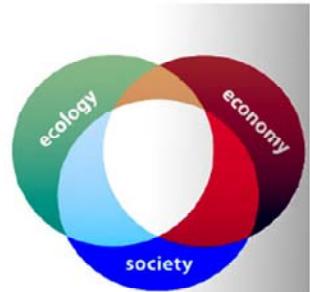


Environmental Sustainability and Cloud Computing



Thomas L. Rosenberg, MSc., MBA
Saratoga, CA 19 Feb 2010

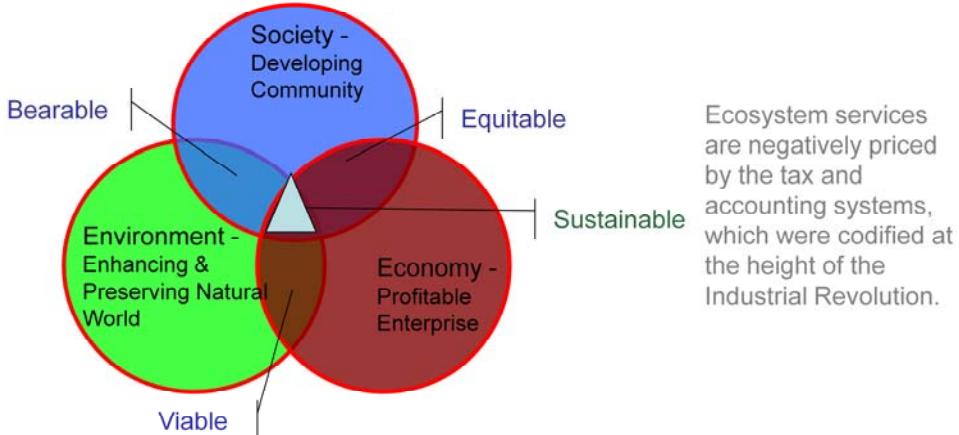
Agenda

- What is environmental sustainability?
- The business case for environmental sustainability
- Sustainability and IT
- Sustainability and Cloud Computing

Definition of Sustainability

What is Environmental Sustainability?

At their root, climate change and sustainability are issues about payment for ecosystem services.



Ecosystem services are negatively priced by the tax and accounting systems, which were codified at the height of the Industrial Revolution.

Systems thinking can resolve many of the perceived contradictions in sustainability by addressing the underlying behavioral patterns and structures that cause non-sustainable activities.

- *Ecosystem services are the services or functions that create hospitable conditions for life on this planet (e.g.: clean air, clean water, food, fiber, fuel, biodiversity, waste dilution and decomposition, and aesthetics).*

From an historical perspective - sustainability is not a whole new paradigm. Rather it is the next evolutionary step in the social contract that has been built up with case law and social norms since the 1850's.

Bearable - the amount of pollution that people are willing to tolerate in their immediate surroundings

Viable - the amount of command and control compliance burden the business community is willing to withstand

Equitable - social contract and fringe benefits - 40 hour work weeks, days off, pension, health care, etc

Addressing each one of these points individually, creates inefficiencies and additional burdens. Only by moving into the center - Sustainability - can synergistic efficiencies be leveraged, reducing costs, reducing risks, driving innovation, growing stakeholder value

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The Business Case

The Business Case for Sustainability



- Eco-efficiencies
 - Cut costs
 - Less energy, less water, less raw materials and other inputs
 - Less waste, lower compliance costs and risks
- Risk Management
 - Climate risk (suppliers, operations, markets = fiduciary responsibility e.g. new SEC regulation, EPA reporting, etc.)
 - Compliance risk
- Drive innovation
 - New products/technologies, new markets,
 - Competitive advantage - “future proofing” the business
- Grow Shareholder Value

IT interfaces with each one of these aspects

IT can be

a cost center and a brown drag on the organizational ship OR

A green strategic asset that creates profits by offering a transparent measurement system to manage eco-footprint, reduce costs, reduce risks, drive innovation and grow shareholder growth

Food for thought...

ICT energy consumption is expected to double by 2020. However, if utilized properly, ICT could save 5X that amount in energy consumption and avoided emissions.

(Gartner Research and Climate Group research)

Will ICT (Information and Communications Technology) be a brown drag/cost center on the corporate ship or will it be a strategic green asset that drives efficiencies, innovation and profits?

Flight time: Making small changes in the right places can have huge impacts on sustainability and climate change

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Where does IT fit with Sustainability?

