4-16-2011

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芽|Sprouts Working Papers on Information Systems ISSN 1535-6078

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Abstract
Business continuity and the reliance on energy-enabled resources for critical processes is an area of scant research. Using an environmental waste lens, we posit that business process modeling (BPM) during the software engineering process presents a dual opportunity: by contributing to sustainability; and to increase organizational readiness during times of crisis. Modeling provides a vehicle for the assessment of business (organizational) processes and practices. The assessment of information communication technology (ICT) usage behavior is another use when modeling information systems that tackle environmental sustainability. For example, the ongoing deployment of social media and mobile technologies are impacting day-to-day interactions but aren't assessed for impact or value-added (i.e. increased personal interactions, redundancy, immediacy), they are simply incorporated into everyday use. This research uses BPM as a vehicle to assessment ICT usage behavior within the alignment of sustainable business practices and business continuity. Recognizing environmental impacts through day-to-day business practices can empower users and increase their readiness to respond when called upon in times of crisis. Resilience and the continuity of business are factors that rely on sustainable ICT infrastructures. Overall, the alignment of sustainability and business continuity (crisis management) could benefit greatly from implementations that reduce energy use and mirror the conditions often present during a disaster.

Keywords: Business continuity, green IT, ICT usage behavior, sensor networks, sustainability, crisis management, organizational readiness

Permanent URL: http://sprouts.aisnet.org/11-13

Reference: Avery Gomez, E. (2011). "Towards Sensor Networks: Improved ICT Usage Behavior for Business Continuity," Proceedings > Proceedings of SIGGreen Workshop . *Sprouts: Working Papers on Information Systems*, 11(13). http://sprouts.aisnet.org/11-13

TOWARDS SENSOR NETWORKS: IMPROVED ICT USAGE BEHAVIOR FOR BUSINESS CONTINUITY

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Introduction

Constrained resources albeit for personal or professional use are not as routine in the United States when compared with other parts of the world. As such, the availability of energy-enabled resources (services), such as information communication technology (ICT) devices and web enabled systems are taken for granted unless a crisis takes place. The interdependencies between two or more applications magnify this problem. Critical systems typically place emphasis on safety, security, availability and dependability and are categorized as: safety-critical systems, mission-critical systems or business-critical systems (Somerville, 2007). We focus on business-critical systems "whose failure may result in very high costs for the business using the system." Two impacts of business-critical systems when resources are constrained include: the readiness of critical personnel and the ability to deploy alternate energy options. The term that best suites the balance between energy-enabled resources and critical systems is survivability—the ability of a system to continue to deliver service whilst it is under attack or partially disabled (constrained resources)—such as reduced bandwidth. (Somerville, 2007; Ellison, 1999). We posit that business process modeling (BPM) should include an alternate path that identifies how critical systems can become operational with constrained and/or require the use of alternate energy resources. A BPM process that details an alternate path should also become a deliverable of the software engineering development lifecycle. Watson et al. (2010) note the importance of organizations to "change, and reinvent business processes to better support sustainable practices". We extend this important point to include resilience and the ability to adapt a business process in situ when resources are constrained. The ability to "scale back" resources and decrease the use of energy-enabled resources becomes another organizational contribution for sustainable business practices. For example, accessibility to business systems can lag behind lean mobile cell services in disaster areas. Mobile cell towers often reach disaster areas with lean service capabilities and until resources are restored.

ICT usage behavior (knowledge, preparedness and practice) even for simple business communication can be challenging. Using a simple social media application, such as Facebook, that one might leave open in a browser on a computer can suddenly become a barrier from a mobile device. While the application itself can operate from a computer browser and also a mobile device (API via SMS), the user may be denied access because the mobile instance had not been authorized in advance. Mobile phones to disseminate news, medical information, education, and emergency services to vast numbers of underserved people in poor, rural areas are rapidly increasing (Gomez, 2008; Benjamin, 2006) but the routine usage behaviors, especially when aligned with business applications remain an area of need. In 2010 alone, mobile phone usage (namely APIs via SMS) for international crisis response (Haiti, Chile, and Pakistan) provides a testament to both the limited ICT usage behavior when confronted with disaster and in turn how collaboration can take place when resources are constrained.

