Waste (amount)	15	66.7	18	38.9	9	66.7

Hypothesis 1: Commonly reported measures will improve over time.

A trend of improvement among commonly reported measures over time emerges from 2006-2009 among indicators EN3 (Direct energy consumption by primary energy source), EN8 (Total water withdrawal by source), EN16 (Total direct and indirect greenhouse gas emissions), and EN20 (the NOx component of NOx, SO2 and other significant air emissions by type and weight). While this trend can be analyzed further with additional years of reporting data, the results of this study suggest support for Hypothesis 1 in the years 2006-2009.

RQ-2: How is financial value impacted by change in sustainability measures?

Hypothesis 2: Building on the majority of findings in prior research, improvement in CSP will predict an increase in financial value.

Stock Price

Using stock price as the dependent variable, results suggest small (though statistically significant) effects, such that for every 1,000,000 cubic meter increase in water usage, stock price increases by $0.116. Additionally, for every 1,000,000 metric ton increase in CO2, there is a $2.34 *decrease* in stock price. **Table 3** below shows the coefficients for each predictor variable.

Table 3
Relationships between outcomes and predictor of financial value in the CSP-CFP link

	Stock Price	
EN8: Total water withdrawal by source	1.16E-07	**
EN16: Total direct and indirect greenhouse gas emissions by weight	-2.34E-06	**
Number of Employees	-1.18E-05	
P/E Ratio	0.003	
Revenue	-5.57E-11	

* p<0.05, ** p<0.01

Revenue

Using revenue as the dependent variable, results indicate that for every 1,000,000 metric ton increase in CO2, there is a $1.7 billion *reduction* in revenue. **Table 4** below shows the coefficients for each predictor variable. This result suggests that there is indeed a business case with respect to CO2 reductions. The CO2 result is consistent with the results of the stock price analysis above, in that diminished financial value is the result of decreased CO2 emissions.

Table 4
Relationships between outcomes and predictor of financial value in the CSP-CFP link

	Revenue	
EN8: Total water withdrawal by source	23.423	
EN16: Total direct and indirect greenhouse gas emissions by weight	-1701.706	**
Number of Employees	146084.634	**
P/E Ratio	1.89E+06	
Stock Price	-2.00E+07	

* $p<0.05$, ** $p<0.01$

Third-Party Value

The analysis in which TPV was the dependent variable showed no significant effect of commonly reported sustainability measures [EN3 (Direct energy consumption by primary energy source) & EN16 (Total direct and indirect greenhouse gas emissions)] on TPV (P/E Ratio).

Discussion

Commonly Reported Indicators

RQ-1 revealed the commonly reported core GRI environmental indicators from 1999-2009. It is not surprising that the most commonly reported indicators are also the "low-hanging" fruit of environmental measurement: EN3 (Direct energy consumption by primary energy source), EN8 (Total water withdrawal by source), EN16 (Total direct and indirect greenhouse gas emissions by weight), EN20 (NOx, SO2 and other significant air emissions by type and weight), and EN22 (Total weight of waste by type and disposal method). With the exception of EN16, companies likely already have systems in place to capture these data because of utility billing (e.g., electricity, water, and waste disposal), or because they must operate within specific emission tolerances (in the case of EN20). Reporting these indicators suggests a re-organization

of information within companies instead of true innovation in measurement, at least not in any systematized way across the sample.

Improvement

Results from **RQ-1a** indicate that between 2006 and 2009, there is an improvement trend among commonly reported indicators, with the exception of EN22 (Hazardous waste – amount). While this trend can be partially explained by additional data points in those years resulting from an increase in the number of reports, it is an important benchmark by which future reports can be tracked, assuming that the number of reports and the number of indicators reported continues to increase (as has been the trend for GRI reporters since 1999).

The Business Case

RQ-2, building a business case for sustainability, yielded interesting results when EN16 (Total direct and indirect greenhouse gas emissions) was tested for effects on the financial measures of revenue and stock price. The business case resulting from this study is that an increase in CO2 emissions results in a reduction in revenue; this suggests that poor environmental management has real financial impacts. The result in the opposite direction of the business case, an increase in stock price as water usage increases [EN8 (Total water withdrawal by source)], has a couple of possible implications; it could mean that companies are prioritizing CO2 emission reductions over water use restrictions, or it could be that some indicators more strongly predict financial results than others.

It is important to note that a portion of this study was dedicated to developing financial measures that are more directly impacted by sustainability measures than in previous studies. Towards this end, the term TPV was used as the financial dependent variable. Regression

analysis using TPV as the dependent variable did not yield significant results, and though similar analyses using revenue and stock price did produce results, future research should continue to develop more specific indicators of the financial impacts of sustainability activities, to avoid criticisms that movement in financial indicators are due to circumstances unrelated to sustainability activities, such as broader market shifts or poor corporate decisions not directly related to sustainability.

Comparability

The results also demonstrate the comparability problem discussed at the beginning of this manuscript. Of the 17 core indicators, only six are reported more than 50 percent of the time. Thus, companies can only be compared on a few indicators. Further, the GRI has designed the "core" and "additional" indicators typology specifically to address comparability, and to proactively address concerns over whether indicators are relevant to *all* participating businesses or industries. Though this vision of comparability may one day be realized, results here indicate that the field is far from achieving this goal.

When core indicators are reported, they are rarely reported consistently; it is common for companies to measure indicators such as CO2 emissions using a variety of methodologies, including their own unique assumptions. Assumptions are used to specify what is to be included in an indicator, which is sometimes a result of a lack of specificity in the GRI's guidelines. Without speculating on the motivations for doing so, some companies capture data from only a few core operations or specific processes, which fails to paint a complete picture for the entire company, especially since readers have no way to evaluate the relative environmental intensity of one operation compared to another. Inconsistent assumptions thus harm not only inter-company comparability, but also intra-industry comparability; an oil and gas company, for

example, may not make the same assumptions as another (otherwise comparable) oil and gas company. As a result, one company may appear to be more "sustainable" than another simply by omission of information.

Another comparability issue is the units in which indicators are reported. Though the GRI provides specific guidance on which standard units should be used in reporting, in practice, companies use a variety of units. While, for research purposes, it is possible to convert units to the GRI specifications (as was done in this study; GRI specifications and units used are listed in **Appendix A: Table 5**), this is likely beyond the commitment of the average consumer or investor. As a result, one could easily unknowingly compare CO2 emissions data from two companies, one in metric tons with and one in kilograms. Further, some results cannot be compared even after conversions because companies inconsistently report some indicators in either volume or weight. One example is energy indicators; in some cases oil is reported in gigajoules, whereas in others it is reported by weight or in number of barrels. Without details on how it is used, it is difficult to compare these measurements.

Limitations

There are three primary limitations that impacted this study: control over data design, comparability between reports, and overlap between current events and the sampling frame. Data design issues and comparability have already been discussed in detail in this manuscript. Essentially, the data in sustainability reports was not intended for the type of analysis conducted in this study. Regarding comparability, the most salient issue to this study is the number of variations in the reporting of indicators; this variation made it difficult to test more than a few indicators' impact on financial value.

With respect to current events, the years containing the most data, 2006-2009, were interrupted by a global financial crisis that impacted all financial indicators, and may have affected the results. As such, future research may choose to skip years 2008, and even 2009, when considering long-term financial trends as connected to sustainability indicators; or, these years could be used as a case study of changes in sustainability indicators during extreme financial circumstances.

Conclusion

This study is among the first (that the author is aware of) to investigate changes in sustainability indicators in corporate sustainability reports over time; in this case, over a decade of reporting. Using improvement in the context of sustainability raises important questions about progress towards sustainability. Additionally, results of this study raise issues concerning the implications of inconsistent reporting, and the question of what is actually being measured in the name of sustainability.

Improvement

Arguments against the use of the term "improvement" are welcome, especially given that GRI-defined "improvement" has historically meant improvement in the reports themselves, not in the indicators therein. Only recently has the focus been amended to include comparability among reports and usefulness of information for consumers of the reports (Hill & GRI, 2007).

An investigation of improvement raises two important questions: First, what is improvement? This study calculated improvement based on absolute amounts, such as total amount of water consumed and carbon emitted. There are companies who have likely improved considerably on a normalized basis over the past 10 years, while declining in sustainability

performance on an absolute basis. However, while normalized reductions should not be discounted completely, they do not impact global emission increases, which form the foundation of problems such as climate change.

Second, what will compel businesses to improve? Academic literature on the subject suggests that there is power in the business case (e.g., Brammer & Millington, 2008; Callan & Thomas, 2009; Godfrey, Merrill & Hansen, 2009). CEOs are also in favor of this approach, from former DuPont CEO Chad Holliday (Holliday, Schmidheiny & Watts, 2002) to the founder of environmentally focused company Seventh Generation, Jeffrey Hollender (Hollender, 2010). The results of this study indicate that (at least for some environmental indicators) there is a business case to be made; as CO2 emissions increase, revenue and stock price suffer. However, this is not to say that the business case is "solved." Researchers will hopefully continue to add evidence to this concept, and continue to challenge methods and results in order to make the business case a stronger, and even irrefutable one for business leaders.

Inconsistency

Another clear outcome of this research is the amount of inconsistency in reporting, even within the same framework. As noted earlier, companies reported the original 17 environmental indicators of the G3 guidelines in 181 different variations. This creates not only a data problem for researchers (to which the author can attest), but more importantly, it creates a comparison problem for investors, analysts, and others interested in assessing the sustainability performance of a company or industry.

There are few plausible solutions to this issue, but one that has been put forth (even before the intra-framework comparability issue was a problem) is the standardization of sustainability reporting. Among the most vocal of standards proponents is Schaltegger (1997),

who notes that standards are required to ensure that the public is receiving high quality information. He further argues that the public is easily duped by attempts at reporting because they are largely unable to discern whether the quality of information is sound, and in some cases, whether the company doing the reporting is actually behaving in an environmentally-friendly (or, *sustainability*-friendly) manner commensurate with their reports. The only way, according to Schaltegger (1997), to ensure that information is useful for stakeholders is to standardize: "For external stakeholders, information about the environmental impact of firms is only useful if they know that the information is recorded in accordance with some basic conventions" (p. 91). Further, Schaltegger (1997) argues from the angle of verification (also called "assurance"), with reference to the auditing functions that are synonymous with financial reporting, noting that we can only verify information through means of auditing if "…clear, measurable standards are defined…" (p. 97).

The GRI has also recently begun advocating for standards, of which it hopes its framework will be the foundation. A strong statement in support of standards was part of a new focus for the GRI following a self-review as it neared its first decade of existence (Hill & GRI, 2007).

Of course, standards can also have negative ramifications, particularly for micro SMEs [which range from less than 10 to 250 employees (European Commission on Enterprise & Industry, 2010)] who would likely be without a seat at the table when standards are created. The logic behind this argument and other considerations regarding standards is well reasoned in papers such as those by Busch (2000) and Busch and Tanaka (1996).

The point of this manuscript is not to argue the merits of standards. However, I would argue that standards ought to be considered for specific industries or for specific types of

organizations (such as multinational corporations with revenues over $1 billion), so that analysts, investors, consumers, and even the media can get accustomed to digesting sustainability measurement data. If, as Schaltegger (1997) indicates, we as consumers of this data cannot be assured of its accuracy or quality, how can we ever begin to debate its merits or relevance in terms of what we are attempting to measure? Theoretically, there are third parties who currently audit and assure some reports; scholars such as David Owen (Nottingham University) are aggressively pursuing research on these assurance practices. However, many consumers may be skeptical about even the assurers in a post-Enron-Arthur Andersen era.

The basic descriptive results of the manuscript should also not be overlooked. It should be clear to the GRI that additional work is needed to specify measurement and reporting practices where ambiguity in the interpretation of indicators is possible.

Measuring Sustainability

The final question to consider in a manuscript like this is whether what is being measured is "sustainability" at all. We as a society cannot agree on what sustainability is, the argument goes, so how are we to measure it? Further, sustainability is constantly evolving, so how do we measure a moving target? Companies have addressed this issue semantically by calling their reports CSR reports, or ESG reports, and leaving the term "sustainability" out of the title (e.g., Anheuser-Busch, 2002; Chevron, 2007). Others have framed reports as a company's "progress" on sustainability, or its "journey" towards sustainability (e.g., Freeport-McMoRan, 2008; Newmont Mining, 2007), a nod to sustainability as a path and not an end in and of itself. Still, the GRI calls itself "a network-based organization that has pioneered the development of the world's most widely used *sustainability reporting* framework" (emphasis added) (GRI, 2007).

The results of this study, I believe, are a first step towards understanding real progress. While the results suggest that some improvement (as specified by GRI indicators) is being made, how much, and whether companies are improving fast enough is up for debate. Some will argue that normalized improvements are good enough, and that sustainability progress cannot come at the cost of economic (financial value) progress. However, normalized improvements, in the language of organizational change, are typically first order; they are small improvements without real fundamental, cultural changes. While it is my belief that it is fundamental changes that will ensure that *any* future economic growth will be possible, exact data and predictions are ever changing, and must compete publicly with daily messages to the contrary.

Some might read this manuscript and feel as though sustainability can never be measured, in part because it is too difficult to measure what we cannot agree on. I have always explained this issue by noting that we as scholars have a duty to catalog what companies are calling sustainability because no matter how we debate the etymology or current iteration of the term, companies are embracing it and are calling the results of their efforts "sustainability." I would argue that only by making it easier for people to understand the information and compare it, can we create a foundation for intelligent conversations and public debates about the concept itself, at least as it applies in a business setting.

From the beginning, sustainability reporting has taken cues from accounting, which serves as the foundation for financial reporting (such as the reports mandated by the SEC). In creating a financial reporting system, the SEC's objective was that: "…all investors…should have access to certain basic facts about an investment," and this information compelled the SEC to require financial disclosures in order to create a "common pool of knowledge" for investors (SEC, 2008). Extending the SEC's language to sustainability reporting (which is plausible given

the agency's consideration of sustainability reporting requirements) and considering the results of this study, the current reporting paradigm is far from creating the "common" of a "common pool of knowledge" for sustainability indicators.

Future Research

Opportunities for future research are many. As a direct result of this manuscript, the sample, U.S. based companies, should be expanded to include other global reporters who have reported multiple times. Though certain of the data challenges, particularly inconsistencies in measurement, are sure to grow more complex, the extra data points from an additional 500 or 1,000 reports would strengthen the results outlined above, or may serve to highlight important regional differences including policy levers' manifestation in specific company actions.

Next, future studies could broaden the scope of the indicators captured, to include social indicators and triple-bottom line economic indicators (in addition to SEC-mandated financial data). These could be analyzed in the same way as the environmental indicators used for this study, and any similarities or differences in the results would be interesting to researchers pursuing which key elements of sustainability disclosure are most relevant to companies and to companies' financial performance. As it is outlined in this manuscript, at present, the business case is really one for environmental management, not the more holistic "sustainability."

Third, there are opportunities to build upon this work as new reports are released, and in particular as standardization efforts gather steam under the concept of "integrated" reporting, which will bring financial and sustainability reporting together into one reporting format; in 2010, the GRI and Prince Charles' sustainability accounting organization, The Prince's Accounting for Sustainability Project (A4S), announced a new joint initiative to do just that (GRI, 2010; GRI, 2010a; KPMG International, 2008).

Finally, a more philosophical issue addressed briefly at the beginning of this manuscript must enter into the sphere of public debate; that is a conversation about what duty public corporations have with respect to embracing sustainability and living its values. As this research in part shows, it is difficult for companies to do both – profit seeking and sustainability – well, or rather, change themselves in a fundamental way to embrace sustainability as the foundation of business, in a climate where their charters demand that profit take a higher priority than sustainability. It is my belief that as sustainability and its attendant issues grow more familiar to those connected with the business world, the opportunities to explore and debate the topic will continue to grow. Yet, without a very open public dialogue about the nature of profit-seeking business, reporting will continue to be hindered by inconsistent expectations of public accountability.