The best sustainability programs are characterized by stakeholder engagement, transparency & expanding (human) networks. IT can play a pivotal role in the optimization of these programs

- 2%: 98%, 15%
- Strategically, IT is in a unique position to work across all stakeholder groups within organizations
 - to provide a platform to accurately measure and manage eco-footprint
 - to facilitate (human) networking and collaboration through transparency and inter-operability both internally and externally to the organization
 - to help the organization effectively and efficiently respond to market and regulatory drivers



Currently ICT is responsible for 2% of global GHG emissions (~NL or ARG).

Expected to double by 2020.

Has potential to reduce overall global emissions by 15% if fully leveraged (McKinsey Report on energy efficiency)

How IT can help with Regulatory Drivers

IT can provide a vital window into the state of the enterprise through data collection, management and presentation

- SEC interpretative guidance issued 27 Jan 2010
 - All public companies must disclose to investors any climate risk (or “material effects”) on business operations

“Efforts to reduce climate change can profoundly affect the valuations of many companies, but executives so far seem largely unaware...”

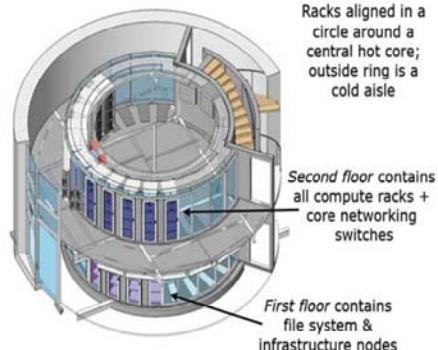
- “How Climate Change could affect corporate valuations,” McKinsey, October 2008

- US EPA December 2009 ruling that CO₂ emissions qualify under the Clean Air Act as “endangerment” to public health and welfare and requires large emitters to report their GHG emissions

How IT can Build Competitive Advantage

By helping the organization reconsider its approach to...

- Eco-footprint management system (or organizational metabolism)
- Procurement
- Operations
- Logistics
- Data centers
- Design
- Infrastructure platform for innovation
- Addressing E-waste: IT is made of mostly non-renewable materials



CLUMEQ, Quebec. DataCenterKnowledge

Eco-footprint management system (or organizational metabolism)

Must be visible at all levels of the organization to relevant roles

measuring, monitoring and verification, eco-efficiencies (energy, water, raw materials, cradle to cradle design, e-waste, etc), data center design, power requirements,etc), mfg and bus process efficiency, innovation platform, logistics, etc.)

UPS - 1 mile not driven = 15000 tons CO₂e avoided emissions. Use software to optimize routes and track miles driven (3B annually). Metrics are the Holy Grail

Reducing flight time by 1 minute on each end – air time or taxiing, taxiing on 1 engine, tightening airspace through GPS technology, etc., can save millions of dollars per year for airlines, greatly reducing airport congestion, fuel costs and unnecessary GHG emissions.

IBM - the environmental costs and financial costs are closely linked. Hence in the self-interest of the corporation to get involved

- Using dynamic pumping, the public water sector could save 10% of the 3-4% of Total US energy they currently consume

- Green Sigma initiative: Lean, Clean, Green

1E - over 10 years has created software to measure wasted energy in PCs - PC's left on at night ~\$2.8B, un(der) used servers turned off could save ~\$4B. Decommissioning those unused servers ~\$25B (\$4K/server/year in software, hardware and operational costs)

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Today

- SaaS for carbon accounting/ environmental management systems is a rapidly growing niche.
- IaaS - can address some sustainability points from energy efficiency, TCO and innovation perspectives.
- PaaS - From a Sustainability perspective, PaaS could be used in facilitating collaboration and transparency, data management and presentation.



SaaS for carbon accounting/ environmental management systems is a rapidly growing niche.

Nearly 60 players in this space including: Hara, SAP/Clear Standards, PlanetMetrics, Climate Earth, CSRware.

IaaS - can address some sustainability points from energy efficiency, TCO and innovation perspectives.

Players in space include: Digital Realty, Sun modular container data centers, IBM, Google

PaaS - From a Sustainability perspective, PaaS could be used in facilitating collaboration and transparency, data management and presentation.

Food for thought...

"If designers, architects, engineers, general contractors, energy auditors, land use planners and policy makers are able to access services that use vast sets of dynamic, complex and otherwise un-integrated data on the cloud for pennies a minute, think of the massive impact this could have on buildings, infrastructure, land use and urban design and policy-making."

- Emma Stewart & John Kennedy, Autodesk, Inc.