This research focuses on ICT usage behavior, awareness of energy resources and alternatives for business continuity in distributed work environments with interdependencies to critical systems. A major challenge of current BPM solutions is to be able to continuously adapt business processes over time in response to the business environment and to keep them robust and operational for critical business processes. We highlight the importance of "sustainability" as a deliverable using BPM to demonstrate this need. We use an environmental waste lens from an organizational (private sector, grassroots, etc.) perspective where individuals (citizens) are "employees" and may also be in "critical roles" for the continuity of business. We posit that business process modeling to acquire functional requirements and viewed through an environmental waste lens will highlight options within systems where business processes can be adapted for the continuous technology changes (mobile, GPS, sensor networks).

Following the introduction, this paper begins with a brief review of the literature focusing on ICT usage behavior with constrained resources affecting the continuity of business. A short review of Green IS and business continuity follows before introducing the importance of an alternate path using BPM (behavior). Large scale crisis (disasters) from 2010 are used as examples to support awareness and the need for organizational/individual readiness and also present ways to use BPM for business process improvements as next steps of this research in progress.

Literature Review

ICT Usage Behavior and Constrained Resources

Improving access to valuable electronic information on the Internet relies on training and opportunities for practice (ICT usage behavior). Dov Te'eni's (2001) studies relating to message form and the adaptiveness of a message suggesting effective communication can be achieved contribute to ICT usage behavior. Adaptiveness, offers limited research and is defined as "the potential to adapt (personalize) a message to a particular receiver (Te'eni, 2001; Daft and Lengel, 1984)." Te'eni (2001) mentions that adaptation to both the circumstances and the devices are factors that constrain message form (ICT usage behavior). Te'eni's model aims to explain how people choose the message form and medium according to goals, which for our purposes are both organizational goals and ICT usage behavior. For example in crisis management, the adaptiveness of the message itself is dictated by the medium available and device capabilities (mobile) that are operational.

Short message service (SMS) text-messaging is one ICT usage behavior that remains at the forefront as a sustainable architecture when resources are constrained. The 160 character architecture, recognized as an SOS equivalent, is resilient and interoperable (Gomez, 2008; McAdams, 2006). The benefits of SMS are two-fold: interoperable text-messaging and the SMS architecture as delivery service. The store and forward (queued) delivery service also ensures immediacy as the small packet architecture bypasses alternate services (MMS, voice, video, data over 160 characters). Moreover the drain on battery power of the device user is minimal. At present several alternate energy options (solar chargers, car inverters, and battery generators) allow for rapid battery charging. To conceive of a large collaborative effort mediated by SMS text messaging is unthinkable yet was the case for several weeks during the Haiti 2010 Earthquake. In the case of the Haiti 2010 Earthquake, both landlines and electricity failed. Few relief organizations had high-speed satellite capabilities at the onset of the crisis and in many cases; it was the community citizens (Haitians) who were feeding the SMS text requests for aid via their own cell phones. The incoming texts from users in the disaster location were acquired via a 4636 short-code exchange (Connell, 2010). The backend processes that resulted from the text messages were handled around the globe in real-time where fully functioning resources were in place. Overtime, the actions taken and use of other systems resulted in early sensor network applications such as GPS.

With the rise in mobile device users globally in addition to their resilient nature (SMS) along with low energy usage (portable connections), we highlight the importance of ICT usage behavior. Moreover the SMS architecture is being utilized as a gateway to/from sensor networks. During a crisis, at best low-tech resources (SMS) may be the only source of connectivity placing emphasis on ICT usage behavior. Research from the author of this paper highlight's a web-based application developed to assess ICT usage behavior. Finding from the study, which collected 300 short messages (150 pre-training messages and 150 post-training messages) support the need for improved ICT usage behavior (Gomez, 2008). Alike, the Haiti's earthquake in January 2010, with 4636 short code ,further demonstrate the importance of ICT usage behavior and also how resilient mobile technologies are (alternate energy for charging).

