The Strategic Role of Information Systems in Supporting Sustainability

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ABSTRACT
As sustainability becomes more mainstream, companies face increasing demands to address environmental and social factors as part of their daily operations. The result is that companies need to attend to an ever increasing set of regulations that vary by jurisdiction and often overlap along with demands for more transparency and reporting on how they are meeting these requirements. Delivering on these commitments, which is a first step towards embedding sustainability into the fabric of the company, comes with a high cognitive load. It is natural under these circumstances to turn to information systems (IS) to help manage the task. Our study examines how one large integrated energy company is attempting to use IS to support these foundational sustainability efforts and asks to what extent IS can successfully meet the challenge.

Keywords
Sustainability, Green IS, cognitive load, compliance, fit

INTRODUCTION
Today, most large firms recognize the need to integrate social and environmental concerns into their operations. In fact, a recent global survey of more than 700 CEOs found that 93 percent see sustainability as important to their company’s future success (Accenture, 2010). Yet despite this, the study also found significant performance gaps between those who merely agree with the importance of embedding sustainability and those who actually report success in achieving that objective. While a growing number of companies are working to incorporate a sustainability focus in their strategies and operations, charting the course and getting there can be two different things. One basic step in this journey is compliance with environmental regulations.

Here we make use of data gathered as part of a larger research project that employed grounded theory methodology to examine the root causes behind an environmental compliance failure in one of North America’s largest oil companies, Suncor Energy. The goal of the project was to establish the root causes of the infractions as well as to assess the actions being undertaken to further embed sustainability into the organization and in particular, to improve their ability to comply with environmental regulations. During the data gathering phase of the project, it became apparent that the organization was making considerable investments in information systems to help manage the cognitive load of ensuring compliance. Yet, while they have turned to information systems to help with compliance, there are underlying reasons why that in itself may represent a challenge. In this paper, we ask: In what ways can information systems support an organization’s strategic transition towards sustainability, starting with regulatory compliance? What are the opportunities and what are the challenges?

BACKGROUND
Sustainability is regularly described in terms of an organization’s need to address economic, social, and environmental concerns (Bansal, 2005; Elkington, 1998; Rondinelli and Berry, 2000; Schmidheiny, 1992), often referred to as the ‘triple bottom line.’ Managers are told that the business should be contributing to healthy economic, social and environmental systems. However, the processes and activities that will enable firms to be sustainable and optimize the triple bottom line are not clearly defined. Because there is no “blueprint for sustainability” (Haugh and Talwar, 2010: 387), integrating sustainability into the ‘DNA’ of a business remains a major challenge. Many companies still struggle to move beyond just
complying with existing regulations, and only a small minority make sustainability an everyday, guiding principle within their organization.

Implementing sustainability often requires reorienting the organization and a shift in managerial mindset (Waddock and McIntosh, 2009). This is a process that requires more than “the dissemination of leaflets and reports and a few training days for selected employees” (Haugh and Talwar, 2010: 386). Instead, the value system of the organization must change (Cramer, 2005), sustainability must be incorporated into the organization’s business (Perez-Aleman and Sandilands, 2008); and a new strategy must be implemented that has sustainability at its core (Hart, 1997; Shrivastava, 1995). The journey involves embedding sustainability into an organization’s culture (Howard-Grenville and Bertels, forthcoming).

One thing that is clear is that delivering on an organization’s sustainability commitments comes with a high cognitive load, so it comes as no surprise that many organizations are turning to information systems (IS) to help manage the task. IS has the potential to support sustainability in many different ways (Melville, 2010; Watson, Boudreau, Chen, and Huber, 2008). On one side there are Green IT initiatives whereby organizations ensure that the information technology itself is constructed, used, and eventually disposed of in the most sustainable way possible (Mann, Grant, and Singh Mann, 2009; Molla, Cooper, and Pittayachawan, 2009). In contrast there are Green IS initiatives, whereby the information systems are used to support organizations in their efforts to ensure all their products and processes are sustainable (Watson, et al., 2008). Such initiatives can address a range of issues, including pollution prevention, product stewardship and clean technology (Hart, 1997). The current paper falls into the Green IS domain, specifically pollution prevention, broadly defined. While some recent research has addressed the specific opportunity to use IS to address various aspects of climate change (Dwyer and Hasan, forthcoming; Hasan, Ghose, and Spedding, 2009) and energy informatics (Watson, Boudreau, and Chen, 2010), those authors also note the paucity in general of IS literature focused on Green IS. Broader issues such as how organizations use IS to embed sustainability into their operations have not been addressed (Melville, 2010). Melville (2010) specifically calls for research on how information systems can be used to affect individual behavior that leads to sustainability. The present paper takes a first step by looking closely at some of the real challenges involved in actually trying to do just that.