Tomorrow

A cloud-based platform can enable designers to make smarter decisions based upon higher quality and richer data. It can also accelerate the workflow process, meaning that smarter designs come to market faster

3 major benefits to offering a cloud-based service:

1. Real-time analyses and virtual collaboration by a wide range of professionals and their contractors and clients, streamlining work processes and the identification of opportunities earlier in the work flow
2. Complex and dynamic sets of data can be incorporated into the design
3. Speculative and predictive computing allows the user to ask the computer for the opportunities to save energy, water, and carbon emissions for a given set of parameters. The power of the cloud allows for thousands of iterations per second

Emma Stewart and John Kennedy, Autodesk Inc

<http://www.environmentalleader.com/2009/07/20/the-sustainability-potential-of-cloud-computing-smarter-design/>

Real-time analyses and virtual collaboration by a wide range of professionals and their contractors and clients (architects, building designers, energy auditors, etc) can be performed over the Internet, streamlining work processes and the identification of opportunities earlier in the work flow.

2. Complex and dynamic sets of data can be incorporated into the design. (e.g. Building designers use Typical Meteorological Year (TMY2) weather data from airport weather stations). With location-specific data increasingly important, a cloud-based program can provide millions of data points from virtual weather stations within five miles of the site in question.
3. Speculative computing allows the user to ask the computer for the opportunities to save energy, water, and carbon emissions for a given set of parameters. The power of the cloud allows for thousands of iterations per second.

Thank You!

Questions?

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Environmental Sustainability

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More information on IT & Sustainability

- IT can be used effectively in measuring, monitoring and verification of an organization's ecological footprint.
- These measurements can help to optimize the organization's eco-efficiencies (energy, water, raw materials, (zero) waste, logistics, data center design, power requirements, etc for manufacturing and business process efficiency, and serve as an innovation platform.
- IT can also facilitate cradle to cradle design, and find new ways to reduce and eventually eliminate e-waste.

More on IT & Sustainability P. 2

- UPS - 1 mile not driven = 15,000 tons CO₂e avoided emissions. Use software to optimize routes and track miles driven (3B annually). Metrics are the Holy Grail
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- In 2006, the DOE estimates that U.S. data centers used 61 billion kWh of electricity, representing 1.5 percent of all U.S. electricity use, or the amount used by about 6 million US houses.

Appendix 2

Cloud Computing & Sustainability

| Business Need | Sustainable Design technique | Key Functionality Enabled by Cloud Computing |
|--|---|--|
| Increasing aggressive regulatory mechanisms and market demand for green buildings (certified LEED, net-zero, carbon neutral, etc.) | <p>Study various design options using whole building energy and water simulations to minimize total energy and water use by making incremental changes and resimulating.</p> <p>Review published research to determine potential for renewable energy in the region of the project to determine if it is sufficient for total energy use calculated above.</p> <p>Calculate carbon emissions of onsite fuel use and estimate carbon emissions from electric use from electric grid power plant data if available. Determine if emissions are "zeroed" relative to baseline building type.</p> | <p>Simultaneous simulations and analyses that calculate all of the items to the left and more using up to date data and local weather data.</p> <p>Optimize package of energy and water efficiency measures that minimize costs and carbon emissions ie. rather than getting to a result this gets you to the solution very rapidly.</p> |
| Designing low energy buildings requires architects and building engineers to increasingly pay attention to the local and changing climatic conditions. Using coarse and older data does not capture changing conditions nor the local conditions and puts designers at risk. | Struggle to find relevant weather data that is local to the project and captures climate changes. | Access hourly weather and wind data that is recent and within 7 km of actual site |

*Emma Stewart & John Kennedy, Autodesk, Inc.
<http://www.environmentalleader.com/2009/07/20/the-sustainability-potential-of-cloud-computing-smarter-design/>*

Cloud Computing & Sustainability P. 2

Cloud computing could be the tool that unlocks one of the main drivers of unsustainable practices: poorly informed decision-making

- At the macro-economic level, cloud computing helps achieve economies of scale by centralizing compute power and democratizing access.
- At the CIO level, cloud computing helps shift the mindset to commoditize computing power, not servers, and therefore drive efficiencies via virtualization and greater utilization rates which allows systems to scale up or down due to load fluctuations.
- At the data center level, cloud computing's drive towards consolidation paves the way for new standards for energy efficiency.
- At the R&D level, cloud computing creates incentives for software engineers to code more efficient applications, as often their company will become the host for said applications.

- Emma Stewart & John Kennedy, Autodesk, Inc.

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Speculative and predictive computing are potentially even more powerful tools in the cloud-based designer's toolbox.

Speculative and predictive computing allow the user to ask “what if” or “which one” about considerations that will directly determine the life-time environmental footprint of their design.