# Green IS: Building Sustainable Business Practices

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## Learning objectives

- Understand the need for sustainability
- Know the difference between green Information Systems (IS) and green Information Technology (IT)
- Use the u-factors to analyze how IS can support a green physical system
- Apply a framework to identify opportunities for green IS and green IT
- Understand the need to align corporate and IS green strategies
- Understand three different approaches to ecological thinking

## Sustainability

A global UN survey to determine the issues dominating the future identified sustainable economic development as the preeminent issue. The report notes, 'Never before has world opinion been so united on a single goal as it is on achieving sustainable development'. The current trend in our consumption of the earth's resources is unsustainable and is creating major environment problems. Climate change, resource depletion, loss of biodiversity, and air pollution have a major impact on many citizens and the earth, and we need to change our current behavior. Our present use of the earth's finite resources cannot be maintained. We need to move to sustainable development, which 'meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland, 1987, p. 8).

The environmental burden is a function of population, wealth, and technology and controlling the first two factors is extremely challenging. The larger the population, the more impact it has upon the earth. In addition, the vast majority of people aspire to affluent lifestyles, and wealthier people consume far more resources than less affluent people. Technology is both a cause of the environmental burden and also a potential solution.

Technology such as coal-fired power stations provides the electricity we need to support an affluent lifestyle, but at the same time it creates carbon emissions that contribute to global warming. Alternatively, renewable energy technologies based on wind and solar, for example, are possible solutions for sustainability, though each has negative consequences as well (e.g., the energy and materials required to construct wind turbines or solar panels).

In the IT space, the disposal of equipment is a major environmental problem because of the toxic products in computers and displays. However, IS has been the major contributor to productivity growth in many countries over the last half century. We will need IT to run the information systems that will support sustainable business practices.

Technology is an important means by which we can address our global problem. Leveraging technologies to produce goods and services that are environmentally friendlier is a momentous endeavor, and may in fact constitute 'one of the biggest opportunities in the history of commerce' (Hart, 1997).

Many business leaders are linking sustainability to their corporate strategy. They recognize that they have key responsibility to participate in solving this critical global problem and that their customers expect them to provide green products and services. Sustainability requires sustainable business practices because of the dominant role of corporations in the global economy, and IS will be a major element in the transition to a sustainable economy (Esty & Winston, 2006)

## The need for green IS and green IT

The IT industry, often at the forefront of managerial practice, is an active player in supporting sustainable economic development. CIOs have identified Green IT as one of the most important strategic technologies for 2008. We carefully distinguish between green IS and green IT. There is a key difference.

- An information technology (IT) transmits, processes, or stores information.
- An information system (IS) is an integrated and cooperating set of software using information technologies to support individual, group, organizational, or societal goals.

Green IT is mainly focused on energy efficiency and equipment utilization. It addresses issues such as

- Designing energy efficient chips and disk drives
- Replacing personal computers with energy efficient thin clients
- Use of virtualization software to run multiple operating systems on one server
- Reducing the energy consumption of data centers
- Using renewable energy sources to power data centers
- Reducing electronic waste from obsolete computing equipment
- Promoting telecommuting and remote computer administration to reduce transportation emissions

Green IS, in contrast, refers to *the design and implementation of information systems that contribute to sustainable business processes*. Green IS, for example, helps an organization to

- Reduce transportation costs with a fleet management system and dynamic routing of vehicles to avoid traffic congestion and minimize energy consumption
- Support team work and meetings when employees are distributed throughout the world, and thus reduce the impact of air travel. IS can move remote working beyond telecommuting to include systems that support collaboration, group document management, cooperative knowledge management, and so forth.

- Track environmental information (such as toxicity, energy used, water used, etc.) about the creation of products, their components, and the fulfillment of services
- Monitor a firm's operational emissions and waste products to manage them more effectively
- Provides information to consumers so they can make green choices more conveniently and effectively.

Green IS has a greater potential than green IT because it tackles a much larger problem. It can make entire systems more sustainable compared to reducing the energy required to operate information technologies.

Green IS, and sustainable development, should not been seen as a cost of doing business. Rather, they are opportunities for organizations to improve productivity, reduce costs, and enhance profitability. Poor environmental practices result in many forms of waste. Unused resources, energy inefficiency, noise, heat, and emissions are all waste products that subtract from economic efficiency. Less waste means a more efficient enterprise. Firms that actively pursue green IS to create sustainable business practices are doing the right thing for their community, customers, investors, and future generations.