APPENDICES

APPENDIX A: TABLE 5 – LIST OF VARIABLES, UNITS, AND JUDGMENTS

Variable Name	Variable Description	Units	Judgments
EN1	Materials used by weight or volume	Metric tons	1 (improvement) = Decrease
EN1a	Natural gas used *as a material* (not as fuel source)	Cubic meters	1=Decrease
EN1b	Plastic resins	Metric tons	1=Decrease
EN1c	Corrugated	Metric tons	1=Decrease
EN1d	Sodium chloride	Metric tons	1=Decrease
EN1e	Dextrose	Metric tons	1=Decrease
EN1f	Tobacco	Metric tons	1=Decrease
EN1g	Wrapping and packaging materials	Metric tons	1=Decrease
EN1h	Cigarette Paper	Metric tons	1=Decrease
EN1i	Coal as a material	Metric tons	1=Decrease
EN1j	Oil as a material	Cubic meters	1=Decrease
EN1k	Paper	Metric tons	1=Decrease
EN1l	Wood	Metric tons	1=Decrease
EN1m	Non-ferrous metals (e.g. aluminum, copper)	Metric tons	1=Decrease
EN1n	Plastics	Metric tons	1=Decrease
EN1o	Glass	Metric tons	1=Decrease
EN1p	Ferrous metals	Metric tons	1=Decrease
EN1q	Adhesives, coatings, solvents, paints	Metric tons	1=Decrease
EN1r	Resins (liquid / volume)	Cubic meters	1=Decrease
EN1s	Wood (reported as volume)	Cubic meters	1=Decrease
EN2	Percentage of materials used that are recycled	Percent	1=Increase
EN2a	Paper	Percent	1=Increase
EN2b	Manila and non-traditional paper	Percent	1=Increase
EN2c	Packaging	Percent	1=Increase
EN2d	Cups	Percent	1=Increase
EN2e	Polyester	Percent	1=Increase
EN3	Direct energy consumption	Gigajoules	1=Decrease
EN3a	Energy consumption from oil (energy units)	Gigajoules	1=Decrease
EN3b	Energy consumption from natural gas (energy units)	Gigajoules	1=Decrease
EN3c	Energy consumption from coal	Gigajoules	1=Decrease
EN3d	Energy consumption from hydro	Gigajoules	1=Increase
EN3e	Energy consumption from grid	Gigajoules	1=Decrease
EN3f	Energy consumption from fuel (Fairmount - Fuel #400) (Energy units)	Gigajoules	1=Decrease
EN3g	Energy consumption "electricity"	Gigajoules	1=Decrease
EN3h	Jet fuel (energy units)	Gigajoules	1=Decrease

Table 5 (cont'd)			
EN3i	Biogas	Gigajoules	1=Increase
EN3j	Propane (energy units)	Gigajoules	1=Decrease
EN3k	Wood (scrap)	Gigajoules	1=Increase
EN3l	Diesel oil	Gigajoules	1=Decrease
EN3m	LPG (liquefied petroleum gas)	Gigajoules	1=Decrease
EN3n	District Heating (Steam & Chilled)	Gigajoules	1=Decrease
EN3o	Energy consumption from "green" / renewable electricity	Gigajoules	1=Increase
EN3p	"Other" energy consumption (reported as "other")	Gigajoules	1=Decrease
EN3q	Biodiesel (volume)	Cubic meters	1=Increase
EN3r	Gasoline	Gigajoules	1=Decrease
EN3t	Nuclear	Gigajoules	1=Decrease
EN3u	"Total" energy	Gigajoules	1=Decrease
EN3v	Biofuels	Gigajoules	1=Increase
EN3w	Ethanol	Gigajoules	1=Increase
EN3x	Hydrogen	Gigajoules	1=Increase
EN3y	Energy from "Fuel"	Gigajoules	1=Decrease
EN3a1	Energy consumption from oil (volume)	Cubic meters	1=Decrease
EN3b1	Energy consumption from natural gas (volume)	Cubic meters	1=Decrease
EN3f1	Energy consumption from fuel (Fairmount - Fuel #400) (Volume)	Cubic meters	1=Decrease
EN3h1	Jet fuel (volume)	Cubic meters	1=Decrease
EN3j1	Propane (volume)	Cubic meters	1=Decrease
EN3j2	Propane (weight of material)	Metric tons	1=Decrease
EN3k1	Wood (scrap) (weight of material)	Metric tons	1='increase
EN3l1	Diesel oil (volume)	Cubic meters	1=Decrease
EN3r1	Gasoline (volume)	Cubic meters	1=Decrease
EN4	Indirect energy consumption	Gigajoules	1=Decrease
EN8	Withdrawal (as original indicator notes)	Cubic meters	1=Decrease
EN8a	Water "consumed"	Cubic meters	1=Decrease
EN8b	Water taken from stressed areas	Cubic meters	1=Decrease
EN8c	Surface water	Cubic meters	1=Decrease
EN8d	Well water / Groundwater	Cubic meters	1=Decrease
EN8e	Municipal water	Cubic meters	1=Decrease
EN8f	Ocean water	Cubic meters	1=Decrease
EN8g	Withdrawal (as original indicator notes - measured in weight)	Metric tons	1=Decrease
EN11	Location & size of land (original indicator)	1 or 0	1=Increase
EN11a	Total acreage	Square kilometers	1=Increase
EN12	1=Yes, 0=No	1 or 0	1=Increase

Table 5 (cont'd)			
EN12a	Undisturbed	Square kilometers	1=Increase
EN12b	Disturbed by company	Square kilometers	1=Decrease
EN12c	Permanently restored / restored	Square kilometers	1=Increase
EN12d	Set aside / protected	Square kilometers	1=Increase
EN16	Direct carbon emissions by weight	Metric tons CO2 equivalent (e)	1=Decrease
EN16a1	Travel	Metric tons CO2e	1=Decrease
EN16a2	Purchased electricity	Metric tons CO2e	1=Decrease
EN16a3	Auto / Fleet	Metric tons CO2e	1=Decrease
EN16a4	Air travel	Metric tons CO2e	1=Decrease
EN16a5	Freight	Metric tons CO2e	1=Decrease
EN16a6	Purchased heating oil	Metric tons CO2e	1=Decrease
EN16a7	Commuting	Metric tons CO2e	1=Decrease
EN16b	Perfluorocarbon (PFC) emissions (direct)	Metric tons	1=Decrease
EN17	Indirect (scope 3) emissions	Metric tons CO2e	1=Decrease
EN19	Emissions of ozone-depleting substances by weight	Metric tons / CFC-11e	1=Decrease
EN20	NOX	Metric tons	1=Decrease
EN20a	SOX	Metric tons	1=Decrease
EN20b	VOC [included as emissions, not greenhouse gas (GHG) or ozone-depleting]	Metric tons	1=Decrease
EN20c	Particulates	Metric tons	1=Decrease
EN20d	Mercury	Metric tons	1=Decrease
EN20e	Carbon monoxide (CO)	Metric tons	1=Decrease
EN20f	Superfund Amendments and Reauthorization Act (SARA) Air [formerly Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)]: http://www.epa.gov/superfund/policy/sara.htm	Metric tons	1=Decrease
EN20g	"Total" - generic	Metric tons	1=Decrease
EN20h	Ammonia	Metric tons	1=Decrease
EN20i	Hydrochloric acid	Metric tons	1=Decrease
EN20j	N-methyl pyrrolidone	Metric tons	1=Decrease
EN20k	Ethylene glycol	Metric tons	1=Decrease

Table 5 (cont'd)			
EN20l	Xylene	Metric tons	1=Decrease
EN20m	Other	Metric tons	1=Decrease
EN20n	HAP (hazardous air pollutants)	Metric tons	1=Decrease
EN20o	Arsenic	Metric tons	1=Decrease
EN20p	Lead	Metric tons	1=Decrease
EN20q	Selenium	Metric tons	1=Decrease
EN20r	Formaldehyde	Metric tons	1=Decrease
EN20s	Hydrogen Fluoride	Metric tons	1=Decrease
EN20t	Phenol	Metric tons	1=Decrease
EN20u	Styrene	Metric tons	1=Decrease
EN20v	Sulfur Hexafluoride (SF6)	Metric tons	1=Decrease
EN20w	Methane	Metric tons	1=Decrease
EN20x	Nitrogen	Metric tons	1=Decrease
EN21	Water discharge - impaired (volume)	Cubic meters	1=Decrease
EN21a	Water discharge - non-impaired	Cubic meters	1=Decrease
EN21b	SARA Water	Metric tons	1=Decrease
EN21c	Biochemical oxygen demand	Metric tons	1=Decrease
EN21d	Chemical oxygen demand	Metric tons	1=Decrease
EN21e	Total suspended solids	Metric tons	1=Decrease
EN21f	Water Discharge (Total)	Cubic meters	1=Decrease
EN21g	Nitrates	Metric tons	1=Decrease
EN21h	Phosphorous	Metric tons	1=Decrease
EN21i	Hydrocarbons	Metric tons	1=Decrease
EN21j	To surface water	Cubic meters	1=Decrease
EN21k	To groundwater	Cubic meters	1=Decrease
EN21L	Total dissolved solids	Cubic meters	1=Decrease
EN21m	Coliform	Cubic meters	1=Decrease
EN21n	Metals	Metric tons	1=Decrease
EN21o	Water discharge - measured in weight (21)	Metric tons	1=Decrease
EN21p	Biochemical Oxygen Demand (BOD) - measured in volume (21c)	Cubic meters	1=Decrease
EN21q	Total suspended solids - measured in volume (21e)	Cubic meters	1=Decrease
EN21r	Water Discharge (Total) - in weight (21f)	Metric tons	1=Decrease
EN22	Total waste	Metric tons	1=Decrease
EN22a	Waste-to-energy	Metric tons	1=Increase
EN22b	Recycle / Recovery / Reuse	Metric tons	1=Increase
EN22c	Treatment (when given together, divided in half)	Metric tons	1=Decrease
EN22d	Incineration	Metric tons	1=Decrease
EN22e	Landfilled	Metric tons	1=Decrease
EN22f	Hazardous waste	Metric tons	1=Decrease
EN22g	Non-hazardous waste	Metric tons	1=Decrease
EN22h	Hazardous waste disposed	Metric tons	1=Decrease

Table 5 (cont'd)			
EN22i	Hazardous waste recycled	Metric tons	1=Increase
EN22j	Paper recycled	Metric tons	1=Increase
EN22k	Metal recycled	Metric tons	1=Increase
EN22l	Oil recycled	Cubic meters	1=Increase
EN22m	Total chemical waste	Metric tons	1=Decrease
EN22n	Chemical waste treated	Metric tons	1=Decrease
EN22o	Chemical waste incinerated	Metric tons	1=Decrease
EN22p	Chemical waste landfilled	Metric tons	1=Decrease
EN22q	Chemical waste recycled	Metric tons	1=Increase
EN22r	Total solid waste	Metric tons	1=Decrease
EN22s	Solid waste incinerated	Metric tons	1=Decrease
EN22t	Solid waste landfilled	Metric tons	1=Decrease
EN22u	Solid waste recycled	Metric tons	1=Increase
EN22v	Hazardous waste-to-energy	Metric tons	1=Increase
EN22w	Hazardous waste incinerated	Metric tons	1=Decrease
EN22x	Aqueous treatment	Metric tons	1=Decrease
EN22y	Hazardous aqueous treatment	Metric tons	1=Decrease
EN22z	Computer / e-waste recycling	Metric tons	1=Increase
EN22aa	Nuclear waste	Cubic meters	1=Decrease
EN22bb	Hazardous waste treated	Metric tons	1=Decrease
EN22cc	Hazardous waste stored on site	Metric tons	1=Decrease
EN22dd	Ash produced	Metric tons	1=Decrease
EN22ee	Ash landfilled	Metric tons	1=Decrease
EN22ff	Composted	Metric tons	1=Increase
EN22gg	Ash re-used	Metric tons	1=Increase
EN22aa1	Nuclear waste - weight	Metric tons	1=Decrease
EN23	Number of spills	Number	1=Decrease
EN23a	Number of spills - petroleum	Number	1=Decrease
EN23b	Volume of spills - petroleum	Cubic meters	1=Decrease
EN23c	Volume of spills (total, not differentiated)	Cubic meters	1=Decrease
EN23d	Maritime oil spills (number)	Number	1=Decrease
EN23e	Number of chemical spills	Number	1=Decrease
EN23f	Volume of chemical spills	Cubic meters	1=Decrease
EN23g	Number of "other" spills	Number	1=Decrease
EN23h	Volume of "other" spills	Cubic meters	1=Decrease
EN26	1=Yes, 0=No	1 or 0	1=Increase
EN27	1=Yes, 0=No	1 or 0	1=Increase
EN27a	Batteries	Percent	1=Increase
EN27b	Misc %	Percent	1=Increase
EN28	Monetary value of significant fines	US Dollars	1=Decrease
EN28a	Number of non-monetary sanctions for non-compliance with environmental laws and regulations	Number	1=Decrease

APPENDIX B: CODING SHEET

Code Sheet – G3 Guidelines, "Core" Indicators

Environment Performance Indicators

Aspect: Materials
EN1 – Materials used by weight or volume

EN2 – Percentage of materials used that are recycled input materials

Aspect: Energy
EN3: Direct energy consumption by primary energy source

EN4: Indirect energy consumption by primary source

Aspect: Water
EN8: Total water withdrawal by source

Aspect: Biodiversity
EN11: Location and **size** of land owned, leased, managed in, or adjacent to, protected areas of high biodiversity value outside protected areas

EN12: Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas

Aspect: Emissions, Effluents, and Waste
EN16: Total direct and indirect greenhouse gas emissions by weight

EN17: Other relevant indirect greenhouse gas emissions by weight

EN19: Emissions of ozone-depleting substances by weight

EN20: NOx, SO2 and other significant air emissions by type and weight

EN21: Total water discharge by quality and destination

EN22: Total weight of waste by type and disposal method

EN23: Total number and volume of significant spills

Aspect: Products & Services
EN26: Initiatives to mitigate environmental impacts of products and services, and extent of impact mitigation

EN27: Percentage of products sold and their packaging materials that are reclaimed by category.

Aspect: Compliance
EN28: Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with environmental laws and regulations.

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CHAPTER 2: STRATEGIC DECISIONS TO ADOPT SUSTAINABILITY OBJECTIVES IN SMEs: THE CASE OF BIOFUEL INFRASTRUCTURE IN SERVICE STATIONS

Introduction

Much of the infrastructure that dispenses gasoline and diesel fuel in the U.S. is located in service stations. In Michigan, nearly 95 percent of service stations are locally owned and operated (Industry Association Director / Service Station Owner, personal communication, 4/13/2007), and are served by small oil companies that form a distribution network; these oil companies may also own one or several service stations. These local oil companies and service stations are considered SMEs, which range in size from 1-250 employees (European Commission on Enterprise & Industry, 2010), account for 90 percent of businesses worldwide (GRI, 2008), and contribute significantly to the global economy[7]. Their status as SMEs means that they share certain unique characteristics, which will be addressed later in this manuscript.

For decades, fueling stations have offered multiple grades of gasoline and/or diesel fuel to individual and commercial customers; but in 2006 and 2007, the types of fuels offered began to change, as some service stations and oil companies became interested in biofuels, which were compatible with a growing fleet of vehicles that could burn E85 (a blend of 85 percent ethanol and 15 percent gasoline), or biodiesel (a variety of blends, ranging from 5 percent biodiesel and 95 percent petroleum diesel, up to 100 percent biodiesel). These biofuel compatible vehicles required little, if any, modifications to use the new fuels.

[7] "Small businesses," as defined by the U.S. Small Business Administration, comprised half of for-profit, non-farm GDP in the U.S. from 1998-2004 (Kobe, 2007).

During this period, ethanol and biodiesel incentives sprang up to support the growth of fuel manufacturing facilities, automobile manufacturers, and infrastructure at service stations to dispense the fuels. There were skeptics of biofuels from the start, particularly those who felt that they were nothing more than an incremental adjustment on an unsustainable transportation pathway. Further, there was little evidence that people who owned biofuel-compatible cars actually used biofuels; an article in *Automotive News* in 2007 estimated that only one percent of the owners of flexible fuel vehicles (which can be fueled by either gasoline, ethanol, or a blend of both) actually used ethanol (Herbst, 2007).

This manuscript investigates a crucial link in the growth of biofuels: biofuel infrastructure. It assumes that even though a biofuel pump is not necessarily a proxy for the implementation of a full-blown sustainability agenda, it does represent one example of an objective on the path to environmental sustainability, at least as perceived by many people who thought that biofuels could move us closer to more environmentally sustainable fuel (e.g., Farrell et al., 2006; Shapouri, Duffield & McAloon, 2004), a perception that is still evident, as reflected in data collected for this study (e.g., Service Station Owner, personal communication, 5/10/2010).

Regardless of the role of biofuels in sustainability, the process of integrating biofuel infrastructure with service station and oil companies' existing equipment can be considered a pilot project for what comes next, such as electric car quick-charge stations. In 2010, two mass-produced models of electric cars are set to be released by traditional auto manufacturers (the Chevrolet Volt and Nissan LEAF), in addition to low-production specialty electric cars like Tesla Motors' Roadster 2.5, and numerous low-speed models that are used in housing communities or

on college campuses. Though electric cars have been touted as an example of *home-based* fueling possibilities, the service station is still dominant in the American driving landscape.

Biofuel infrastructure is examined here through in-depth interviews with service station owners and others in the fuel industry from across the state of Michigan. Michigan was chosen as the area of study for two reasons: first, Governor Jennifer Granholm has ascribed a great deal of importance to the future of biofuels in the state (State of Michigan, 2006), exclaiming: "The state that put the world on wheels will be the state that makes those wheels independent of foreign oil;" second, Michigan is one of six states[8] in which there is a large concentration of ethanol pumps in the Midwest (each state contains over 90 ethanol fuel pumps) (DOE, 2009).