**METHODOLOGY**

As noted above, this paper makes use of data gathered as part of a larger research project, led by one of the authors of this paper. The goal of the initial project was to examine the challenges that Suncor was experiencing related to environmental compliance and to understand what actions were being taken to better embed sustainability, and in particular environmental compliance, into the fabric of the organization. The project is unusual because it stems from a court order related to two offences under Alberta’s Environmental Protection and Enhancement Act. The Crown and Defence Counsel made a joint submission to the Court for a creative sentence to fund a research project on regulatory compliance. As the research team selected for this highly sensitive and public research project, we have been given an unusual level of access to the company to discuss their compliance challenges as well as the steps they have been taking to address them. We have also had unique access to key decision makers not usually interviewed in more conventional management research projects: environmental regulators, investigators, prosecutors, corporate legal counsel and even judges, who are the ultimate arbiters on regulatory compliance.

During the initial data gathering phase of the project, we observed that the organization was making considerable investments in information systems to help improve their ability to manage the cognitive load of ensuring compliance. Consequently, a second project has developed to complement the investigation, and the remaining authors of this paper were brought on to conduct additional data gathering and interviews related to the role of information systems. Throughout the project, we have employed an inductive approach, making use of grounded theory methodology (Glaser and Strauss, 1967). Over a two year period from 2009 to 2011, we conducted 49 semi-structured interviews within Suncor Energy with employees ranging from the most senior levels through to operations and 21 interviews with external regulatory stakeholders.

**The Case**

Suncor Energy is one of the largest integrated energy companies in the world and the largest operating in what is considered to be one of the most environmentally contentious industries in existence today: Canada’s oil sands. While headquartered in Calgary, Suncor’s operations are globally distributed, with the bulk of their assets in Alberta’s Athabasca region—the location of the world’s largest oil sands deposit. Even within Alberta, their oil sands operations extend across multiple remote sites that require busing employees for several hours or in some cases, flying them in using private air strips on week on/week off rotations. This is a high growth industry, with intense pressures for expansion and intense competition for qualified talent. Their operations span the full range, from exploration to design and construction of new facilities, R&D for continuous improvement of technology, and operations.
Extensive interviews within the company reveal that going beyond environmental compliance towards sustainability is a core strategic priority for Suncor, given that it operates in such a highly environmentally contentious industry. Suncor started on its journey toward sustainability almost two decades ago, with the creation in 1992 of the company's first Board standing committee devoted to monitoring the company's environment, health, and safety performance along with the introduction of its first "We Care" environment policy that outlined employees' environmental responsibilities (Coglon, 1999). As a result, Suncor built a solid reputation as an industry leader on sustainability. Suncor has been lauded for its corporate sustainability reporting (Herremans and Herschovis, 2006); has been repeatedly listed on the Dow Jones Sustainability World Index; and in 2007 was named one of Fortune Magazine's 10 Green Giants (Murphy, 2007).

Yet, despite this, Suncor has suffered from a series of recent operational challenges, including several issues related to environmental compliance. In 2005, a fire at their upgrader resulted in reduced production for eight months and in 2009, Suncor pleaded guilty to three environmental charges stemming from two separate incidents. In one case, a production cap was imposed on their in-situ operations that resulted in significant lost revenues. In response, Suncor strengthened its project controls, including the impact of project changes, within its management systems to prevent these types of incidents from occurring again. Many of the changes that they implemented involved improving current information systems, or developing new ones to cope with the cognitive load of adhering to their compliance obligations.

Data Analysis

We analyzed the transcripts of these interviews making use of Atlas.ti (2010), a qualitative analysis software package. We began by coding on four main themes: Goals - What were they trying to achieve (including what problems were they facing)?; Means - How were they going about it?; Ends - With what degree of success?; Challenges - What challenges still remain? During the initial coding, we were surprised by the extent to which IS was discussed, especially as means. The question became to what extent are these really solutions? What are the challenges? Why did these IS challenges arise? And where did they arise from? Our coding process has been inductive and emergent (Holton, 2007). At this stage, we continue to delve into the data looking at issues of fit between the solutions that they were employing and their goals. We are still early in the data analysis process and have the opportunity to follow up with key informants. What follows are our initial findings based on our preliminary analysis.

FINDINGS

The perceived importance of information systems for managing regulatory compliance became clear from the earliest interviews and helped to direct our choice of interviewees and the questions asked. Our first observation was the existence of many different systems of various types. One type was a registry designed to catalogue all relevant regulations and commitments, and to help ensure completion of associated tasks (e.g., regular data collection and reporting) through dashboards and email reminders. Such a system was expected to play a prospective, planned role. In contrast, a different type of system was used to capture information about adverse incidents after they happened, a retrospective, ad hoc activity. While there were multiple systems across the organization, they tended to take one of these two forms. With our interviewees we discussed two systems: a newly implemented registry, which was a centerpiece of their compliance activities, and one of the incident reporting systems.