Green IS and Business Continuity – Preliminary Analysis and Discussion

Reinventing existing business processes and also the development of new processes both afford opportunities to tackle Green IS initiatives and business continuity together. Green IS can be viewed "as an integrated and cooperating set of people, processes, software, and information technologies to support individual, organizational, or societal goals (Watson et al. 2010)." In turn business continuity involves critical systems and people that support organizational goals returns us to "survivability" and "availability" where survivability ensures the survival of an organization and availability ensures critical organizational functions will continue without stoppage, irrespective of the adverse circumstances or events (Haddow, 2008; FEMA, 2010). Since business continuity planning is not a function that takes place during a crisis, we posit that during system engineering, sustainability requirements and

business continuity requirements are paired for further analysis as an alternate path of the BPM. Successful continuity plans include routine activities within critical business processes. Determining which routine activities can be a win-win with effective energy use for sustainability introduces the discussion that follows.

Modeling for Alternate Energy Resources – Preliminary Analysis and Discussion

We begin our analysis on ICT usage behavior using the Unified Modeling Language (UML) (Fowler, 1997). UML is a standard notation (Larman, 1998) that can be used for business process modeling (BPM). BPM provides a means for describing value-added behavioral activities associated with a set of services to outside actors (i.e. citizens or organizational practitioners) while protecting the interests of the other stakeholders or internal practitioners (Cockburn, 2001). Essentially, BPM is used to document the current state of a process and the intended future state of a process, focusing on the how the process is being performed (Cockburn, 2001). The current state of many business critical systems, especially legacy wrapped systems cannot accommodate mobile device access (constrained screen size, device capabilities). A future state of such systems might include a sensor that intercepts information and then releases essential packets of information through lean technologies to mobile devices. In most cases, the future state would access an application through full-service technologies yet can enable the alternate path for continuance of service when resources are constrained. It is also possible for an individual in a critical role to have only remote access on a mobile device. The alternate path could be deployed for these instances.

Recognizing Unified Modeling Language (UML) enables communication with domain experts and is beneficial by displaying a snapshot of one aspect of your business or system (Fowler, 1997), we highlight that sustainability and business continuity are an alternate path within more than one domain and may also have many interdependencies. The research at hand looks at the critical processes for business continuity that could align with crisis response when energy resources are constrained. Our concept model (Figure 1) uses interoperability when resources are constrained as the domain, which is "an alternate frame for the problem (Melville, 2010)." Melville also notes that the sustainability context extends the social, organizations and individual domains and is complex and also multilayered. The concepts identified serve as a guide and enabler to enhance communication with the users and to promote a deeper understanding of ICT usage behavior when resources are constrained. It should be noted that many concepts would not be exercised for day-to-day use.