The manuscript examines decisions to integrate biofuel infrastructure in the product mix in two ways: first, through the lens of traditional objectives and barriers to entry into the biofuel marketplace, and second, using elements of behavioral decision research to examine potential biases and heuristics that characterize SME decisions.

Results of the study indicate that despite the excitement and "buzz" around biofuels, relatively few stations offer them. Decisions by service station owners and oil companies to include biofuels have resulted in questionable ROI, and it is apparent that well-catalogued decision biases such as representativeness, availability, and overconfidence helped to characterize the decision processes of participants. As such, continuing down the same policy path of offering partial incentives for infrastructure may not be the optimal solution for encouraging mass adoption of alternative fuel vehicles, whatever those may be in the future.

[8] Additional states with high pump concentrations: Illinois, Iowa, Indiana, Minnesota, and Wisconsin

Background & Justification

Brief introductions to both the service station and biofuels industries are included below; this information will be relevant throughout the manuscript. Additionally, an overview of strategic decision literature through the lens of behavioral decision science research is included, which applies to the decision process discussed in the *findings* section.

Service Station Industry

The service station industry is characterized by a three-tier structure: producers, distributors, and retailers. The face of the industry is service stations; stations retail fuel, and are often the only part of the supply chain with which consumers directly interact. Service stations procure their fuel from distributors, who are called "jobbers" in industry parlance (in this manuscript, jobbers are referred to as "oil company owners and employees"). These jobbers are the link between fuel refiners (typically large multinational companies such as BP or ExxonMobil) and the retailers. Jobbers purchase fuel from refiners for storage at "bulk plants," where it is stored until it is delivered to the retailer.

There are 117,908 service stations in the U.S., and the average store sells just over 118,000 gallons of fuel per month (Census Bureau, 2009; NACS, 2009) [average monthly sales at Michigan service stations is closer to 100,000 gallons (Industry Association Director / Service Station Owner, personal communication, 4/13/2007)], which across the U.S. equals nearly 170 billion gallons annually. In 2008, these fuel sales accounted for an average of $3.9 million in sales per store (NACS, 2009). Biofuels account for a small but growing proportion of the total amount sold; government estimates, for which 2007 are the latest available statistics, show

approximately 54,000,000 GGEs (gasoline gallon equivalent[9]) of E85 sold, and just over 320,000,000 gallons of biodiesel sold (DOE, 2010b). In 2007, at the time of initial data collection, there were 1,767 fueling stations in the U.S. that offered biofuels (EIA, 2007); by 2010, this number was 2,051 (DOE, 2010a).

Though fuel sales account for large revenues, profit margins are quite slim, as low as $0.02 / gallon (Horsley, 2007; Industry Association Director / Service Station Owner, personal communication, 4/13/2007; Mufson, 2009), and these typically decrease as retail fuel prices escalate. Profits are squeezed further because fuel sales account for approximately 70 percent of gross sales at Michigan service stations (Industry Association Director / Service Station Owner, personal communication, 4/13/2007); thus, nearly all of the profit margin must be made with the remaining 30 percent of gross sales. In general, fuel sales are considered a loss leader for stations (e.g., Service Station Owner, personal communication, 5/10/2010); owners calculate that customers will fuel their vehicles, and then come inside to purchase beverages, tobacco products, or food products, on which the retailer can make substantially greater profits (these products account for the other 30 percent of gross sales). As will be discussed in more depth in the results section of this manuscript, low profit margins on fuel sales have hurt biofuel infrastructure adoption because of the long time horizon for repayment of the initial investment.

The landscape of traditional fuel sales is also changing. In addition to interest in biofuels and other alternative fuels (such as Compressed Natural Gas, or CNG), consumers are increasingly purchasing "regular" unleaded as opposed to higher-priced mid-grade and premium

[9] Because ethanol has a lower efficiency rating than gasoline (fewer miles per gallon), the unit GGE is used to provide an accurate comparative basis with gasoline.

fuels. Mid-grade sales have dropped from 30 percent of gasoline sales in 1998 to about 15 percent in 2008 (NACS, 2009).

Those familiar with service stations will recognize the "canopy," which houses fueling infrastructure, and displays a brand, such as BP, Shell, or Sunoco. While these brands *may* indicate an ownership relationship, often it is merely indicative of a branded fuel-supplier relationship and/or marketing arrangement; i.e., the fuel sold under the branded canopy is produced by that brand (e.g., BP, Shell, or Sunoco). The station itself is owned and operated by independent owners (who own one or a handful of stations), small oil companies that own one or several stations, or in some cases multinational oil and gas companies that own hundreds of stations. In Michigan, according to an industry association director interviewed for this study, "92-95 percent of the retail locations…are locally owned and operated" (Industry Association Director / Service Station Owner, personal communication, 4/13/2007).

Finally, the service station industry is highly competitive. Though it is not characterized as rapidly changing (as are "high-velocity" environments such as the technology industry) pricing of fuel is extremely important to attract and retain customers. According to The Association for Convenience & Petroleum Retailing (NACS), over 30 percent of consumers will drive five to ten minutes out of their way to save one cent per gallon of gasoline (NACS, 2007). Stated differently, "…if you're off more than 2 cents a gallon (from) your competitor's price, you start to lose 20 percent of your sales volume every hour" (Industry Association Director / Service Station Owner, personal communication, 4/13/2007).

Biofuel Industry

As noted earlier, in 2007, biofuels were considered by some to be the fuel of the future (e.g., Farrell et al., 2006; Shapouri et al., 2004), promising lower emissions from vehicles, and a

more environmentally friendly fuel stock than petroleum. This promise, in combination with lucrative government incentives, resulted in a biofuel "boom," particularly for ethanol, as evidenced by the construction of ethanol production facilities, and a push to increase ethanol fueling infrastructure at US service stations [currently, only 2,051 stations offer ethanol, and only 2,610 offer some form of biofuel, out of 117,908 total service stations in the U.S. (Census Bureau, 2009; DOE, 2009; DOE, 2010a)].

This push was no more apparent than in Michigan, where the Granholm administration announced an infrastructure grant initiative, called the Biofuel Infrastructure Incentive Program (State Employee, personal communication, March 9, 2007). This program was designed to increase the number of biofuel pumps in Michigan by offering incentives to service station owners for the installation of biofuel-compliant pumps (State of Michigan, August 29, 2006).

The incentive program was one manifestation of a larger movement underway in Michigan to increase the production of biofuels as a driver of economic development in a state that has experienced waves of job losses due to a decline in manufacturing in recent years [Michigan had the highest overall loss of manufacturing jobs from 2000-2005 among Great Lakes states, with over 200,000 job losses (Friedhoff & Wial, 2006)]. This economic development narrative was also apparent in areas considering siting an ethanol production facility, such as Brightleaf[10], Michigan (Town Officials, personal communication, 2/12/2008), and included such benefits as job creation, and another lucrative market for farmers to sell their crops (Town Officials, personal communication, 2/12/2008; Township Trustees, personal communication, 2/28/2008). The support of farmers was crucial in early siting decisions, as some plants gave farmers the opportunity to invest in the facilities (Farmer, personal communication,

[10] Town name has been changed.

2/27/2008), and those facilities relied on mutually beneficial relationships with farmers for feedstock, such as soybeans and corn (Ethanol Plant Executive, personal communication, 5/13/2008).

In the years since 2007, *corn-based* ethanol has endured a variety of criticisms in both popular and academic forums (e.g., Donner & Kucharik, 2008; Martin, 2008; Streitfeld, 2008), yet enthusiasm for biofuels in general has not subsided. In particular, ethanol has remained an element of the future fuels conversation, in part due to government mandates, and projections of ongoing funding for newer, experimental forms of ethanol, such as cellulosic ethanol (e.g., Schmer, M.R., Vogel, K.P., Mitchell, R.B., & Perrin, R.K., 2008; Voegele, 2009). Additionally, US automakers have made fresh commitments to dedicate a significant portion of their future production fleet to ethanol-compliant vehicles (Munro, 2009). The 2009 American Recovery and Reinvestment Act (the "stimulus package") also added a fresh round of infrastructure incentives for alternative fueling stations (NACS, 2009). Further, the ethanol production industry has found a growing market in exports; year-to-date exports of ethanol through June 1, 2010 surpassed exports for all of 2009, according to the Renewable Fuels Association (RFA) (NACS, 2010a).

Biodiesel has always played a secondary role in the biofuel fervor. Though biodiesel, particularly lower blends such as B5 (5 percent biodiesel, and 95 percent petroleum diesel) and B20 (20 percent biodiesel, and 80 percent petroleum diesel), requires no modifications to burn in diesel engines, the market in the U.S. is somewhat limited because there are very few diesel passenger cars compared with gasoline-powered cars [diesel light-duty vehicles are 3-4 percent of the U.S. market (Mitchell, 2008)]. Thus, the market is confined to the delivery and long-haul trucking markets.

Thus, though the industry has faced setbacks and more thorough scrutiny of the energy lifecycle associated with production, biofuels, and in particular ethanol, are still relevant; but for newer forms of biofuel to be widely used, they must still be accessible through service station infrastructure. Despite advances in home-based fueling, such as the "Phill" CNG fueling system pioneered by Honda, or forthcoming electric vehicles, most of us still take our cars to one of the nearly 120,000 service stations in America to fill up.

Yet service stations and oil companies' status as SMEs presents unique challenges when deciding whether to add ethanol-dispensing infrastructure to their stations. Decision makers in these organizations face a strategic decision quandary rooted in uncertainty about the future of biofuels, and the significant financial risk SMEs face when deciding whether to invest in new infrastructure (which ranges from modifying existing fuel pumps to the installation of additional underground fuel storage). A brief background on strategic decisions is provided below.

Strategic Decisions

Strategic decisions are not always obvious, but they do have common attributes: they are infrequent (e.g., Eisenhardt & Zbaracki, 1992), complex (e.g. Mintzberg, Raisinghani & Theoret, 1976), fraught with uncertainty (exacerbated by an unpredictable environment) (e.g., Shrivastava & Grant, 1985), require a significant commitment of resources and noticeably impact the organization (e.g. Frederickson & Iaquinto, 1989), and are difficult for organizations because of a lack of data, which slows the initial decision process and the resulting feedback from that decision (Schwenk, 1984). Each of these characteristics describes the decision to add biofuel infrastructure for service stations. Adding infrastructure can cost up to $100,000 (according to participants) and can significantly disrupt consumer traffic during construction; for a small company, it is a substantial investment.

Behavioral decision researchers have long studied the heuristics that characterize individual decisions, and the biases that result from those heuristics (e.g., Ariely, 2008; Hsee, C.K., 1998; Kahneman & Tversky, 1974; Plous, 1993). Overwhelmingly, the evidence has pointed to individuals' inability to make "good" decisions, or decisions consistent with stated objectives. When these individual decision makers are in positions of influence, where their decisions impact larger communities – such as corporate leaders or the chief executives of SMEs – these biases and heuristics cross into the realm of strategic decisions, where decision errors have the potential to be more damaging (Barnes Jr., 1984; Schwenk, 1984). Potential errors are magnified yet again when examined at the SME level; SMEs are traditionally under-resourced (e.g., Borga, Citterio, Noci, & Pizzurno, 2009; Lawrence, Collins, Pavlovich, & Arunachalam, 2006), and so have less ability to recover from a decision that does not lead to economic success. Thus, the consequences they face from a bad decision have the potential to be more detrimental to their long-term fiscal health.

There are many heuristics and biases that can apply to strategic decisions, but this manuscript focuses on three that are particularly applicable at the SME level, and that emerged from the analysis of this study: representativeness, availability, and overconfidence.

Representativeness and availability have been identified as decision heuristics (also termed decision shortcuts) on both individual (e.g., Tversky & Kahneman, 1974) and organizational (e.g., Barnes Jr., 1984; Schwenk, 1984) levels. Representativeness, as applied to strategic decisions, is a heuristic whereby the SME decision maker may assume that a small sample of information is statistically representative of a broader population. This can lead to a decision bias: insensitivity to sample size (Barnes Jr., 1984; Tversky & Kahneman, 1974).

Availability is the ease with which certain events can be recalled (Tversky & Kahneman, 1974). This can lead to decision biases in small businesses through, for example, ignoring alternatives because they may be more difficult to imagine (Schwenk, 1984). For example, if a company is considering offering products that are more environmentally friendly, the product options may be limited by what can be readily called to mind.

Overconfidence particularly plagues entrepreneurs and small business owners; due to constrained resources, limited personnel (and subsequently, expertise), and the need to make multiple decisions simultaneously, small business managers are prone to make decisions without an established decision process or market analysis (Busenitz & Barney, 1997), and may be overconfident about the decisions made under such conditions, leading them to ignore potential pitfalls. Further, Busenitz and Barney's (1997) research also indicates that more deliberative decision makers self-select into larger organizations with established institutional procedures for decision support; that is, decision makers more prone to some decision heuristics are more likely to work in smaller, entrepreneurial organizations.

The research questions below address strategic decisions in SMEs from two perspectives. The first two research questions represent a normative decision process; that is, the decision process is deliberative and assumes a logical flow of considerations leading to a decision. The use of this method of decision making in practice has been questioned by empirical research since the 1970s (e.g., Mellers, B.A., Schwartz, A. & Cooke, A.D.J., 1998; Slovic, Fischhoff & Lichtenstein, 1977; Tversky & Kahneman, 1981), which is why the third and fourth research questions take a different approach, examining the decision process in light of research on behavioral decision making at the strategic level, which yields a very different decision model.

Research Questions & Hypotheses

RQ-1: What are the most important objectives decision makers consider when deciding whether or not to install biofuel infrastructure?

Hypothesis 1: Decision makers will examine whether biofuels can improve their financial bottom line, while also considering objectives such as the number of biofuel-capable cars and trucks in close proximity to their location.

RQ-2: What are the barriers that decision makers face when considering the adoption of biofuel infrastructure?

Hypothesis 2: Decision makers' self-identified barriers will consist of, among others, financial resource constraints, uncertainty regarding the future of ethanol, and regulatory uncertainty.

RQ-3: What role do the personal values of the decision maker, relative to sustainability, play in the decision to add (or not add) biofuel infrastructure?

Hypothesis 3: Consistent with strategic decision theories, especially where the number of decision-makers is small (as is likely the case with many SMEs), the values of the decision maker will have a significant impact on the final decision about whether or not to add biofuel infrastructure.

RQ-4: What role do judgmental heuristics and biases (e.g., availability or representativeness) play in the decision to add (or not add) biofuel infrastructure?

Hypothesis 4: In instances where a normative decision making process is not followed, decision makers will utilize heuristics and biases to make biofuel infrastructure decisions.

Method & Data Collection

In-depth interviews were used to investigate the research questions outlined above. The interviews were conducted over a three-year period, from 2007 – 2010, and this manuscript combines data collected for two separate, but complementary, projects.

Sample

Purposive sampling techniques were used to create a sample of service station owners, oil company owners and employees, industry association members, and energy industry experts, from across Michigan. The initial list of service station owners and oil companies was taken from publicly available data housed at the U.S. Department of Energy's (DOE) Alternative Fuels and Advanced Vehicles Data Center (AFDC). This database contains the name, location, and contact information for all service stations that offer specific types of alternative fuels across the U.S.; it lists 61 unique (companies that own multiple service stations are counted as one unique company) oil companies or service stations in Michigan.

Additionally, snowball sampling techniques were used to find contacts within oil companies who liaise with the service station community directly. In these instances, one interview represents a much larger footprint of information than one service station because one company may control or own multiple service stations. For example, one participant owns 20 stations in Michigan, and another organizes deliveries for half of Michigan's service stations. Snowball sampling also resulted in contacts in industry associations, and energy industry experts.

The complete dataset includes 32 interviews; of these, 22 represent service station owners, oil company owners and employees, industry association members, and energy industry experts. The other 10 interviews were collected as part of a project funded by the U.S.

Department of Agriculture (USDA) and The Kellogg Foundation, which examined ethanol plant siting issues in rural towns in Michigan. These interviews provided useful context for specific issues in the ethanol industry in Michigan, such as the crucial role of farmers and farming community support. Dr. Wynne Wright at Michigan State University generously agreed to share the data from this study.

As the focus of this manuscript is SMEs, it should be noted that 21 of the 22 interviews were with SMEs, though one interview was conducted with the fuel-retailing manager of a large regional chain of retailers that sells biofuels at its service stations.