To set up the registry, a task force of Environmental Health and Safety (EH&S) specialists working with subject matter experts (SME’s) from the operating facilities met over many months to try to identify all of the compliance requirements. The requirements took many forms: general federal and provincial regulations regarding water and air quality, emissions, waste disposal, etc., company specific commitments negotiated as part of the construction and operation permit approval process, and less well specified commitments made during environmental public hearings attended by concerned stakeholders. For each requirement, the task force identified constituent tasks, assigned those tasks to specific roles and, where appropriate, scheduled email reminders to ensure the tasks were completed on a timely basis. At the time of the interviews, this process had been completed for only one of a number of operating facilities (specifically, the operation where the recent infractions had occurred), and had not yet been extended to the design and construction phase. While we were unable to determine the actual number of requirements in the registry at that point, we were told it was in the order of 2800.

The incident reporting system for the same operating facility was an SAP module. Whenever incidents occur, operating personnel are responsible for submitting a report. This data is collected and analyzed to ensure that remediation is performed for each incident, and that emerging patterns are identified so that systemic process problems or training issues can be addressed.

Both of these systems had associated challenges. To be effective, a registry needs to be both comprehensive and up-to-date. Unfortunately, while theoretically a database is well-suited for capturing large amounts of data, in practice the ongoing
changes and additions to existing regulations, together with a degree of ambiguity in how they apply to an oil sands operation, created a large data management task. In the words of one EH&S manager:

“when we rolled it out we knew we wouldn’t get it perfect in terms of how we describe some of the conditions, the regulatory conditions within our approvals within the tool but we thought you know let’s do the 80/20 rule.”

In addition, each regulation had to be restructured as a set of tasks that could be assigned to specific roles for execution. As the job of scanning the environment for regulatory changes and defining those regulations for the system was both large and complicated, it was made the responsibility of specialists in the EH&S group, yet these individuals did not always have the operating process expertise required to do the job of defining and assigning tasks well:

“First of all you’d have to understand what you’re reading and you’d have to understand the operation and the equipment and so on. And we’re not process engineers or mechanical engineers so there’s limitations to what our abilities are.”

On the other hand, individuals in the operating units with process expertise did not have the appropriate systems knowledge to take over this responsibility. In the long run, IT personnel became quite overloaded. Even when the task was understood, knowing who to assign it to was difficult:

“you know it has to have an owner, it has to have a date and all these kind of things. And how do you do that when things are so dynamic and they go between us and various contractors and all that.”

Furthermore, with continuous operation at remote sites handled by crews who flew in for seven long days and then had seven days off, roles were filled by a rotating roster of individuals.

Additional issues arose because the technology being used was completely new and still evolving. Regulations that were developed for different types of operations do not always translate well into a new environment:

“Some of the regulations get a little confusing in that --particularly the ERCB directives and so on-- don’t have anything really specific to [our operations] right, so there’s regulations that apply to us and they don’t apply particularly well. And so interpretation gets confusing and complicated. And so that adds another complexity to it, it’s just understanding what and how those ERCB directives do apply.”

While keeping up-to-date with evolving regulations is a challenge, at least regulations are published by the various regulatory agencies. In contrast, there are a variety of commitments made to stakeholders during public hearings that are ill-defined and only informally recorded, yet the organization must comply with them as well. With all these data management challenges, the registry can only ever be a partial solution for ensuring compliance.

There were a different set of challenges associated with the incident reporting system. In that case, the people charged with making those reports were very infrequent users of the system, and due to that unfamiliarity they found it hard to use, particularly as the system was not user friendly. Furthermore, front-line operators in the field did not always have access to a computer. As a result, two specialists were given the role of being a human interface to the system. In addition to resolving the data entry challenges, they acted as “gatekeepers … [to] control the quality of the information going into the system.”

DISCUSSION

As we examined our preliminary findings regarding challenges in using systems to support environmental compliance, we started to view the issue as one of poor fit between the systems and the compliance tasks. Recent work on the topic of fit (Strong and Volkoff, 2010) distinguishes between two types of fit (coverage and enablement) and two types of misfit (deficiencies and impositions). Furthermore, fit applies to six different domains (functionality, data, usability, role, control, and organizational culture.) In this case, the incident reporting system clearly has some usability misfits. These issues might be solved through implementing a different system, a solution Suncor was considering. From a task perspective, the system actually met most of the data and functionality requirements quite well. That is, it was set up to record all the necessary data surrounding an incident, and enabled specialists to analyze that data. The more difficult challenges arose from external factors, such as infrequent use or lack of access to computers, leading to role problems (specialists spending a lot of time doing data entry instead of incident resolution or analysis.) Similarly, the registry provided good coverage fit, and was in addition easy to use. Specifically, presuming it was available, all the necessary data about compliance requirements could be entered, together with appropriate tasks and assignments, and most people liked the system. The main challenge with the registry was that it imposed a requirement of explicit, unambiguous data, preferably as stable as possible, and clear role assignments in an environment where data was frequently ambiguous and could change or be added to at any time. One way
to view such impositions of the system on the organization is to reframe the problem as the organization not meeting the requirements of the system. This is the reverse of the way we usually think about fit, but from this perspective we can begin to understand which aspects of environmental compliance are not well supported by systems and will require a different approach.