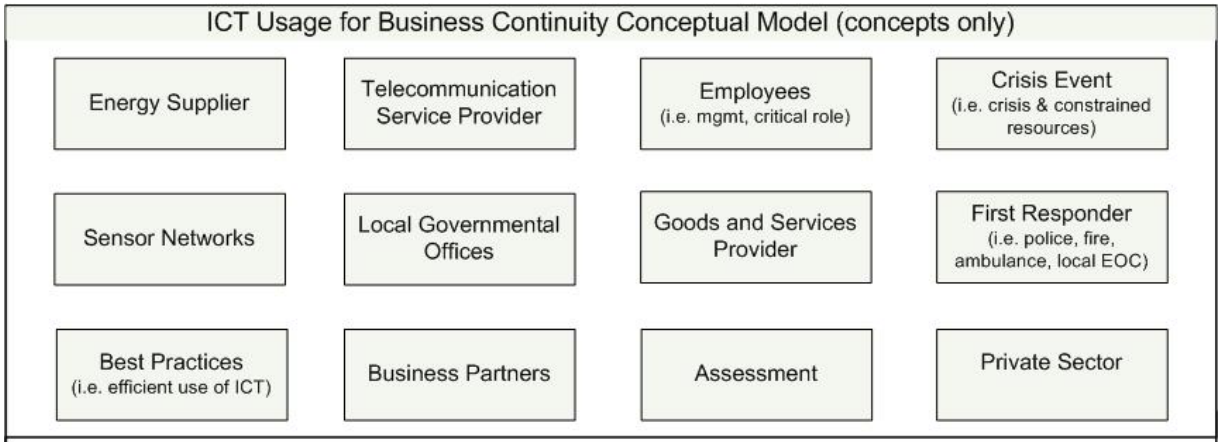

Figure 1. Concept Model for ICT Usage and Business Continuity (Larman, 1998, Fowler, 1997)

The employee (user) in a critical role is the primary actor and supports the initiatives (business processes) set forth by the organization with which they are aligned. An organizational perspective places energy suppliers, telecommunication service providers, goods and services providers, business partners, first responders, sensor networks and governmental agencies, as supporting actors to the employee (primary actor). An actor as defined by Fowler (1997) is a role the user plays with respect to the system; the user being a human or system. For purposes of our research, the system is the ICT infrastructure for critical business processes. Telecommunication services (i.e. telecomm service, wireless, satellite) and sensor networks are considered supporting actors who play a role in business practices to enhance and strengthen our targeted goal to reduce energy waste within their organization both with effective business practices and improved ICT usage behavior of employees.

Improving ICT Usage and Response Readiness for Business Continuity

Continuing with an environmental waste lens (global perspective) we take a bird's eye view of an organization whose aim is to improve ICT usage and employee response readiness. Recognizing an iterative process will be needed to develop sustainable business practices that ensure the continuity of business, we posit that critical processes should be identified first and thereafter focus on ICT usage behavior for employee readiness. The conceptual model (Figure 2) is presented to complement initiatives both within the United States and globally; empowering employees to do their part both within an organization and then to apply those same concepts in their personal lives. There are two fundamental differences between the global conceptual model and the organizational model: the characteristics that represent each aspect of environmental waste; and the specific focus on ICT usage both in reducing the use (waste) of resources and increasing readiness to respond when resources are constrained in a crisis. Timely and accurate information is needed when communicating in a crisis (Rice and Katz, 2001), especially when resources are constrained (connectivity).