Analysis

Analysis was based on both recorded interviews and detailed interview notes. While ten interviews were recorded, most service station owners (particularly independent owners) and oil company owners and employees agreed to participate only if they were not recorded. Supply relationships are of great value in the industry, and as noted later in this manuscript, some key actors in the supply chain are aggressive in their preservation efforts of the status quo (keeping stations focused on buying oil, gasoline, and diesel), making the topic of new fuels delicate. Additionally, interviews often took place outside, during maintenance procedures or auto repair, thus making audio recording problematic.

After the transcriptions and notes were completed, a matrix was created to categorize all of the information by research question, and subsequently by theme within that question. Quantitative and qualitative results were then generated from this matrix, and included in the findings section below.

Findings

Results are presented per each research question below.

RQ-1: What are the most important objectives decision makers consider when deciding whether or not to install biofuel infrastructure?

Hypothesis 1: Decision makers will examine whether biofuels can improve their financial bottom line, while also considering objectives such as the number of biofuel-capable cars and trucks in close proximity to their location.

Consideration of decision makers' financial bottom line is in part captured by the "cost" and "Return on Investment (ROI)" responses in **Table 6** below. Additionally, many of the objectives considered relate tangentially to the financial bottom line because they differentiate the company in the local marketplace ("competitive advantage"), or allow it to attract new customers ("customer request" and "ability of biofuels to attract new customers").

Consideration of specifics, however, such as the number of biofuel-capable cars in a particular geographic area, is more problematic. SMEs typically do not have the resources to conduct this type of in-depth market analysis, a sentiment expressed enthusiastically by one oil company employee: "We are not Mobil Exxon (sic), they have economic models…we are owned by a family" (Oil Company Biofuels Manager, personal communication, 6/3/2010). Still, one company was able to obtain geographically delineated biofuel-compatible vehicle sales information by partnering with General Motors (GM), who provided data on clusters of flexible fuel vehicle sales (Service Station Owner, personal communication, 2/15/2008).

Thus, what would be considered a normative method of market analysis is not possible for the decision makers in this sample; instead, their version of market analysis is less formal,

and consists of information in the popular press about forthcoming flexible fuel vehicle commitments from manufacturers (e.g., Oil Company Owner, personal communication, 4/8/2007), and/or information disseminated through industry associations and the major oil companies (e.g., Service Station Owner, personal communication, 2/8/2008 & Service Station Owner, personal communication, 2/11/2008). Consumer demand research, far from the focus groups and nationwide surveys one associates with large corporate marketing initiatives, is often anecdotal, gauged by an undocumented number of customers walking into a store and asking for a product (e.g., Service Station Owner, personal communication, 5/10/2010), or in oil companies by farmer or service station delivery requests (e.g., Oil Company Biofuels Manager, personal communication, 6/3/2010).

While scale and the size of the potential market is very different for both large corporations and gas stations or small oil companies, the risks of making the wrong decision can be more disastrous for SMEs; one participant talked extensively about being "stuck" with specialized equipment that will not work with other types of fuel, which has soured the company on future alternative fuel investments (Oil Company Owner, personal communication, 5/7/2010). With little profit margin and few financial reserves, decisions have the potential to cause significant financial damage to a small business.

Objectives

The most important objectives considered by decision makers in the industry are listed in **Table 6** below; in-depth explanations of each objective are included in **Appendix C**. Objectives are listed in order of importance, with frequency across the sample serving as a proxy for importance. Please note that the objective of "cost" was considered by everyone interviewed, and

thus does not appear in the table. Cost is differentiated from ROI because only explicit mention of the ROI calculation (as opposed to the generic "cost") resulted in its inclusion here.

Table 6
Objectives considered in the decision to install (or not) biofuel infrastructure

Objectives considered	Percentage
Competitive Advantage	45.45%
Biofuels Support Community & Farmers	36.36%
Ability to Use Existing Infrastructure	31.82%
Biofuels' Role in Weaning the U.S. from Foreign Oil	27.27%
Customer Request	27.27%
Partnership / Mentoring Role Within the Industry	22.72%
Availability of Incentives (including equipment and fuel)	22.72%
Public Relations Benefits	18.18%
Ability of Biofuels to Attract New Customers	18.18%
ROI	18.18%
Service Station Owner Wishes to Appear Innovative	18.18%
Environmental Benefits of Biofuels	18.18%
Ease of Procurement	4.54%
Biofuels Less Expensive (than Gasoline)	4.54%
	n=22

RQ-2: What are the barriers that decision makers face when considering the adoption of biofuel infrastructure?

Hypothesis 2: Decision makers' self-identified barriers will consist of, among others, financial resource constraints, uncertainty regarding the future of ethanol, and regulatory uncertainty.

The hypothesis is plausible in this sample, but was too narrowly conceived; service station owners and industry representatives identified 11 barriers to entry to the biofuels retail market, which are shown in **Table 7** below, and explained in greater detail in **Appendix D**.

Specific to the hypothesis, "financial resource constraints" are captured in the "expense of infrastructure" response, while "uncertainty" in both the "future of ethanol," and in the

"regulatory environment," is represented in the responses "uncertain regulatory environment," and "questionable long-term fuel availability." The hypothesis did not account for "industry brand resistance" among the most important barriers, which includes tactics used by large brands in the industry to make it more difficult for service station owners to sell biofuels.

Table 7
Barriers to installation of biofuel infrastructure

Barriers	Percentage
Expense of Infrastructure	63.63%
Industry Brand Resistance	22.73%
Uncertain Regulatory Environment	13.63%
Fuel Quality Issues (biodiesel)	9.09%
Questionable Long-Term Fuel Availability	9.09%
Service Station Owner Attributes	9.09%
Available Space (for Infrastructure)	9.09%
Length of Time to Payoff	4.54%
Public Awareness	4.54%
Risk (as a small company compared to larger retailers)	4.54%
Lack of Analytical Resources (for market analysis)	4.54%
	n=22

RQ-3: What role do the personal values of the decision maker, relative to sustainability, play in the decision to add (or not add) biofuel infrastructure?

Hypothesis 3: Consistent with strategic decision theories, especially where the number of decision-makers is small (as is likely the case with many SMEs), the values of the decision maker will have a significant impact on the final decision about whether or not to add biofuel infrastructure.

Among those who expressed personal feelings about biofuels (16 of the participants), the hypothesis is plausible except for one respondent who chose not to provide biofuels (Service Station Owner, personal communication, 2/11/2008), and one of the oil company employees (Oil

Company Owner, personal communication, 5/7/2010). The service station owner who did not elect to provide biofuels is watching (at last contact) the marketplace for developments that may make biofuels affordable for the station (such as a revenue sharing plan with an oil company); the primary reason this owner cited for not offering biofuels was the cost of infrastructure (Service Station Owner, personal communication, 2/11/2008). By contrast, the oil company employee responded negatively to every question about biofuels, and tried to steer the conversation towards a general disagreement with, or disbelief of, multiple environmental issues, such as global warming (Oil Company Owner, personal communication, 5/7/2010).

In the subsample of those who favor biofuels personally, five cases are particularly instructive, because each participant returned to the importance of personal feelings in their decision throughout the conversation. For three of these service station owners (one of whom is a fleet manager who operates stations), the driving force was a personal farming background, or a strong family connection to farming, combined with a belief that biofuels are beneficial for farmers (similar to the siting considerations for ethanol production facilities discussed at the beginning of this manuscript) (e.g., Service Station Owner, personal communication, 5/11/2010, Fleet Manager, personal communication, 5/11/2010, & Service Station Owner, personal communication, 8/28/2007). Another of these five owners felt passionately that biofuels help to keep money in both the U.S. and state (Michigan) economies (when compared to gasoline or diesel fuels) (Service Station Owner, personal communication, 5/7/2010). Finally, the fifth owner was pressured by a spouse who felt that biofuels were an important solution to environmental emission concerns (Service Station Owner, personal communication, 2/5/2008).

Confidants

Though slightly beyond the scope of **RQ-3**, the role of personal feelings of those advising service station owners, or those who have a personal relationship with service station owners, is consistent with a decision "confidant," a concept from the strategic decision literature (e.g., Eisenhardt, 1989; Shrivastava & Grant, 1985). Particularly in small businesses, or in "high-velocity" (rapidly changing) environments, decision makers tend to rely on one or a small group of core advisors, who are highly influential and who speed the decision process by serving as a manageable proxy for the larger organization (other employees or stakeholders). The spousal pressure apparent in the decision of the service station owner discussed above is consistent with the idea of a confidant; in a family run business, such as this service station, it is conceivable that the boundary between spouse and business confidant could easily become blurred.

Confidants are also evident in distributor relationships with service station owners. The importance of close fuel industry relationships has been discussed in other parts of this manuscript; the influence of these relationships on decisions is apparent in the interview data. For example, one participant suggested that the service station would no longer be in business if it were not for the assistance and advice of the station's primary distributor (Service Station Owner, personal communication, 5/11/2010). Further, 22.72 percent of respondents cited industry relationships as an important objective considered for the biofuel infrastructure decision. Thus, it is plausible that distributors in this industry could also be considered strategic decision confidants.

The role of the confidant serves as a useful segue from personal feelings and relationships to judgmental heuristics and biases, which are the subject of **RQ-4**. When confidants are heavily

leaned upon for decisions, to the point of ignoring potential alternatives, decision biases can result.

RQ-4: What role do judgmental heuristics and biases (e.g., availability or representativeness) play in the decision to add (or not add) biofuel infrastructure?

Hypothesis 4: In instances where a normative decision making process is not followed, decision makers will utilize heuristics and biases to make biofuel infrastructure decisions.

The use of judgmental heuristics is best illustrated by service station industry participants who used the phrase "gut feel" to characterize their decision process (e.g., Oil Company Owner, personal communication, 5/19/2010 & Oil Company Biofuels Manager, personal communication, 6/3/2010; Service Station Owner, personal communication, 2/5/2008 & Service Station Owner, personal communication, 8/28/2007). One participant detailed the contrast between small business decision making and larger, more analytical corporate processes, by suggesting that resources are a key difference between the two, and that successful service station owners have an "intuitive" sense about the industry and are able to make decisions "by the seat of their pants" (Oil Company Biofuels Manager, personal communication, 6/3/2010).

An analysis of the biofuel infrastructure decision processes of decision makers, which began with a discussion of the objectives service station owners consider as part of **RQ-1**, resulted in the identification of three judgmental heuristics commonly used among this sample: representativeness, availability, and overconfidence.

Representativeness

Representativeness, which in strategic decisions can be manifested through overgeneralizations based on small sample sizes (Schwenk, 1984), is apparent in one of the most

commonly identified objectives service station owners consider when deciding whether or not to install biofuel infrastructure: customer demand. Over one-fourth (27.27 percent) of the sample cited consumer demand as a primary objective when considering biofuels; every participant in the sample mentioned something about the importance of consumers (even if not in the form of an "objective" or "barrier"), whether it was keeping consumers happy, or offering a variety of products for the consumer to choose from.

However, evidence of customer demand was primarily anecdotal (based on walk-in or phone requests). One participant invested in a separate biofuels storage tank at a bulk distribution facility based on customer requests, but could not recall any quantitative accounting that captured information about how many customers would purchase such a product (Oil Company Owner, personal communication, 5/7/2010). Two additional participants described scenarios where customers entered their store and asked about biofuels, which they interpreted as a proxy for a significant demand beyond that handful of customers (Service Station Owner, personal communication, 2/11/2008 & Service Station Owner, personal communication, 5/7/2010).

Thus, decisions about biofuels were made among these participants without any formal systems of market analysis or accounting for customer demand. The market analysis conducted was based on anecdotal customer requests, potentially leaving these stations vulnerable if those customers did not turn out to represent an accurate sampling of consumers in the area, or, if the customers who do purchase biofuels are as price sensitive about biofuels when compared to gasoline, as they are to gasoline price differences between stations (discussed earlier).

Availability

Biofuel infrastructure was the most readily available choice for decision makers with the following characteristics: those who value partnerships in the industry (e.g., Service Station

Owner, personal communication, 5/11/2010), those who seek to offer more environmentally friendly products (e.g., Service Station Owner, personal communication, 5/6/2010), those eager to distinguish themselves as innovative (e.g., Service Station Owner, personal communication, 8/28/2007), or those who seek a competitive advantage in the marketplace (e.g., Oil Company Owner, personal communication, 5/19/2010).

While four participants had experience with hydrogen or natural gas (Service Station Owner, personal communication, 5/7/2010; Service Station Owner, personal communication, 5/11/2010; Fleet Manager, personal communication, 5/11/2010; Oil Company Biofuels Manager, personal communication, 6/3/2010) infrastructure, most had considered only biofuels (to meet their objectives, detailed in **RQ-1**), as it was the most available choice to them. There are three reasons for this based on the analysis for this study: First, biofuels are an alternative fueling solution that is "off the shelf," that is, diesel vehicles can burn biodiesel without any modifications, and manufacturers continue to increase the percentage of their fleet that is compatible with ethanol (Munro, 2009). Participants were able to easily experience biofuels, and three were encouraged by oil companies to drive personal vehicles with biofuels before making their decision (Service Station Owner, personal communication, 8/28/2007, Service Station Owner, personal communication, 5/10/2010, & Service Station Owner, personal communication, 5/11/2010).

Second, service station owners heard about biofuels almost exclusively in industry association publications (as opposed to other types of alternative fuels or alternative vehicles). These publications, or publications produced by their suppliers, are how service station owners learn about new innovations or current events *in their industry* (e.g., Service Station Owner, personal communication, 4/8/2007). This echoes results from the data collected in Brightleaf,

Michigan focused on the siting of an ethanol production facility; farmers had heard about ethanol through industry or trade publications, and based on that became more interested in pursuing biofuels for their area (e.g., Town Officials[11], personal communication, 2/12/2008).

Third, industry partners supported biofuels because they had already invested in infrastructure to meet potential future demand. If service station owners came to them seeking to meet the objectives outlined in **RQ-1**, biofuels were offered as a solution. These industry partners are important because of their stewardship role in the industry, particularly among independent service station owners (e.g., Service Station Owner, personal communication, 5/11/2010). Industry partners were specifically credited with influencing two participants to install infrastructure (Service Station Owner, personal communication, 5/10/2010 & Service Station Owner, personal communication, 5/11/2010).

The problem with availability, however, is that it limits options. Though four participants spoke of space and cost reasons for turning down offers for hydrogen or natural gas infrastructure (Service Station Owner, personal communication, 5/7/2010; Service Station Owner, personal communication, 5/11/2010; Fleet Manager, personal communication, 5/11/2010; Oil Company Biofuels Manager, personal communication, 6/3/2010), availability likely also limited serious considerations of other ways to meet their stated objectives; this could have been an investment in alternative fuels, or perhaps other improvements to their store, product offerings, or marketing efforts.

[11] Officials are also farmers.

Overconfidence

As small businesses, participants in this study are more likely to be overconfident in their strategic decisions (Busenitz & Barney, 1997), thus overlooking some of the potentially negative outcomes related to these decisions (Barnes Jr., 1984). Though not entirely forthcoming about the profits made from offering biofuels[12], only four participants shared concerns about following the same path again in the future (Oil Company Biofuels Manager, personal communication, 6/3/2010, Service Station Owner, personal communication, 5/10/2010, Oil Company Owner, personal communication, 5/7/2010, & Service Station Owner, personal communication, 5/7/2010). This is despite the fact that, objectively, the cost of investing in alternative fueling infrastructure may not bring the same returns as other investments.

Though one service station owner estimated $100,000 in free public relations from opening a biofuel pump, the tangible calculation of actual returns is less clear, given that average profits in the industry can be as low as $0.02 per gallon, this particular owner had no data to support this estimate, and this station's investment in the fuel pump was $100,000. Additionally,

[12] Few participants had precise biofuels sales data available (or were unwilling to share it). Data that was shared is detailed below:

(1) E85 sales comprise 10% of total fuel sales (Service Station Owner, personal communication, 5/6/2010)
(2) E85 sales comprised 4,000 gallons per month in 2007, but were down to 1,500 gallons per month in 2010 (Oil Company Owner, 5/7/2010)
(3) E85 sales are 3,000 – 4,000 gallons per month (Service Station Owner, personal communication, 5/11/2010)
(4) E85 sales account for 2% of overall business, and biofuel Sales account for 1.5% of overall business (Oil Company Owner, personal communication, 5/19/2010)

as noted above, previous profit estimates in the industry largely depend on sales of gasoline, a different product than ethanol or biodiesel, both of which are at the mercy of incentives. Complicating the calculation of ROI, ethanol is more expensive for service station owners to purchase than regular gasoline (Industry Association Director / Service Station Owner, personal communication, 4/13/2007).