To see what such an approach could reveal, we start by considering the impact of one of the core requirements of systems like the registry, namely to have clearly defined, relatively stable data. When we consider the sorts of environmental requirements that need to be catalogued in a registry, we can see many different types and sources of potential ambiguity. At the most basic level, there are times when what is expected has never been clearly defined. This can often be the case when those requirements arise from a public hearing, where at times minutes are not even kept, but any undertakings expressed at the meeting are considered obligations for the firm. At other times, requirements may be clearly understood in principle, but how they apply in an environment that is different from the one for which they were conceived is not clear. One example related to the regulations around flaring (a process of burning off excess hydrocarbons during emergency shut-downs), which were brought over from conventional oil and gas to the in-situ oil sands setting. While the regulations made sense in the original environment, in the in-situ oil sands setting, a strict interpretation of the regulation could end up in a net production of emissions instead of preventing them, as intended. Under the circumstances, how such regulations should be interpreted was not at all clear. A third type of problem might arise in the way a regulation is stated in the first place. For example, while some regulations stipulate unambiguous task requirements, such as 'water turbidity must be measured weekly', others are framed as prohibitions, such as 'you must ensure that there is no damage to wildlife'. In the latter case there is considerable ambiguity around how tasks can be designed to ensure compliance. A fourth type of ambiguity surrounds who will be made responsible for tasks, such as when those tasks are shared by employees or between employees and contractors. This level of ambiguity associated with various dimensions of the data is in contrast to what one might expect with respect to data in a standard manufacturing environment or accounting department, where transactional data is generally straightforward and explicit. That said, there is also reference in the enterprise systems literature to systems imposing a reduction in flexibility because of the need for explicit specification that cannot always accommodate every circumstance (Strong and Volkoff, 2010). In general we need to look at environmental compliance requirements and assess the different ways in which they are a poor fit with the requirements of a system. With the examples above we have begun the task of identifying sources and types of ambiguity, and will extend this analysis as the research continues.

While ambiguity in environmental compliance data is likely to affect many organizations, other challenges that we observed may well be particular to Suncor. For example, one of the challenges was finding the individuals with both strong operating process knowledge and deep environmental compliance knowledge to perform the translation of each compliance requirement into a set of clear tasks appropriately assigned. Suncor’s structure includes a centralized EH&S group that took responsibility for initial set-up of the registry. These individuals acknowledged that in future this task should be conducted by someone embedded in the operations with direct knowledge of the technology and processes involved, but who at the same time appreciates compliance issues. That said, a further complication arises from the separation between design, construction and operation of any facility, handled by different organizational units. Thus an embedded compliance officer would need to follow a project as it crossed from one organizational silo to the next. An example of why this would be needed is that permit approvals that are negotiated during the design of a new facility generate requirements that apply for the facility’s lifetime, but once built the knowledge of those original negotiations is not passed on.

In general this suggests that a system by itself is not enough to manage environmental compliance. In the long run, compliance must be integrated or embedded in operational processes. As long as compliance management takes the form of a system simply bolted onto an operation, it will fall short of what is needed. As discussed by Melville (2010), the beliefs of individuals play an important role in their actions; this implies that a culture of sustainability must be embedded in the organization. A recent review of the literature on embedding sustainability into organizational culture (Bertels, Papania, and Papania, 2010) reveals that a portfolio of practices is required. What we saw in the case of Suncor was that systems could be used to support the embedding of sustainability into organizational culture by providing necessary information to those who need it. At the same time, systems can undermine such efforts by intermediating between individuals and relevant compliance activities. Further examination of this issue is required to understand the best way to employ systems to support environmental compliance.

CONCLUSION

Our preliminary analysis of this rich data set reveals that while information systems have a lot to offer organizations in their goal of achieving sustainability, there are certainly limits to the degree of support they can provide. Our study has demonstrated that data ambiguity represents a key issue in the context of sustainability, and we have begun the process of
understanding the sources and types of ambiguity. Our study also points to the need to tease out the relationship between systems and people, and to further explore how to embed a culture of sustainability in the organization so that those gaps not covered by a system get picked up by people.

REFERENCES