Managers seeking to create sustainable organizations and green IS should find frameworks very useful for thinking about problems, brainstorming solutions, and planning implementation of innovations. Hence, it is important to provide some frameworks for assisting in the development of green IS. We start by recognizing the four fundamental drives of information systems.

## The information drives

We are addicted to information. People in affluent societies surround themselves with information appliances, such as cell phones, music players, and navigational systems. In the developing economies, nearly everyone can see the value of a cell phone and aspires to own one. Humans' inner need for information leads them to seek information systems that provide ubiquity (e.g., cell phones), uniqueness (e.g., navigation systems), unison (e.g., synchronized calendars), and universal services (e.g., high functionality smart phones) (Junglas & Watson, 2006). Satisfying these four information drives is a key ingredient in creating a successful IS, and we also believe critical to designing sustainable business practices. Only recently have we had the IT to fulfill these intrinsic human information drives, mainly because of the advent of network technologies, such as the Internet, WiFi, GPS, and mobile phone systems.

Table 1: The information drives and their physical counterparts

| | **Informational** | **Physical** |
|---|---|---|
| **U-construct** | **The drive to ...** | **The drive to ...** |
| Ubiquity | have access to information unconstrained by time and space | have ready availability of a desired resource |
| Uniqueness | know precisely the characteristics and location of a person or entity | have the capability to tailor precisely the use of a physical resource to one's unique needs |
| Unison | have information consistency | have procedural consistency |
| Universality | overcome the friction of information systems' incompatibilities | overcome the friction of physical differences |

If we are to change industry and society in the direction of greater ecological sustainability, we need to understand how to satisfy the four information drives. First, let's clearly define each of the drives from both a physical and informational perspective.

## Ubiquity

Ubiquity, in an informational sense, is *'access to information unconstrained by time and space'*. This means, for instance, that I want to be able to use my cell phone to call anyone no matter where I am in the world, or that I expect to be able find a WiFi connection in a hotel room or coffee shop so I can access the Internet. The worldwide popularity of cell phones is clear evidence of the strength of this drive.

In a physical sense, ubiquity is *the ready availability of a desired resource*. While we might expect that information and communication service should be accessible nearly everywhere, our expectations of physical resources are tempered by experience and reality. If we are to build a sustainable society, there needs to be a certain density of critical physical resources for them to be generally useful (e.g., the frequency of buses and placement of bus stops will affect patronage).

An appropriate IS can enhance physical ubiquity by supplying customers with information about the physical system. For example, people using a public transit system would find it very convenient to know the location of the nearest bus stop, their distance from it, the arrival time of next bus, and whether seats are available. Ubiquitous information access could be used to increase the utilization of many physical assets and thus contribute to sustainability.

## Uniqueness

Uniqueness, from an information point of view, means *'knowing precisely the characteristics and location of a person or entity*'. We can use a GPS[1] to find out where we are. Companies are using RFID[2] tags for identifying products (so they can look up a database to find out their characteristics) and scanners to track their movement (so they know where they are). Some people embed RFID tags in their car so they can find it if it is stolen.

Physically, uniqueness is *the capability to tailor precisely the use of a physical resource to one's unique needs*. People often prefer using a personal car to taking public transportation because a car can get you can from A to B exactly the way you want to go. To provide higher levels of physical uniqueness for public systems, we need to support them with information systems so that consumers can more readily match available resources to needs (e.g., how to use a public transit system to get from the airport to a hotel). Increasing the utility of public transport will reduce emissions for cars.

Some luxury cars now offer the capacity to remember a particular person's setting for the driver's seat, external mirrors, favorite radio, station and so forth. Each time the person hops into the driver seat, she can select her unique identifier (e.g., driver number), and her predefined preferences are automatically set. This example illustrates how an IS, the car's preference memory system, supports tailoring physical resources to a person's unique needs.

1. Global Positioning System.
2. Radio frequency identification.

## Unison

In an information sense, unison is *'information consistency'*. People want a single source of accurate data. Corporations talk of the 'single view of the customer', which means an integrated database that contains a single entry for each customer. Too often, organizations have built functional systems that serve the needs of different sectors of the organization (e.g., marketing or production), and consequently, they can have duplicate, not necessarily identical, information about customers, suppliers, and so forth in different databases. At a personal level, we prefer to have a single set of browser bookmarks that are available on whichever computer we use to access the Web.[3]

Physically, unison is *procedural consistency*. This refers to a procedure for accessing or using a physical resource that has little variation across access points. A city transit system, for instance, might have the same process for buying tickets for bus, train, and water transport. Thus, consumers have to learn only one convenient procedure. Because personal time is a scarce resource for many people, procedural consistency is desirable and reassuring.