Another participant detailed an example of a service station that recently installed biofuel infrastructure, and its struggle to profit from the decision:

> He (service station owner) does about 3,500 gallons of gasoline a day, and he does 20 gallons a day of E85. It was a $12,000 expense to put that E85 pump in; at 20 gallons a day…he was losing a dollar a gallon because he was trying to eat some of the additional cost. Keep in mind, E85 is a much more expensive product than regular 87 octane gasoline. So he showed me his numbers, he was making $70 a day, making his two cents off the 3,500 gallons of gasoline he was selling. And he was losing $20 a day off the 20 gallons of E85 he sold. So at the end of the day he had fifty bucks in his pocket. Do the math – multiply that by 365. (Industry Association Director / Service Station Owner, personal communication, 4/13/2007)

By including these examples, I do not wish to indicate that biofuel infrastructure installation decisions were necessarily *poor* ones, or that every service station that chooses to offer biofuels is making a mistake; emerging indicators research suggests that intangibles and personal feelings may actually be accountable. I only wish to point out that due to the presence of decision biases for service station owners deciding whether or not to install biofuel infrastructure, the decision to do so may have been a sub-optimal choice for an investment in their business, given known small business concerns from the literature, as well as stated objectives concerning cost and its impact on ROI. Also, the information quality on which these decisions were made, while it was often the best the owners could do given resource constraints, was not of the quality that even they would have liked it to be prior to making such a decision.

Discussion

There is little academic research on the service station industry, particularly with regard to decision processes. Yet, the industry is integral to transportation infrastructure in the U.S. (a key ingredient in environmental and social sustainability concerns), and will continue to serve as a gatekeeper role for new alternative fuels, at least until home-based (or as yet imagined) fueling options are perfected. This manuscript investigates one such gatekeeper process, at the first real sign of a transition away from the petroleum-based fueling infrastructure that has dominated the industry since its inception.

This manuscript used four research questions to examine the decision process surrounding biofuel infrastructure. The first question referred to the objectives service station owners and other decision makers consider when deciding whether to install biofuel infrastructure; though not a formal elicitation, these objectives serve a similar purpose as those that would comprise a prescriptive decision processes such as structured decision making (e.g., Hammond, Keeney & Raiffa, 2002; Keeney, 1992). The results, which were dominated by three objectives: competitive advantage, support of the local community, and ability to use existing infrastructure, reflect the competitive nature of the service station industry. Given the vast number of service stations (5,000 in Michigan alone), owners feel it is important to stand out among competitors, and in this study, biofuels was the mechanism to do so, though it is also worth considering whether other, more fiscally rational measures could have allowed them to meet this objective.

The second research question asked decision makers to consider barriers to entry to the biofuels market. The predominant view was that the cost of infrastructure was the greatest hindrance (63.63 percent), followed by industry brand resistance (22.73 percent). The cost

consideration is one that is essential to this process. It is worth noting that only one participant in the sample installed biofuel infrastructure from the ground up (i.e., starting from scratch). Every other participant utilized a combination of incentives, early-stage planning, or existing equipment to be able to offer biofuels.

While these narratives make for interesting interviews, the inability to install infrastructure from the ground up is problematic for future endeavors and fueling advances, particularly if those advances require more than incremental adjustments to current equipment. The four participants who discussed other alternative fueling possibilities (Service Station Owner, personal communication, 5/7/2010; Service Station Owner, personal communication, 5/11/2010; Fleet Manager, personal communication, 5/11/2010; Oil Company Biofuels Manager, personal communication, 6/3/2010), for propane and hydrogen infrastructure, had difficulty conceptualizing how these options would fit within their current fueling infrastructure, and how they could afford them. Biofuels were possible because they were not too far afield from existing products – there was an existing market, they offered (perceived) local benefits, and they were easy to incorporate into the current product mix. Creating new space for infrastructure in an urban setting, or digging up the ground in a rural setting, may prove much more problematic (or cost-prohibitive) to future fueling innovations.

This is to say nothing of industry resistance; though the oil and gas industry claims to invest heavily in biofuel projects [e.g., ExxonMobil's plans to produce ethanol from algae (ExxonMobil, 2010)], according to participants, the industry is a potential impediment to biofuels because it does not want the fueling pumps underneath its branded canopies (where patrons are accustomed to looking for fuels). Naturally, some participants felt that the industry had subversive reasons for not wanting the fuels offered, such as the possibility that biofuels

would cannibalize large companies' gasoline and diesel sales (e.g., Service Station Owner, personal communication, 5/7/2010). Similar to the infrastructure expense problem, industry resistance could create formidable resistance to future fueling infrastructure advancements, largely because (as this study has indicated) the cost of new infrastructure (for something more complicated than a relatively simple conversion to ethanol or biodiesel) is too much for some independent stations and oil companies. Thus, larger funding streams will be required, or new ownership models for service stations will need to be implemented, as new products emerge.

Research questions three and four investigated alternative explanations for the decisions to add biofuel infrastructure to product mixes. Question three examined personal biases, and results indicate that both personal biases, and the role of the confidant [consistent with previous research on the role of confidants (e.g., Eisenhardt, 1989; Shrivastava & Grant, 1985)] were important in the decisions of participants. In these cases, the confidant was someone from within an existing relationship, such as a spouse or a distribution partner.

Question four's findings, primarily the presence of decision heuristics and biases in decisions about biofuels, will not surprise decision scientists or behavioral economists, but may be interesting to those who study more traditional theories of organizational decision making and policy making. The goal of some decision science research, such as that supporting structured decision making, suggests that creating awareness among decision makers of potential biases, or pursuing a more prescriptive approach to decision making, may make these biases more explicit, thus helping to overcome them (e.g., Hammond et al., 2002; Keeney, 1992). However, there are two concerns with using this approach with service station owners and oil companies: first, stakeholder efforts to engage SMEs on other sustainability issues, such as corporate sustainability reporting, have yielded few tangible results due to limited resources at both the

SME and the intervener levels (e.g., Borga et al., 2009; Lawrence et al., 2006; Perrini & Tencati, 2006); second, though research has shown that formal decision support can be effective in for-profit environments (e.g., Clemen & Kwit, 2001) and in governmental and non-profit environments (e.g., Arvai, McDaniels & Gregory, 2002; Gregory & Failing, 2002), there is little evidence to support this effectiveness in SMEs specifically. As this manuscript highlights, SMEs are quite different from larger corporations, or government or nonprofit entities. Still, applying these methods in SMEs could make for worthwhile future research.

Conclusion

The empirical contribution of this manuscript is its insight into how service station owners and other SMEs in the fuel industry make decisions about new innovations in fueling. I have identified the objectives they are most likely to consider, as well as key barriers to entry into new markets. This information is useful to policy makers who wish to encourage the adoption of future fueling technologies; currently, the U.S. Congress is now considering methods to encourage this type of adoption, in the form of infrastructure grants for electric cars (NACS, 2010). Grants and incentives are one of the objectives SMEs consider when weighing new fueling infrastructure installations, but as this manuscript illustrates, it is not the only or most important one, and it may not be enough.

For future technologies to take root in the service station community, other appeals must be made to allay concerns on a variety of issues, but primarily local ones – that is, will the fuel sell, and is there a market for it. In short, what is the ROI for the infrastructure, and what is the competitive advantage to be gained. Absent large-scale incentives, and depending on the cost of new electric or other fueling infrastructure, the calculations may not compel service stations to participate in large-scale infrastructure drives. Further, if biofuel infrastructure as examined in

this study is an indicator of the pace of new developments, new infrastructure will not appear quickly.

Perhaps a more compelling outcome of this manuscript is its role in a philosophical debate in the decision science community regarding the concept of "nudging." Thaler & Sunstein's (2008) primer on nudging is predicated on the idea of "choice architecture," which is administered by "choice architects," who are people in the position to structure the choices of others[13]. In essence, because of the heuristics that all of us use in making decisions, we are "nudge-able" (Thaler & Sunstein, 2008). Despite their potential usefulness however, nudges are controversial because of the ethical implications of nudging people (or businesses) in a particular direction that is judged by an "other" to be the correct course of action.

A careful reader of this manuscript will find the tools necessary to manipulate decisions in small businesses, and nudge them towards certain ends; these tools are evident in the decision heuristics discussed in **RQ-3** and **RQ-4**. However, who will decide what ends these are, and how will we know whether they are sustainable? There are those who, just a few short years ago, would have argued that E85 presented a *more* sustainable path in transportation than the current paradigm (e.g., Farrell et al., 2006; Shapouri et al., 2004). As we learn more about hybrid and electric cars, we will likely also learn more about the ecological stresses caused by the use of lithium to manufacture batteries, and that we have simply pushed our energy problems farther up the infrastructure chain, from gasoline to coal (for additional electricity generation). So we are

[13] A commonly cited example of this concept from the book "Nudge" (Thaler & Sunstein, 2008) is that of a cafeteria manager who is in a position on a daily basis to help customers choose healthy food products by placing them in the direct line of sight of customers instead of placing items such as cake in the same position.

left with an adaptive sustainability challenge, now that the question ceases to be about service stations and fueling infrastructure, but about how we drive, when we drive, where we go, and how often we do it. And depending on how those questions are answered, service stations may no longer be part of the transportation landscape – a sustainability challenge of a different type.

Another lingering question is whether there is time for such a slow process of infrastructure upgrades. Given the expense necessary to upgrade infrastructure, the next innovation could be public re-charging stations for electric cars [such as those proposed by rental car companies who are helping to subsidize quick charge stations for their increasing fleet of electric vehicles (GreenBiz, 2010)], or massive changes in population clusters, perhaps towards urban centers where fewer vehicles are required. With respect to environmental sustainability at least, there is not much time to make large-scale changes on the time horizon of climate change, and replacing or bolstering service station infrastructure may be, for lack of a better term, a clunky way to go about it.

Given all of this, SMEs of all types are important; as noted at the beginning of this manuscript, they make up 90 percent of global businesses (GRI, 2008), and are responsible for about half of U.S. private, non-farm Gross Domestic Product (GDP) (Kobe, 2007). If not service stations, then other SME decisions based on sustainability objectives are worthy of future investigations, to learn more about the unique conditions and constraints under which SMEs operate, and how SME-specific barriers can be overcome to work towards sustainability objectives. Sustainability is a team effort, and global corporations cannot be the only focus of sustainability initiatives; if they are, we will find ourselves drastically short in the increasingly global calculus required to assess progress towards sustainability.

APPENDICES

APPENDIX C: OBJECTIVES CONSIDERED IN THE DECISION TO INSTALL (OR NOT) BIOFUEL INFRASTRUCTURE (EXPLANATIONS)

Competitive Advantage
Competitive advantage refers to the desire to offer biofuels in a specific market area where no other (or few other) stations offer them. When pursuing an "entry" strategy, businesses often look for a niche that allows them to expand market share (Porter, 1981).

Biofuels Support Community & Farmers
This objective refers to both positive customer feedback [customer remark: "I'm glad that you support the local farmers" (Service Station Owner, personal communication, 5/6/2010)], and the perception among service station owners that offering biofuels has a positive impact on the local economy.

The role of farmers in biofuel-related decision making extends to communities beyond service station owners and oil companies; a siting decision for at least one ethanol plant in Michigan garnered similar support from the local farming community due to economic benefits such as higher prices for crops (Farmer, personal communication, 2/27/2008; Farmer, personal communication, 2/27/2008a; Economic Development Officer, personal communication, 4/1/2008).

Ability to Use Existing Infrastructure
Service station owners use existing infrastructure if at all possible in order to save costs, and reduce the time required to recoup their investment. Existing infrastructure might include kerosene tanks that can be converted to ethanol use (Service Station Owner, personal communication, 5/11/2010), or the use of an idle or low-performing underground tank, such as for mid-grade or premium-grade gasoline (Service Station Owner, personal communication, 5/10/2010).

Biofuels' Role in Weaning the U.S. from Foreign Oil
The belief that offering biofuels, and/or that biofuel use in general, will reduce the amount of petroleum that is imported into the U.S.

Consumer Requested Biofuels
Customer requests were a driver of the decision to offer biofuels, though they were not tabulated in any formal way; one service station owner described the number of requests as "several" customers who came in asking if biofuels would be offered (Service Station Owner, personal communication, 5/7/2010a).

Partnership / Mentoring Role Within the Industry
This objective refers to the powerful role that relationships can play in small business decision-making. In two cases, auto companies partnered with owners to install infrastructure or promote biofuels (Service Station Owner, personal communication, 2/15/2008; Fleet Manager, personal communication, 5/11/2010). Two other owners were influenced by their fuel suppliers, who were

biofuel advocates with fuel readily available for delivery alongside traditional fuels (Service Station Owner, personal communication, 5/10/2010 & Service Station Owner, personal communication, 5/11/2010). Finally, one service station owner received substantial assistance from the City of Forestdale[14] in both filling out an application for grant assistance, and in the public relations effort that accompanied the opening of the new ethanol pump (Service Station Owner, personal communication, 5/11/2010).

Availability of Incentives (including equipment and fuel)
Incentives include both federal and state incentives to offset the cost of new fueling infrastructure, and that lower the cost of fuel at the pump for consumers. Currently, Michigan offers both types, the latter in the form of a tax credit to decrease the end-user price of ethanol (DOE, 2010).

Public Relations Benefits
These include appearances by politicians, as well as listings on travel and alternative fuel locator websites (Oil Company Owner, personal communication, 4/8/2007; Energy Industry Expert, personal communication, 4/9/2008). One service station owner estimated the value of public relations attention received following the installation of an ethanol pump at $100,000 (Service Station Owner, personal communication, 2/5/2008).

Ability of Biofuels to Attract New Customers
This can be characterized as a "one-stop-shopping" approach, so that having another product increases the likelihood that the service station will sell more products overall.

ROI
ROI is the financial return that a business receives from a specific investment; the investment is a good one (by this metric) if the costs can be recouped within a reasonable amount of time (as defined by that business), and if it has the potential to turn into a profit making venture after the initial investment is returned. Implicit in the ROI calculation is the ability to make tradeoffs, especially with regard to other potential business decisions that might result in higher profits for a service station when compared to expanding the number of fuels offered (fuel is a low profit item). One participant specifically addressed tradeoffs in the context of ethanol: "Will the ROI for a gasoline pump be more than a new coffee machine?" (Oil Company Employee, personal communication, 6/3/2010).

Service Station Owner Wishes to Appear Innovative
The innovation concern was one shared by two oil company employees who own multiple service stations. It was expressed as a desire to be on the "bleeding edge" (Oil Company Biofuels Manager, personal communication, 6/3/2010), or out in front of market development (Oil Company Owner, personal communication, 5/19/2010).

[14] City name has been changed.

Environmental Benefits of Biofuels
Environmental benefits were referred to generically, though one participant referenced school bus emissions specifically because of the use of biodiesel by school bus fleets (Service Station Owner, personal communication, 5/7/2010).

Ease of Procurement
Service station owners noted that, given low profit margins, there is a very limited distance within which they will travel to pick up biofuels. For those who take delivery, it is easier to offer biofuels if local jobbers offer them, and they can be delivered on a schedule along with traditional fuels.

Biofuels Less Expensive (than gasoline)
Due to tax incentives and other incentives, biofuels can cost consumers less at the pump than traditional gasoline. Because ethanol results in slightly lower fuel economy than traditional gasoline, it must sell for less in order for the tradeoff of lower fuel economy to make sense. Service station owner estimates of how much of a difference must exist in order for ethanol use to make financial sense vary, from $0.20 per gallon (Service Station Owner, personal communication, 5/11/2010), to $0.30 per gallon (Service Station Owner, personal communication, 2/15/2008), up to $0.50 per gallon (Oil Company Owner, personal communication, 5/19/2010).

APPENDIX D: BARRIERS TO INSTALLATION OF BIOFUEL INFRASTRUCTURE (EXPLANATIONS)

Expense of Infrastructure

As in the responses to **RQ-1**, cost is a ubiquitous concern; the cost of biofuel infrastructure is the most frequently mentioned barrier to installing it. Every service station owner (with one exception, detailed below) who installed biofuel infrastructure, even those who utilized grant or incentive funding, was able to do so because they either had existing infrastructure that could be converted to biofuels use (i.e. a kerosene tank or premium grade gasoline tank no longer in use) or they were in the process of building a new station, and thus it was less expensive to install an additional tank underground. Because of their ability to re-use equipment, one service station owner estimated that it only cost approximately $1,000 to convert an existing pump to an ethanol dispenser (Service Station Owner, personal communication, 5/11/2010).

A completely new installation of infrastructure would require digging up the ground under the pumps and either replacing an underground storage tank, or finding space for a new one. Participants estimated the cost of a completely new installation in a range from $50,000 (Service Station Owner, personal communication, 5/11/2010), to $75,000 (Service Station Owner, personal communication, 2/5/2008, & Service Station Owner, personal communication, 2/11/2008), and one estimate of $100,000 (Service Station Owner, personal communication, 2/15/2008).