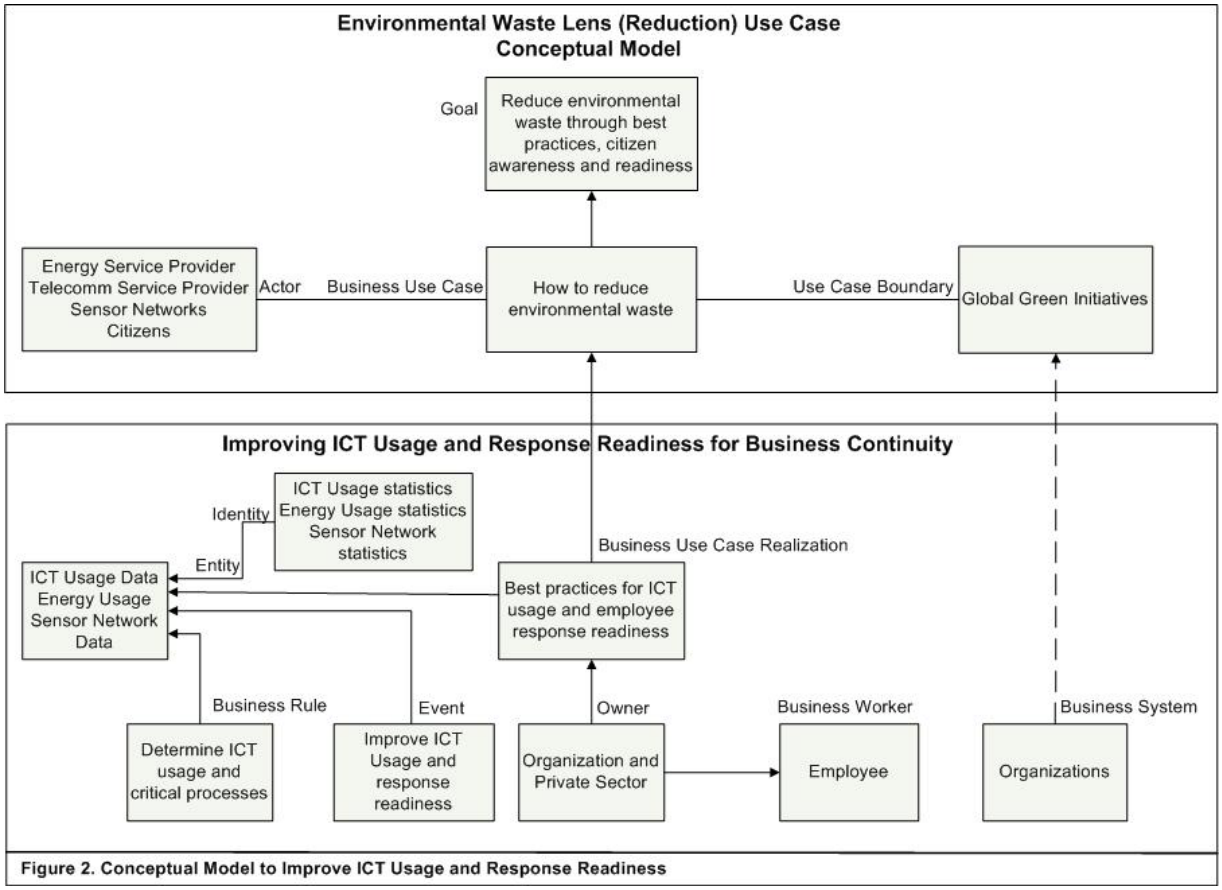

Figure 2. Conceptual Model to Improve ICT Usage and Response Readiness

Organizational Alignment – Business Continuity and Sustainability

The primary objectives with respect to ICT usage behavior and response readiness for the alignment of business continuity and sustainability from the business process model (BPM) objectives are identified below (Table 1). For instance, an organization might monitor sensor network statistics during the summer months and coverage of individuals supporting systems during peak vacation periods. Considering an employee in a critical role may be accessible with a mobile device, the employee may not be trained well enough to respond or may not have the correct device to provide support.

Table 1. Business Continuity to Sustainability Alignment – An Example	
Primary Objectives of Business Continuity	**BPM Summary and Organizational Goals**
Assessment	Sustainable Protocols
• Monitor usage statistics, energy and sensor network statistics	• Assess critical system usage/capabilities
• Diagnose and investigate problems and large resource loads	• Obtain sensor data (alerts, warnings)
Policy Development	Sustainable Usage
• Inform, educate, and empower people with alternate energy options	• Educate Employees
• Develop policies for compliance of critical business processes	• Educate Management
• Develop policies and plans that initiate alternate plans in crisis that constrain resources	• Promote Awareness

Conclusion

This paper presents a vehicle for discussion and feedback on the alignment of business continuity and sustainable business processes as they relate to ICT usage behavior and response readiness. While our focus initiates from crisis management where resources are constrained for short time and until normalcy is reached, we posit that these efforts complement sustainable business practices and can also contribute to global initiatives that tackle environmental waste. One specific item of focus is to have business process models reflect the tradeoff between initial cost savings and the long-term environmental impacts realized by engaging in sustainable best practices. Indirectly, efficient business practices should empower staff and increase their readiness for sensor network options as they become available. Our research presents a need for business process models (BPM) that carefully address the alternate path of critical systems and interdependencies between systems and people. We believe effective ICT usage behavior and awareness of alternate energy options and services will contribute to both sustainable systems for day-to-day use and business continuity plans.

Future research suggests updates to the models presented and the development of initial use case diagrams that highlight ICT usage behavior and instances where alternate energy options are deployed and also where sensor networks are introduced. This research in progress is a first step forward in aligning sustainable processes and business continuity as they relate to ICT usage behavior when alternate energy options are initiated.

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Working Papers on Information Systems | ISSN 1535-6078

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