Information systems can made procedures simple and familiar. They can provide easy to use interfaces that hide procedural complexity and integrate information across physical systems. For example, an Australian arriving at Paris' Charles de Gaulle airport can use a familiar ATM-like kiosk with commands in English that accepts credit cards to purchase a ticket for travel within Paris that covers use of three transit systems. English and the use of a credit card with an ATM are all familiar procedures and highly consistent across many such encounters.

## Universality

Universality, on the information side, is the drive to *'overcome the friction of information systems' incompatibilities'*. The universality drive surfaces in standards (e.g., XML[4]), currency unions (e.g., the euro), and multi-functional smart phones (e.g., one that includes a phone, GPS, camera, PDA, media player). An outstanding example of universality in action is the metric system of measurement.[5] The vast majority of countries follow this standard system. Imagine the difficulty of trading if there were multiple measurement systems, which there were before standardization.

Physically, universality is sought to *overcome the friction of physical differences*. Travelers often take along universal adapters because of regional differences in electrical outlet connections. The chargers for different brands of laptop computers are usually incompatible because of different types of connectors. Fortunately, we have standards, such as USB,[6] that facilitate the transfer of data between computers.

Information systems can help the transition between physical systems. For example, some power supplies for laptop computers can sense the characteristics of the power supply (i.e., voltage and frequency) and transform the input to that required by the computer. The sensor is a simple information system. Physical payment systems are a

3. There are plug-ins for Firefox that support bookmarks unison.
4. XML is a language for data exchange that makes it simpler for the exchange of data by creating industry standard descriptions of items such as a credit card statement, an airline reservation, and medical record.
5. Also known as the International System of Units (SI) ('Système International d'Unités' in French, hence 'SI').
6. Universal serial bus (note the use of universal)

major form of inefficiency (e.g., national currencies), and a smart card based information system can lubricate payments by storing multiple currencies and dynamically converting between them when payments are made. ATM networks that enable international travelers to get local currency, irrespective of the home country of their account, are another means of reducing physical friction.

If a system is to serve its customers, then it should satisfy the four u-drives from both a physical and informational sense. Given the flexibility of information, it is much easier to provide high levels of the informational u-drives and, in so doing, increase the utility of the physical drives. An example illustrates the symbiotic[7] relationship that can be established between physical and informational systems to reduce carbon emissions..

## Vélib

Vélib (a short form of Vélo Liberté, i.e., Bicycle Freedom) is the world's largest public self-service bicycle rental system.[8] The mayor of Paris launched the project in July 2007 to reduce the number of cars on the French capital's roads. The intention is to enable Paris' citizen to use bicycles, instead of cars, for short trips (typically less than 30 minutes) within Paris. Vélib started with 10,648 bicycles and 750 stations and by early 2008 there were 20,000 bikes and 1,450 stations. The project is a great success and recorded 2 million trips on the first 40 days. Its operation is simple; subscribers go to a station, identify themselves, and rent a bicycle. The first 30 minutes of rental are free, with an incremental cost thereafter. Subscriptions are available for one day (€1), for one week (€5), or for a year (€29), with a security deposit of €150.

Vélib's information system is state-of-the-art for bicycle-sharing programs. Each station has a computer terminal ('borne'), from which an individual can purchase a subscription, recharge an account (for one-year subscriptions), determine the number of available bicycles at nearby stations (useful if the current location is empty), or see the state of that person's account. Stations consist of a series 'bornettes', with each bornette consisting of a bicycle stand, locking mechanism, and a swiper to read the subscriber's information. All bikes are uniquely identified with an RFID tag.

We now examine how the informational and physical, respectively u-drives reinforce each other to contribute to Vélib's success. Informational **ubiquity** is high because members can determine bicycles availability for any given station from any device that can connect to the Internet (e.g., a cell phone) or from another station. On the physical side, ubiquity is also high because bicycle stations are 300 meters apart, more than four times the density of Métro stations, which is very impressive because Paris's subway stations are the most closely spaced of any such mass transit system. Bicycles and customers are **uniquely** identified. Consequently, the beginning and ending stations of every ride can be tracked, and this information can be used to decide the placement and size of stations and when to move bicycles between them. Renters can tailor their ride to their personal needs quite accurately (at most 300 meters from the desired destination). A single integrated database is used to keep complete records of stations, bikes, customers and so forth. Furthermore, there is a standard process for rental (i.e., the same type of rental and payment procedures for all stations). Because the informational and physical aspects are both highly consistent ,

7. Symbiosis describes the interaction between two different organisms living in close physical association, and it this case we are applying this concept to two systems, the physical and informational, that can be designed to interact with each other.