Additionally, small independent service stations who do not have complementary business lines to subsidize their fuel costs and margins have an even more difficult time with the decision to install biofuels. As noted in the manuscript, fuel sales are a loss leader for service stations, who rely on complementary business lines to make up earnings. The only participant to undergo a completely new installation was able to supplement the lost revenue (from closing part of the station and thus losing business there) and expense of installing an ethanol pump with auto repair and service business lines, noting:

> If it weren't for my wrecker service and repair business I couldn't have done it…I basically subsidize my gasoline with my profits from other things…and there's no way in the world that if I were just in the gasoline and candy bar business that I could have afforded to do it, there's no way. (Service Station Owner, personal communication, 2/5/2008)

Industry Brand Resistance

Between 92 and 95 percent of service stations in Michigan are owned and operated locally (Industry Association Director / Service Station Owner, personal communication, 4/13/2007), which is often counterintuitive for service station customers, who associate canopy signs such as "BP," "Shell," or "Sunoco" with those large corporations' branded operations. An industry expert described this association: "…to the average consumer, he sees a gas station with a sign that says BP, and he thinks that place is owned by BP, and its not. Just because they have a big

oil sign, doesn't mean that they are owned by big oil any more than big pop or big candy" (Industry Association Director / Service Station Owner, personal communication, 4/13/2007).

Still, these branded canopies have a great deal of marketing influence over service stations, and have traditionally fought attempts by service stations to place ethanol or biodiesel pumps under the branded canopy. This was because the large companies do not offer these products themselves; typically, service station owners and oil companies get these fuels from third party providers. This resistance has created siting and placement issues for some service station owners: "I cannot put E85 on those islands. It has to be physically separated from the Busco[15] products and then identified in such a way as to not imply that it is a Busco product. You can't use Busco color schemes, Busco decals, or those types of things" (Oil Company Owner, personal communication, 4/8/2007).

Uncertain Regulatory Environment

Regulations specific to biofuel infrastructure lagged the initial growth period for biofuels, which created uncertainty for service station owners who wished to install pumps. One participant described a collaborative approach to regulation, in which state regulators, contractors (to build the infrastructure), and oil company management determined the process for pump installation and regulation as a stop gap so that projects could get underway while clearer regulations were written (Oil Company Owner, personal communication, 4/8/2007). Another participant felt that the government's lack of clear regulations had significantly delayed the station's move to offer biofuels (Service Station Owner, personal communication, 8/28/2007).

Fuel Quality Issues

Though participants agreed that fuel quality has improved due to standards such as BQ-9000, promoted by the National Biodiesel Board (NBB), fuel was not considered to be reliable and consistent as recently as 2007. Biodiesel is relatively simple to produce, and some low-quality fuels rushed into the market and caused problems for the industry. Participants referred to "home cooked" fuels (Energy Industry Expert, personal communication, 4/10/2007) as the cause of public perception problems about the biodiesel industry in general. Another participant worried that early fuel problems would cause the industry to get a "black eye" with consumers (Energy Industry Expert, personal communication, 4/9/2008).

Questionable Long-Term Fuel Availability

This barrier is related to the cost of infrastructure installation; if service station owners invest in expensive infrastructure, they want to know that the fuel will be available for them sell on a consistent basis. Long-term and consistent availability would make the ROI calculation more realistic, as owners would have a longer time frame in which to recoup their investment. This barrier was of particular concern to large entities that manage either a fleet of vehicles or multiple service stations (e.g., Fleet Manager, personal communication, 5/11/2010).

[15] Company name has been changed.

Service Station Owner Attributes
Biofuel experts and distributors noted that limited technological competencies and limited time hampered efforts to promote biofuels. Regarding limited technological competencies, an energy industry expert recalled at least two service station owners who were not able to fill out Michigan's infrastructure grant application on their own, and who were not able to fill out online applications because of a lack of computer skills (Energy Industry Expert, personal communication, 4/9/2008). With regard to limited time, an oil company employee noted that service station owners, particularly those who own one or two stations, are so overwhelmed on a daily basis that it was difficult to get them to devote the time or effort needed to learn basic differences between biofuels and traditional fuels (Oil Company Owner, personal communication, 5/19/2010).

Available Space (for Infrastructure)
Service stations, particularly in urban areas, have limited capacity for expansion, and thus space concerns are a potential barrier to biofuel infrastructure. Beyond biofuels, service station owners also spoke about space as a concern in any decision about new fuel offerings; one participant turned down offers for free infrastructure for hydrogen fuels (provided by the company promoting hydrogen fuel) in part because of the additional space that such infrastructure would require (Fleet Manager, personal communication, 5/11/2010).

Length of Time to Payoff
Though growing, the number of biofuel pumps is limited, as are the number of vehicles that are able to burn biofuels, and thus the length of time required to recoup biofuel infrastructure investments can be longer than another similar type of infrastructure investment. As one participant noted: "We have to be realistic that if you put in a biofuel pump tomorrow, you might not have people lining up. This is kind of a longer term investment" (Energy Industry Expert, personal communication, 4/8/2007).

Public Awareness
According to the participants, some members of the public are unaware that their vehicles are compatible with ethanol or biodiesel. As a result, some service station owners and oil company employees also act as advocates, working with customers to educate them about biofuels (e.g., Service Station Owner, personal communication, 5/11/2010).

Risk (as a small company compared to larger retailers)
Small and independent service stations are concerned that a large infrastructure investment, if it proves to be a mistake, is much more harmful to them than it is to larger retailers, which can spread the cost over a larger volume and a more robust product line.

Lack of Analytical Resources
Small companies often do not have the resources to conduct thorough market analyses, such as the type that would help to determine the size of the potential market for flexible fuel vehicles in a given geographic area. As one participant is quoted in the manuscript: "We are not Mobil Exxon (sic), they have economic models…we are owned by a family" (Oil Company Biofuels Manager, personal communication, 6/3/2010).

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CHAPTER 3: WE ALL HAVE A PART TO PLAY: MEETING SUSTAINABILITY OBJECTIVES IN STREET-LEVEL BUREAUCRACY AT THE UNIVERSITY LEVEL

Introduction & Background

Since 2005, a large midwestern university (hereafter, "the University") has been working to integrate sustainability objectives into its culture. Far from a command and control approach, the University has structured its initiatives to allow individual employees and members of the University's community to create sustainability-oriented initiatives within the constraints of their job descriptions.

It is in this context that this manuscript examines the University's sustainability initiatives through the eyes of its "street-level bureaucrats": staff, faculty, and student employees. In-depth interviews are used to extend and apply Lipsky's (1971 & 1980) street-level bureaucracy framework to a University setting, and to issues of sustaianbility.

Results indicate that the framework is applicable to University and sustainability settings, specifically with regard to three key elements of Lipsky's (1980) framework: the manifestation of street-level bureacrats' personal values at work, their use of discretion within their jobs to enact sustainability changes, and their reliance on support from supervisors and senior administrative officials.

Background

The street-level stories of sustainability in this manuscript are nested in a larger narrative about the University's commitment to environmental stewardship (recognizing that sustainability and environmental stewardship are not one in the same), and the change processes that have ensued.

In 2005 the University's President announced her Boldness by Design strategic imperatives – areas in which the University must excel and innovate to fulfill the commitment to transformation. These areas include: enhance the student experience; enrich community, economic, and family life; expand international reach; increase research opportunities; and strengthen stewardship. In response to these imperatives the Director of Finance and Operations[16] announced his office would launch a campus-wide environmental stewardship initiative, thus extending the concept of "strengthen stewardship" to "environmental stewardship". For university employees who had been working on campus environmental issues, this interpretation of stewardship was a clear message from central administration that the University was making a "bold" and public commitment to the environment. This leadership was critical to the success and support of the grassroots stories referenced below.

Central to this context is a 30 year friendship between the Vice President and a faculty member (Professor Jones[17]) who conceptualized a "systems team" approach to understanding and operationalizing sustainability at the University. Because of this friendship, Professor Jones was charged with the task of forming a committee to determine how best to address environmental stewardship at the University. He was given great freedom to design and implement this undertaking along with significant resources to support the effort. Professor Jones agreed to spearhead this task contingent upon an agreement that the University would join the CCX (which the University joined six months later).

[16] Title has been changed.

[17] Name has been changed.

Professor Jones then created a team of colleagues to help him to visualize the University as a system, from which specific sustianability activities could proceed. This early team of four soon grew to seven academic "technical" teams. These teams proposed plans of study and were funded to embark on research to support the initiative. "Operations" teams were formed within one year and were poised to implement recommendations that came out of the research.

As of the time of writing, the University has been working on these initiatives for three years, and what began as environmental stewardship has morphed into a broader sustainability movement, with the "systems team" leading an annual cycle of study, analysis, reporting and recommendations.

Theoretical Framework

Operating within the broader campus sustainability setting described above has been a number of other sustianability-oriented initiatives that, while captured under the umbrella of campus sustainability, are not rooted in official recommendations or policies. These initiatives have come from individuals (or small teams) within the University, and have taken a range of forms, from building-wide recycling efforts to advocating for long-term campus planning changes. These initiatives are the subject of this manuscript, as they come from "street-level bureaucrats," a term coined by Lipsky (1971 & 1980) to describe the members of "street-level bureaucracies," a framework described in detail below.

Michael Lipsky, writing primarily in the 1970s, envisioned specific organizations as "street-level bureaucracies," staffed by "street-level bureaucrats" (Lipsky, 1971; Lipsky, 1980). These organizations were so named because they are responsible for the direct delivery of services to citizens; examples include police departments and schools (Lipsky, 1980). While Lipsky's examples are largely confined to government service provision, it is logical to apply

some of the characteristics of these street-level bureaucrats to those within other large, bureaucratic organizations, such as universities.

Lipsky offers three major characteristics of street-level bureaucrats: direct citizen interaction, a significant impact on those citizens, and, "…within the bureaucratic structure," "…wide latitude in job performance" (Lipsky, 1971, p. 393). It is this latitude (or "discretion" as Lipsky also terms it) that is the central theoretical focus of this manuscript, with specific attention to how that discretion is utilized and influenced. Ultimately, decisions made within certain discretionary boundaries comprise the sustainability policies that are actually implemented on the front lines (i.e. at the street-level) (Lipsky, 1980).

To gain a further understanding of how this operates, it is useful to briefly identify both the citizens and the street-level bureaucrats in a university. It is conceivable that in, for example, the purchasing department, there are street-level bureaucrats who have wide latitude to determine how products and services are procured. Similarly, there are street-level bureaucrats purchasing and serving food for the dining halls on campus, and these actors have discretion over what to buy and how to serve it. The product of their discretion is what Lipsky (1980) defines as "policy," and the citizens served by those policies range from students, to internal clients (e.g. departments purchasing furniture or supplies), and external clients (e.g. vendors supplying products).

Another important feature of street-level bureaucracies is that making decisions within parameters of discretion is not boundless. The discretion of those on the street-level is influenced and bounded by their personal values, the bureaucracy itself (the organization), and by the larger cultural zeitgeist (Lipsky, 1980). Thus, street-level bureaucrats' decisions and actions are their own, but are significantly influenced by these three factors.

Street-level bureaucrats bring their values to their work: "…bureaucratic attitudes toward clients appear to be a function of workers' background…" (1971, p. 400). Lipsky treats values as related to cultural norms, specifically in the realm of demographic assumptions about clients, such as race or socioeconomic status. While these specific attitudes were beyond the scope of this analysis, it is important to recognize the precedent, theoretically, for the influence of personal values on decisions at the street-level. As the data below shows, street-level bureaucrats at the University regularly credit a range of personal values in the decisions they make regarding sustainability.

Organization-level decisions typically set the context for street-level actions. Lipsky (1980) describes street-level bureaucrats as responsive to organizational pressures, primarily a lack of time and resources to thoughtfully attend to each decision and task with full due diligence. In Lipsky's bureaucracies these pressures are manifested in directives such as the need to service more clients in less time. In university parlance, however, organizational pressure could easily be the creation of something akin to the University's environmental stewardship initiative. Even though the organizational pressure is not directly related to bureaucratic routines, environmental stewardship has a major influence on how street-level bureaucrats do their jobs. For example, if one is charged with the task of reducing paper usage, this may lead to a new system for processing, filing, and disseminating information, as it did for one of the participants in this study.

The broader societal culture also influences how street-level bureaucrats make decisions. Lipsky characterizes street-level decisions as: "…colored by prevailing cultural assumptions" (1980, p. 181). Culture impacts street-level bureaucrats in two ways: first, bureaucracies gain legitimacy from social changes (without these changes, bureaucratic change is less likely);

second, street-level bureaucrats are members of the organizational culture that surrounds them (Lipsky, 1971). In the case of the University, the environmental stewardship program was undoubtedly influenced by external cultural shifts toward an embrace of sustainability by organizations. Further, the University is working towards changing its own culture around sustainability, which will eventually impact bureaucratic decisions within the University.

Ultimately, Lipsky paints a picture of a street-level bureaucrat who has daily contact with clients, and who has a significant amount of discretion to make decisions within broad policy parameters. However, these decisions are influenced significantly by the world around them and by larger organizational and administrative policy structures[18].

Lipsky's street-level bureaucrats are similar to staff, faculty, and student employees at the University – in fact, there are street-level bureaucrats at every level of the organization. They interact daily with "clients" who range from student employees, to vendors, and faculty and staff. Additionally, their jobs allow for a relatively wide latitude in decision making, which requires judgments filtered through the context of organizational initiatives; as Lipsky characterizes street-level bureaucrats: "…the nature of service provision calls for human judgment that cannot be programmed, and for which machines cannot substitute" (1980, p. 161).

It seems that by design (either intentionally or serendipitously), the administration has, through the architecture of environmental stewardship and subsequent political support of individual initiatives, utilized the autonomy that street-level bureaucrats possess and applied that flexibility to sustainability policies. This is clearer in some instances than in others, but what is

[18] Similar to the influential "psychological environment" that guides individual decisions in large organizations theorized by Simon (1997).

evident is that the stories collected for this study illustrate the power of the street-level bureaucracy in the twenty-first century, when bureaucracies are no longer limited to government organizations, and when the broader culture is slowly realizing its responsibilities to address the environmental, social, and economic issues that colloquially comprise the concept of sustainability. These street-level bureaucrats have taken their autonomy and run with it; they are functioning within their spheres of influence at the university, and as a result there is progress on multiple fronts.

Research Questions

RQ-1: What discretion do the University's street-level bureaucrats have within the confines of their positions?

Hypothesis 1: University street-level bureaucrats will have a wide range of discretion within their jobs, similar to other large bureaucracies.

RQ-2: Do the University's street-level bureaucrats use their discretion to advance sustainability objectives?

Hypothesis 2: University street-level bureaucrats will use their discretion to advance sustainability objectives, consistent with the psychological environment created by the university.

RQ-2a: If so, how do these employees use their discretion to advance sustainability objectives?

RQ-3: Do University street-level bureaucrats, who implement sustainability objectives within the discretion afforded them, do so because of personal sustainability-oriented values?

Hypothesis 3: Consistent with Lipsky, those University street-level bureaucrats who implement sustainability objectives will do so in part because of their own personal values.

Method

The data for this study was collected through in-depth interviews with 17 participants in various roles at the University, including staff members, student employees, and faculty. The interviews were conducted in the 2008-2009 academic year on the University's campus. They were recorded and transcribed, and analyzed manually by the author. Specifically, themes were identified during transcription and categorized into a matrix; these themes are included in the *results & discusssion* section below.

Snowball sampling was used to identify participants (Patton, 1990). The author began with interviews of staff members who had taken a public role in implementing street-level sustainability policies, and then solicited additional names from those participants and from their colleagues across the university.

Results & Discussion

Each research question is presented below, followed by specific results germane to that question. As expected (and per Lipsky), themes of the importance of values and discretion emerged from the interview data. An unanticipated theme also emerged in addition to the research questions: the importance of support from the top level of the bureaucracy for sustainability initiatives to be successful; this theme is also discussed below. Finally, three stories[19] from the interview data are included to both provide examples of street-level bureaucracy initiatives and to expand upon these three themes.

[19] Names of the protagonists in these stories have been changed.

Values & Discretion

Discretion, according to Lipsky (1980), is one of the unique characteristics of street-level bureaucrats, which sets them apart from other types of organizational employees. They are typically granted wide latitude by administrative agencies to perform their duties as they see fit, albeit within broad parameters (Lipsky, 1980). At the University, this sense of discretion has served in an incubational capacity, allowing the University's street-level bureaucrats to interpret the push towards sustainability in the context of their own value sets. A number of bureaucrats have thus taken it upon themselves to embrace the organizational support of environmental stewardship and make policies within the latitude afforded by it.

RQ-1: What discretion do the University's street-level bureaucrats have within the confines of their positions?

Hypothesis 1: University street-level bureaucrats will have a wide range of discretion within their jobs, similar to other large bureaucracies.

Employees' discretion is difficult to measure quantitatively, and even Lipsky did not attempt this type of measurement (Lipsky, 1980). However, discretion can be parsed according to roles and responsibilities, such that some street-level bureaucrats have the potential to bring about much larger change processes than others[20]; the amount of discretion exercised is in part a function of the discretion granted to each participant by the organization. As such, **Table 8**

[20] Though it remains unclear to what extent this discretion is self-imposed, or a limitation imposed by the bureaucracy.

below lists: (1) the positions of participants in the sample, and (2) the types of activities performed in their job, which in part define the bounds of their discretion.

Table 8
Street-Level Bureaucrat Positions & Activity Descriptions

Function / Office	Activities
Faculty & Staff	
Campus Dining	Ordering materials, guiding material choices, types of processes used, material disposal
Events	Ordering materials, guiding material choices, material disposal
Facilities	Types of processes used, material disposal
Faculty (general)	Types of processes used (for resource allocations)
Interior Design	Ordering materials, guiding material choices, material disposal
Landscaping	Materials used, types of processes used
OCS	Campus process initiatives, program creation
Planning	Campus planning, design of campus (input)
Power Generation	Materials used
Purchasing	Ordering materials, guiding material choices
Student Organic Farm	Program creation
Transportation	Ordering materials, guiding material choices, types of processes used
Water	Campus planning (for water extraction, use, disposal)
*Students**	
Student I	Environmental awareness initiative creation
Student II	Environmental awareness initiative creation
Student III	Environmental awareness initiative creation
Student IV	Environmental awareness initiative creation
	n=17

*Students had positions within the university - research assistants or office positions.

As shown in the table, most of the activities of participants focus on the ordering, use, and disposal of materials at the University, though a few have input into the creation of programs. While few in the sample hold positions that allow them to implement organization-wide changes within their job descriptions, these smaller changes are the focus of Lipsky's

(1980) framework, as multiple front-line initiatives, though small, significantly impact the bureaucracy as a whole.

RQ-2: Do the University's street-level bureaucrats use their discretion to advance sustainability objectives?

Hypothesis 2: University street-level bureaucrats will use their discretion to advance sustainability objectives, consistent with the psychological environment created by the university.

All of the participants in this study used their discretion to advance *environmental* sustainability objectives, though there was little evidence that social or long-term economic sustainability objectives were considered.

Each of the participants has the latitude available to them act *less* sustainably as well, suggesting that they likely also use their discretion for other tasks unrelated to sustainability [for example, per Lipsky, employees use discretion to make their jobs or assignments easier (Lipsky, 1980)]; as discussed in *limitations* below, it remains unclear what percentage of discretion is utilized for sustainability, and what percentage of employees use discretion to advance sustainability objectives.

RQ-2a: If so, how do these employees use their discretion to advance sustainability objectives?

Following the results of **Table 8**, **Table 9** repeats each of the positions of street-level bureaucrats at the University, along with the type of change they were able to implement. Given the variation in discretion afforded each of the street-level bureaucrats in the study, some were

able to change the way they go about their daily tasks, while others were able to implement completely new processes.

Table 9
Street-Level Bureaucrat Positions & Type of Change Implemented

Function / Office	Change Implemented
Faculty & Staff	
Campus Dining	Created new food sources and disposal methods
Events	Integrated new green material "defaults" into conference material purchasing procedures and began composting leftover conference materials
Facilities	Integrated recycling into disposal system
Faculty (general)	Influenced departmental resource allocations
Interior Design	Integration of "green" design materials and disposal
Landscaping	New "greener" landscaping materials, and new process for more accurately distributing materials
OCS	Numerous campus programs to encourage sustainability
Planning	Influenced campus transportation planning to encourage biking & walking, green design
Power Generation	Influenced new fuel source use
Purchasing	Integrated new "defaults," and counseled purchases on "green" products
Student Organic Farm	Created new degree program
Transportation	Created new "green bikes" transportation program
Water	Influenced campus plan on storm water management
Students	
Student I	New environmental awareness initiative - Dim Down
Student II	New environmental awareness initiative - Energy awareness
Student III	New environmental awareness initiative - Energy awareness
Student IV	New environmental awareness initiative - Food resources
	n=17

RQ-3: Do University street-level bureaucrats, who implement sustainability objectives within the discretion afforded them, do so because of personal sustainability-oriented values?

Hypothesis 3: Consistent with Lipsky, those University street-level bureaucrats who implement sustainability objectives will do so in part because of their own personal values.

Personal values were a part of every street-level bureaucrat's activities, but what drove them was not always a concern for "sustainability" per se. Only two participants (12 percent) used the term "sustainability" to define their passion or values. Concern for "the environment" was a more often-repeated value; seven participants (41 percent) described a concern for "nature," "ecology," or conceptions of waste reduction or recycling as personal values that drive their work.

The remaining participants (8, or 47 percent) expressed values that are derived from, or directly influence, the way that they perform their job. Though not specifically related to "sustainability," at a large place such as the University, it just so happens that these values integrate with a holistic view of sustainability. Participants who value education, exercise, and the more abstract "helping people" have all driven intiatives that are captured within the University's broad-based sustainability culture, but only in a system as large as the University do these activities make sense together.

Further, to Lipsky's (1980) notion of the power of the organization itself as an influencer of street-level bureaucrat actions and decisions, three participants (18 percent) had not considered sustainability issues prior to coming to work at the University. For these bureaucrats, it was exposure to a large organization (and, for one participant, the waste generated therein) that prompted them to consider initiatives that now are considered part of the sustainability efforts on campus.

Support from the Top

A university is a unique type of bureaucracy, in that nearly all of its employees exercise some discretion in their daily work lives. Given these multiple layers, a discussion of what "the top" is can be confusing, but for the purposes of this manuscript, the top is the senior administration, including Vice Presidents, the Board of Trustees, and the President. As one participant noted: "This is the one issue that I've seen in 25 years that's cut across every demographic boundary of this campus, from the lowest individual to the lowest department to the very top, the president" (Staff Member, personal communication, October 21, 2008). However, it is important to note that support from "above" is just as meaningful to street-level bureaucrats in their daily tasks, regardless of whether "above" is "the top." Many participants have been supported in their efforts by their supervisors, though they also expressed gratitude to the highest administrative levels for support of these projects.

Lipsky (1980) notes that support from the top is a key factor in helping street-level bureaucrats to understand and define the boundaries of their discretion; this idea was confirmed in this study, as every participant ceded that their initiatives were possible because of support from the top (above). What the University did, in effect, was to amend the organization's job-related boundaries to encompass the environmental realm.

A good example of support from the top is Jim's story. Jim is a street-level bureaucrat who works in the University's landscaping office, and who used the discretion allowed within his job description to research more efficient means of spreading salt on campus roadways in the winter; he also eventually integrated new, more environmentally friendly products to melt ice into this process. Though his ideas have been effectively implemented, he says: "I'm not going

to sit here and take credit for all these things, because we have a great team of supervisors…" (Staff Member, personal communication, September 16, 2008).

Jim is not the only one to have gotten administrative support. It is also evident in Sarah's story (which is detailed below): "I've been very supported in my efforts" (Staff Member, personal communication, September 3, 2008). And, it shows up in Bill's story, a bike expert, who has created a bike program to, in part, encourage alternative means of transportation on campus by making biking more visible and accessible to students, faculty, and staff. Bill told the story of two administrative officials who single-handedly funded and found his team a space to expand their operations.

Street-level bureaucrats are at all levels of the university because the clients served can be defined in many ways; for one employee it may be students, but for another it may be a department chair. Lipsky (1980) did not discriminate with regard to educational or professional backgrounds of street-level bureaucrats; he wrote of teachers and police officers, but also of doctors and lawyers. One of the street-level bureaucrats interviewed is one of a team of campus planners. His concept of administrative support was no different than those who provide service directly to students or staff members. He said: "You know who really gets it? President (Smith[21])" (Staff Member, personal communication, September 11, 2008). He added that the offices of those administrators just below the President (the other administrators at "the top") are the ones "pushing along a lot of these ideas" (Staff Member, personal communication, September 11, 2008).

[21] Name has been changed.

Example Stories

The three stories below echo the three themes discussed thus far: that individual street-level bureaucrats bring their own values to bear in their work lives, that street-level bureaucrats utilize their power of discretion in order to implement sustainability actions, and that support for street-level sustainability activities at the top is required for the success of sustainability initiatives.

Bob: Instructor & Safety Coordinator Meets Recycling Inspiration

Bob is an instructor and facilities specialist at one of the University's over 500 buildings. He spent a great deal of time in the interview talking about his environmental values, for example: "there's just been such an ingrained culture of throwing away in our society that we carry that through in all facets" (Staff Member, personal communication, October 21, 2008). It is this throw-away culture, and what he saw going on around him, that prompted Bob to take matters into his own hands. He went into the bowels of the building, the loading dock, and transformed it into a recycling center. He then created mini drop-off points throughout the building to make it easier for other employees to deposit recyclable waste during their day.

However, recycling is not Bob's primary job; implementing a recycling program was an additional responsibility beyond his primary tasks. "It's been my own mission," he says, "I'm not being paid for this, our recycling facility is self-initiated…we are really quite proud of it" (Staff Member, personal communication, October 21, 2008). In other words, Bob used his discretion as a street-level bureaucrat to create an initiative beyond his job description. While Bob is not technically a recycling coordinator, it is almost as if he feels that recycling *should* be part of his job as a facilities specialist.

Sarah: Making Sustainability the Easy Choice

Another participant, Sarah, who works in Purchasing, offers an additional example of the influence of values on discretion. Sarah is modest about her accomplishments, but her actions are helping to change the way things are done at the University. She began with an individual commitment to recycling (i.e. an environmental value): "I've always been a recycler. We are very green at home" (Staff Member, personal communication, September 3, 2008). It was natural for her to translate that interest to her job, where she began to work with colleagues to set up recycling centers around her office. At first, she would take these items home and recycle them herself, but eventually, as the university's in-house recycling program grew, she was able to hand some of the collection job over to the university.

While recycling is outside of the scope of her job, perhaps Sarah's most lasting impact is within the parameters of her job description. Some of her daily tasks are predetermined; for example, if a department wants to order 15 desk chairs, and they specify the specific brand, color and size, it is her job to fill that order. However, there are multiple occasions when a client will put in a vague request for desk chairs, with no additional specifications. It is in these cases that Sarah has a great deal of discretion; she works with the vendors she utilizes on a regular basis to make sure they are touting their "greenest" products, and she works to have purchasing documents re-written to specify things such as fewer packaging materials when items are shipped. She also works with her clients within the university to make sure they are aware that they can choose a more environmentally friendly option. Additionally, she incorporates an educational component into her interactions with other staff members:

> So I'm trying to tell the buying staff, just tell the vendors that they can use less packaging and that they should send us their greenest products…the more we ask for it and the more we encourage the end users on campus to ask for it and accept it and possibly pay a little

> more…build their budget in a way that they can do this, the more we will see it become the norm. (Staff Member, personal communication, September 3, 2008)

This is in part possible because Sarah is supported by her supervisors. She notes that her direct supervisor is the one who encouraged her to broaden the scope of her ideas department-wide, and to codify these ideas into processes.

Sue: Fast Food Means Local Food

Sue's story is important to include at this point because it combines all of the characteristics of street-level bureaucrats discussed above: she brings her own values to work, she receives support from the administration, and she has her finger on the pulse of the changing student culture at the University. What makes her even more remarkable, however, is that she is pushing to change that culture.

Sue is a woman who is dedicated to her family, and she started making changes in how they eat a few years ago. She wanted to learn more about organic food and local food, and it just so happens that she also works in food services at the University. When, a few years ago she was looking for a way to incorporate more organic food into the University's menu, she "…approached (Mike[22]), who is a manager for the student organic farm and asked if there is any way we can start just getting greens from the student organic farm…" (Staff Member, personal communication, September 9, 2008). In other words, the solution was right under her nose. This manner of solving problems by using the resources already available at the University may not sound like new thinking, but it is an important sign of cultural change in environmental

[22] Name has been changed.

sustainability at the University. Instead of looking outside for help, street-level bureaucrats are turning inside.

Beyond her personal values and organizational support, Sue surveys students annually to find out how changes she is making – including more organic food and locally roasted coffee – are interpreted by them. This research allows her to keep her finger on the pulse of the culture of her clients (students). In truth, there has been some cultural push back. Some students prefer "mass market" peanut butter to natural, for example. But on the whole, students are happy. Students are even willing to accept smaller portions in some cases. Sue has utilized her discretion to offer smaller portions in order to make the changes she wants more cost effective. Costs, which every university must deal with, are one of the necessary constraints that administrative officials have placed on Sue's discretion. Yet, they were patient with her, letting her make a "business case" for using local foods (a case she is still working on).

Limitations

The study's focus on sampling participants who were already involved in sustainability-oriented initiatives certainly influenced the results. Specifically, use of discretion is likely manifested differently among employees who rarely (if ever) consider issues of sustainability and how their jobs can influence sustainability objectives. Further, given that the sample is not statistically representative, it is not known to what percentage of the University's employees the Lipsky framework applies. Future research could use complementary organization-wide surveys to assess how pervasive these concepts are in large organizations.

Conclusion & Recommendations

Lipsky's (1971 & 1980) description of street-level bureaucrats and the bureaucracies they serve is relevant beyond the provision of services in government agencies. The data collected for this study show three themes related to sustainability initiatives at the University: that street level bureaucrats' initiatives are influenced by their own values, that they utilize their discretion to advance sustainability initiatives, and that success is due (at least in part) to support from above (in the bureaucracy). While future research (in universities and in other organizations) is needed to confirm and support the case that Lipsky's framework is indeed applicable to sustainability initiatives, it is apparent from this study that at the University, the framework is a useful lens for understanding the manifestation of sustainability within the mechanisms of a large bureaucracy. Further, whether intentional or accidental, the model for sustainability changes at the University has served it well in terms of the number and success of initiatives.

What makes the University different from the theoretical framework of Lipsky is that Lipsky's street-level bureaucrats are often adversarial to the bureaucratic agencies they serve; they act out of a need to make their jobs simpler and more manageable (1980). By contrast, the University's administration designed an initiative that proactively tried to utilize the discretion that street-level bureaucrats exercise within their job descriptions in a positive manner. Street-level bureaucrats are able to bring their own values to bear within organizational parameters to make things better (according to theirs, and the University's sustainability values), not just to make life easier or to avoid work. In fact, their activities often create more work for them.

The results of this study should also be considered in light of other methods of bringing about sustainability changes. Given the hierarchical nature of many organizations and the history of environmental regulations, it is conceivable that future sustainability initiatives could be

designed within a "command and control" structure. This approach would quash the discretion of individual street-level bureaucrats in favor of more expedient and predictable results. However, there may be unforeseen dangers to this approach, given that street-level bureaucrats can use their discretion to advance policies, or to subvert them. Thus, in future research, it would be useful to replicate this type of study at organizations that have tried a command and control approach to determine whether there are negative ramifications to limiting workplace discretion.

Finally, the stories in this study are primarily about the environmental component of sustainability because this is what the administration has committed to and is supporting. Yet, the concept of sustainability, in the minds of many, extends beyond environmental issues to include social and long-term economic elements. Thus, it will be interesting to learn how the University and other large organizations that are currently implementing sustainability-oriented changes move beyond environmental initiatives towards a vision of sustainability – either their own or a more standardized version. While this path is uncertain, what is clear is that it will largely be up to the street-level bureaucrats to decide whether or not the path is successful.

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CHAPTER 4: CONCLUSION – THE FIFTH CHALLENGE OF SUSTAINABILITY

In 2002, David Orr outlined "four challenges of sustainability" that must be addressed to achieve a sustainability transition. Briefly, the four challenges were: (1) better measures of our interaction with the biosphere, (2) improved governance and citizenship, (3) the education of the citizenry (in part to give us the tools needed to accomplish challenge two), and (4) the ability to see and address "divergent" problems via "a higher level of spiritual awareness" (Orr, 2002, p. 1459). However, Orr's (2002) essay overlooks an important component required for a sustainability transition; specifically, a sustainability transition implies a series of fundamental (or "second order") organizational changes, without which this transition is not possible. The difficulty inherent in this type of change comprises an overarching fifth challenge of sustainability – the transition will require the successful implementation of fundamental change initiatives – on which Orr's (2002) four challenges depend.

Though the role of the individual is important in Orr's (2002) transition, it is organizations to which he ascribes much of the responsibility, beginning a series of parallel phrases with "Only governments can…" (p. 1458). Orr (2002) places the responsibility for reigning in and directing the private sector squarely with governments, yet the years since 2002 have witnessed little progress in this regard[23]. With respect to sustainability, it could be argued that the private sector, together with universities, is leading the way towards a transition of sorts, at least in the U.S.

[23] Excepting the unprecedented nationalization of a handful of corporations during 2008's financial crisis.

Evidence of this transition is in part detailed in the manuscripts of this dissertation, which are connected through four themes of organizational change: (1) typologies of change, (2) drivers of change, (3) degree of change, and (4) pace of change. While categorization within typologies of change (1), and an examination of the drivers of change (2), is useful, the results of this research point to a more fundamental question based on the degree (3) and pace (4) of change; that is, it is not *whether* change is occurring with respect to sustainability (it is, at least as organizations or broader forces have defined it), but whether change is occurring to a fundamental enough degree. Essential components of this broader question include whether the change is (a) fast enough (pace of change), and (b) in the right direction (directionality) so that a sustainability transition can occur before our present balance of environmental, social, and economic systems breaks down.

To address this question and more fully explicate the fifth challenge, the difficulty of change will first be discussed broadly, followed by a treatment of each of the elements of the challenge outlined just above. Finally, the difficulty of change will be presented in the context of Orr's (2002) four challenges, to illustrate their dependence on this fifth challenge.

The Difficulty of Change

The introduction to this collection of manuscripts delved into the rich theoretical literature on organizational change to explore the difficulties inherent in achieving fundamental, lasting change. Gone are the days when, either truthfully or through perception, change was a relatively simple bureaucratic process consisting of a flawless translation of vision from the "corporate" or highest level (Pearce & Robinson, 1988) to implementation at the "functional" level (Pearce & Robinson, 1988). This type of change management would be simple – all it

would take, for advocates of organizational sustainability, is to convince the right managers, and change would happen.

This simply is not the case. Decades of research point to much more nuanced and culturally-laden models of change, whereby initiatives are interpreted through a series of cognitive decision biases manifested at all levels of the organization, from strategic decisions (Barnes Jr., 1984; Schwenk, 1984) to front-line employees (Lipsky, 1980); as such, the original intent of initiatives is typically lost in the space between espoused theory and practice.

Further, change models assume that an organization *wants* to change; and save for research on triggers, it says nothing of institutional barriers to change, such as corporate charters that legally require corporations to seek profit and growth, and a global financial system (in which all types of organizations are nested) that rewards financial gains over social and environmental progress. Even universities and non-profits are increasingly susceptible to market forces, adjusting staffing levels and in some cases mission to appease a system larger than themselves, hence the rise of "for-profit" universities, and corporate sponsorship of college classes (Gray, 2009).

Thus, over time, researchers have come to understand organizational change as a complex and difficult process, nested within larger (increasingly globalized) systems. This complexity is especially evident in fundamental change processes, which helps to explain their extremely low success rate (Burnes, 1996).

Degree of Change

The difficulty of change is likely one reason that the organizations investigated in this collection of manuscripts are having difficulty moving beyond first order (Kezar, 2001) change to the kind of fundamental efforts needed to advance the sustainability transition. Using the

language of change introduced earlier in this dissertation, SMEs have yet to move beyond the "incremental adjustment" phase of change; the university profiled, and some corporations, have moved to "modular transformation," a higher order of change, but have thus far fallen short of true fundamental shifts.

Though these manuscripts do not represent fundamental changes, there is strong support for the idea that organizations must change immediately and fundamentally in order to prevent imminent disaster (e.g., Hammer, 1990; Hart & Milstein, 1999). Dunphy, Griffiths and Benn (2002) note:

> Incremental change strategies are useful for organizations seeking to move between one phase of sustainability to the next. However…not all organizations will be able to move forward *fast enough* on the path to sustainability by using incremental change strategies (emphasis added). (p. 231).

There are plenty of historical examples of non-fundamental change; a recent example is the consumer protection legislation that was passed in 2010 to increase regulation of Wall Street firms and prevent another financial meltdown. While hailed by its supporters (e.g., White House, 2010), others noted that legislators missed an opportunity[24] to fundamentally reform the U.S. financial system (e.g., Brown, 2010; Thomas, 2010); banks will still operate in roughly the same format, with only a few products eliminated from their profit-making arsenal. Regardless of one's stance in this debate, if only the peripheral issues (i.e., the manner in which these products are packaged and sold) are changed, while the broader system (our reliance on these products for a financially solvent existence past the age of 65) remains in tact, it is difficult to argue that a fundamental change has occurred.

[24] What Kingdon (1995) would call a "policy window."

Specific to sustainability, Dunphy et al. (2002) include several case studies of companies they credit for having made significant changes, such as Shell and Volvo. Yet, these companies' changes do not fulfill the requirements of Dunphy and Stace's (1993) description of "revolutionary" ("fundamental" in this manuscript) change, whereby the entire mission of the company is "reformed." Though the changes made by these companies are likely significant, Shell is still an oil producer, and Volvo still makes gasoline-powered cars and trucks; Volvo even chose to introduce a sport utility vehicle (SUV) to the American market to capitalize on the consumer trend towards larger, less fuel-efficient vehicles just as Dunphy et al. (2002) were writing about the company's sustainability achievements.

Thus, while the difficult work of translating theory into practice in organizations has begun, it is easy for cynics to highlight examples to prove that these changes are not fundamental. Another more recent example is the case of BP, which at the time of writing just recently capped its disastrous 2010 Gulf of Mexico oil spill. In at least one area, however, BP has made great strides in its sustainability efforts; the company has won awards for its corporate sustainability reporting, notably the 2008 first runner up prize in Corporate Register's (the world's largest catalogue of non-financial corporate reports) Best Report category. This juxtaposition between espoused theory and practice is certainly reason to question the authenticity, and hence the degree of change represented by BP's sustainability efforts[25]. This

[25] And suggests a difference in opinion concerning sustainability *in* organizations versus the sustainability *of* organizations; the latter is addressed by scholars such as de Geus (1997), who has studied companies that exist for long periods of time (centuries), and thus are sustainable as organizations, regardless of their integration of environmental, social, and economic bottom lines.

very concept was captured more broadly in a 2010 survey of 50 corporate sustainability executives by the consulting company Deloitte, which concluded:

> As we see it, the challenge now is for companies to find ways to close the distance between their stated sustainability principles and the actions and investments they make to pursue their sustainability objectives. (Deloitte, 2010, p. 3)

Pace of Change

Understanding the pace of change is a crucial component of the degree of change because it sets temporal boundaries on the change process. However, knowing whether change towards sustainability is happening fast enough is empirically difficult at this point. To answer it requires a more complete strategy to address Orr's (2002) first challenge – developing better measures ("indicators" in the language of this dissertation) – as well as benchmarks, to which this collection of manuscripts contributes (through cataloging change processes and the drivers and outcomes of change), but by no means completes.

To know if change is occurring fast enough would require an accurate accounting and prediction of the breakdown both of the earth's natural systems and the world's social systems. A wide range of predictions exists, ranging from ecological treatises (Wessels, 2006) to apocalyptic portraits of life after natural resources (Simmons, 2005). Yet, what Kuhn (1996) would call "Normal Science" has been unable to provide specific dates and details. Orr's (2002) first challenge of sustainability, the need for better indicators, thus still stands as a formidable challenge, and must be extended to include not only better indicators of humans' impact on nature, but of nature's own processes.

In addition to better indicators and benchmarks, we need studies that catalogue the direction of the indicators that already exist; this would serve as a kind of global benchmarking to assess movement among collections of indicators, giving us a sense of how sustainability is

being defined. It would also illustrate how organizations embrace sustainability, and change with respect to it over time. This would not only inform the continued collection of these indicators, but also whether we are moving in the right direction (as is addressed specifically in the *directionality* section below).

Directionality

A scholar would not approach a research project without a sense of what it is one wants to know, yet sustainability is currently being measured and implemented without a clear sense of where we ought to head. Thus, the last component of the broader fundamental change question is the direction of change.

Thus far, a sense of the direction organizations are heading on the road to sustainability has been significantly impaired because of a lack of consensus on what sustainability is, and therefore what it is we should be headed toward. While it was relatively intuitive to make judgments for the purposes of studying corporate sustainability in the first manuscript, these indicators represent the low-hanging fruit of environmental indicators, and judgments are much more difficult when applied to potentially more ambiguous social indicators[26]. To me, it is obvious that emitting less CO2 from year to year is a positive step; it is more sustainable. Yet even this idea was met with controversy at the 2010 biennial meeting of the GRI in Amsterdam. This type of judgment is not in the "spirit" of reporting, which is, according to the GRI, mass participation without accountability for direction. That is, an organization is free to report whatever it feels is relevant, as long as it reports. The assumption is that just by reporting,

[26] Social indicators were not examined in the first manuscript, but they will be the focus of future research.

companies will become "more sustainable;" evidence from manuscript one is reason to argue with this assertion.

Thus, depending on one's perspective, nearly any judgment made about the direction of sustainability is controversial, and in the absence of a clear global power structure (at least one that has shown itself capable of enacting large scale changes for sustainability), it is difficult to know who will make these judgments. Even with an issue like climate change, that is well-catalogued and researched by the world's preeminent scientists [individually and within organizations such as the Intergovernmental Panel on Climate Change (IPCC)], the inability of the world's leaders to come to an agreement in Copenhagen in 2009 is evidence that, at least politically, our system cannot accommodate, or is not ready for, a discussion about moving forward in any meaningful, directed way. Instead, this responsibility is abdicated to non-governmental organizations (NGOs), the private sector, and individual citizens.

Given this lack of direction, two of Orr's (2002) challenges are at a crisis point: first, citizenship and governance are a long way from the creativity of action called for in challenge two; and second, recent research suggests that challenge three, informing the citizenry, is stalled in part[27] because of citizens' lack of awareness and inability to act on the challenges abdicated to them (e.g., Attaria, DeKayb, Davidson & de Bruin, 2010).

[27] It is also stalled because of shifting priorities in U.S. primary education (highlighted below) and certainly because of decision biases that influence how people make decisions about sustainability issues.

The Fifth Challenge

At this point, it is useful to revisit Orr's (2002) challenges in the context of their relationship to the fifth challenge; Orr's (2002) four challenges all depend on successful implementation of fundamental organizational change initiatives.

Orr's (2002) first challenge is the need for better indicators of our interaction with the biosphere. This manuscript has re-affirmed and extended this challenge by calling for better and more predictive indicators of the biosphere itself, and combined measurements of pre-existing collections of indicators. However, current indicator frameworks often apply to, or are produced by, organizations, ranging from businesses to universities and nonprofit consortia. For these indicators to be meaningful, organizations must undergo fundamental shifts that will allow them to internalize and commit the resources necessary to create indicators and measurement processes that are accurate, inclusive, and easily translatable to stakeholders. Perhaps most importantly, organizations must be willing to accept negative results from these processes and create feedback and continuous change mechanisms to allow them to improve with time. Results from the first manuscript indicate serious remaining challenges with all of the attributes just listed.

Orr's (2002) second challenge is an improved (or, in Orr's words, a more "creative") system of governance and a more responsible citizenry. As referenced earlier in this manuscript, a global system of governance for sustainability has yet to emerge. While many organizations have articulated a vision of sustainability, translating this to practice has proved difficult. Though cultural differences and other factors are likely partially to blame for this circumstance, a lack of fundamental organizational change, which in the U.S. governance system would consist of a shift

away from a short-term focus towards longer-term thinking and planning cycles, is also an important component.

Though "the citizenry" is not in and of itself an organization, change issues are still paramount because of the ubiquity of organizations in the lives of citizens – organizations are a source of employment, social services, and policy making. Only fundamental shifts in these organizations' embrace of sustainability will enable (and engage) a broader citizenry. Evidence of this emerged in the third manuscript of this dissertation, where even in a modular transformation environment (a large university), employees were emboldened to create change for sustainability.

The third challenge is ultimately about a fundamental change in our systems of education, such that we can have an honest conversation about what it means to be "educated," and that this definition should include the core competencies of what is ultimately cast as sustainability. Education in the U.S. is still fundamentally a government-run enterprise, at least through the primary years, and thus this challenge is inextricably linked with Orr's (2002) second challenge, discussed above. At present, the U.S. education system is narrowing, rather than expanding its horizons, through an increasingly myopic focus on standardized tests in a post No Child Left Behind world (e.g., Hursh, 2007). Thus, present-day primary education is based on increasingly *fewer* core competencies than have been the hallmarks of the American education system for decades; there has been no fundamental change in our educational institutions, at least in such a direction as would be required to meet the third challenge.

Finally, the fourth challenge, attaining a "higher level of spiritual awareness" (Orr, 2002, p. 1459) necessary to iron out divergent problems, requires a change in the reward systems of the organizations in which citizens work and think – that is, rewarding mindfulness over

productivity. Additionally, collaboration is required in these organizations such that a holistic perspective is encouraged when addressing problems; honoring what Orr (2002) calls "mystery, science, life, and death" (p. 1459). While some organizations certainly collaborate and assess their activities from a systems perspective, many must undergo a fundamental change for this view to become their primary lens. As noted in the second manuscript of this dissertation, for some organizations, particularly SMEs, resources are an impediment to more holistic analyses.

The role of fundamental organizational change is essential to successfully address Orr's (2002) four challenges to sustainability, such that it comprises its own "fifth challenge" on which the others are dependent. Integral to the question of whether change occurs to a fundamental enough degree is further dependent on determining whether change is (a) fast enough, and (b) in the right direction to achieve Orr's (2002) transition prior to the collapse of our environmental, social, and economic systems. Yet, measurement challenges at present preclude us from accurately answering these questions.

In this vein, Orr's (2002) four challenges are likely a utopian vision of how a society can exist and direct itself, through meaningful and engaged conversations at all levels, leading towards more sustainable ends. While clearly more research is needed to assess even our current status with regard to the five challenges (to say nothing of developing strategies for meeting them), organizations are already striking out on their own roads to sustainability. According to the research for this dissertation, it seems that at best these endeavors comprise a sustainability agenda consisting of pieces of what we think sustainability ought to be. The multiple interpretations of these pieces results in a sustainability transition that is not directionless, though it does suffer from a crisis of direction. This leaves yet another question to be answered: is it

better for these organizations to try to achieve what they conceive of as sustainability, or hold off until specific authorities have a better grasp of what it is and how to achieve it.

Given that we may never know what sustainability is, exactly, and that organizations are pursuing sustainability objectives without waiting for the "authorities" referenced above, I would argue that uncertainty should not stop organizations from trying to define and implement sustainability objectives, as long as there are checks and balances on these attempts, such as the research conducted for this dissertation, and that proposed below.

Future Research

Though the conclusions of this dissertation have resulted in additional challenges inherent in moving the sustainability transition forward, a clear research agenda has also emerged. With additional research, our knowledge of organizations in a sustainability transition will grow, and in the future, instead of applying broad organizational change theories to sustainability, perhaps *change for sustainability* will account for its own unique set of theories within the field. In this vein, future research prospects, beyond those spelled out in the individual manuscripts, are outlined per each manuscript below.

First, corporate sustainability research regarding improvement in indicators should be approached from a comparative international perspective in addition to U.S. companies. In this way, leaders of fundamental change can be identified, and an overall sense of the pace of change can be calculated from the larger sample. Additionally, the same or a similar methodology should guide an approach to studying the social and economic elements of corporate sustainability reporting. This prospect grows more exciting when considered in light of the coming trend towards integrated financial and sustainability reporting, where all components of a company's performance will be housed in a single document.

Second, it will be important to follow developments in transportation to determine if service stations remain a viable component of fueling infrastructure. It is apparent that it will be quite difficult, in the absence of massive subsidies and mandates, to upgrade fueling infrastructure to new technologies (e.g., electric quick-charge stations for fully electric cars and trucks) quickly. And, beyond service stations, just as small business owners can make decisions quickly, and lead the way, they can also hinder widespread change initiatives based on values and perceptions of new technologies. Thus, future research should continue to explore the decision making processes of small business owners; while corporate decision making has been well documented, research focusing on the nature of small business strategy is not as thorough. Given that small businesses comprise 90 percent of the world's businesses (GRI, 2008), they will be incredibly important to the direction of sustainability change.

Third, Lipsky's (1980) powerful framework for understanding the context of decisions made by individual bureaucrats should be applied to the private sector. The third manuscript in this collection showed that Lipsky's (1980) theory has promise when applied to a non-profit educational environment, but if it could be shown to be a helpful tool for understanding behavior in a corporate environment, it would be more widely applicable. The concept of "nudges" (Thaler & Sunstein, 2008) could also be applied in concert with Lipsky, as a mechanism for first understanding bureaucratic latitude, and then, in the tradition of Simon (1997), bounding that latitude to direct change in a prescriptive manner.

Finally, the fifth challenge raised in this concluding manuscript has sparked its own research agenda. In addition to the research needed to further detail Orr's (2002) four challenges, understanding and meeting the fifth challenge will require studies to determine the demarcations of "fundamental" versus other forms of change. Dunphy and Stace (1993) offer a useful

typology, as do other scholars highlighted in this dissertation (e.g., Dunphy et al., 2002; Kezar, 2001), but more recognizable boundaries will be required to ensure that those organizations that do achieve fundamental change are characterized as exemplars rather than failures.

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