8. http://www.velib.paris.fr/

the system is high on the two types of **unison**. Informational **universality** is high, because payment and subscription systems work across all bicycle stations. Vélib terminals accept all traditional forms of payments (bank card, credit card, and cash), including the Moneo card, an electronic purse system for cashless small purchases. The Navigo smartcard, which works with the entire Parisian public transportation system, also gives access to Vélib for one-year subscribers. In the physical domain, universality is high because of the uniformity of bicycles, which reduces human learning and gives economies of scale in manufacturing and maintenance.

### Systems design

The Vélib case illustrates the importance of co-designing physical and informational systems. In this case, the IS increases the convenience of Vélib. Customers can quickly find the nearest free bike, pay for a rental rapidly and simply, and be on their way. Vélib's managers can monitor the demand at each station and increase or decrease the number of bikes to maximize utilization. Information adds value to physical systems and in so doing increasing their potential patronage. High quality public systems, from both in a physical and informational sense are required to create a sustainable society.

## A frameworks of sustainability options

There are three types of sustainability goals (Hart, 1997). The first goal is to prevent pollution by minimizing the level of emissions, effluents, and wastes. The second and higher level goal is product stewardship, where one focuses on both reducing pollution and also minimizing the adverse environmental effects associated with the full life cycle of a product. This is also known as the 'cradle-to-cradle' approach, where the end state of a product is involved in the beginning of another. The third and ultimate goal is the use of clean technology that creates no harmful emissions or waste.

The three goals can apply at three different levels: individual, organizational, and societal. The combination framework (Table 2) can be used to identify opportunities to deploy IS or IT to improve sustainability. We now discuss each of the cells.

Table 2: Green IS and IT opportunities

| | **Individual** | **Organizational** | **Societal** |
|---|---|---|---|
| **Pollution Prevention** | flexible printing capabilities<br><br>automated energy conservation system | thin client<br><br>virtualization<br><br>telecommuting | electronic exchange of information<br><br>congestion systems |
| **Product Stewardship** | recycling | reuse components<br><br>recycle computers | governmental policies<br><br>societal norms |
| **Clean Technology** | paperless interaction | video conferencing<br><br>collaboration tools | open source<br><br>Smart homes and appliances<br><br>e-commerce vs. traditional |

| | | | |
|---|---|---|---|
| | | | commerce |

## Individual pollution prevention

There are many actions that you can take to reduce the IT impact on pollution. For example, you can turn off you computer when you will not use it for some hours. You might practice shutting it down when you go to bed. You could print on both sides of a sheet of paper (i.e., duplex) or turn on the energy conservation preferences for your operating system (see Exhibit 1) so that your computer will go to sleep after a certain period of inactivity. Flexible printing capabilities exist for most operating systems; yet, they are rarely activated. It is estimated that applying energy settings, such as 'sleep when inactive', can reduce greenhouse gas emissions at a rate equal to taking more than 8,000 passenger cars off the road for an entire year, or conserving 16 million liters of gasoline.[9]

## Individual product stewardship

In additions to using energy more efficiently, you can play a significant role in product stewardship, such as in recycling used electronic products. For example, in Athens, GA, an organization exists[10] that takes unwanted computers, refurbishes them, installs Linux and OpenOffice, and gives them to charitable organizations. Organizations are relying on you to support cradle-to-cradle manufacturing. When you decide to dispose of an electronic product, check its manufacturer's web site for recycling options and procedures.

Information systems can facilitate product stewardship by providing information and creating networks to support recycling. Started in 2003, the Freecycle Network,[11] promotes waste reduction by providing individuals and non-profits an electronic forum to recycle unwanted items. As they say, 'one person's trash can be another's treasure'. The Freecycle concept has since spread to over 75 countries and includes millions of members. Freecycle claims to keep over 275 metric tons of goods per day out of landfills.

## Individual adoption of cleaner technology

Many of us find it difficult change established habits. Substitution is the simplest change. For example substituting check writing by paying bills online is a relatively easy change with a positive impact on the environment. It is faster and more convenient, and adds up: If every US home received and paid its bills online, annual greenhouse gas emissions would drop by 1.9 million metric tons, and waste would be reduced by nearly 1.45 million metric tons per a year.[12] UNESCO reports that of the average 1,510 sheets of paper produced per person in the world per year, at least half of this sheets goes through printers and copiers to produce office documents. A single tree produces about 80,500 sheets of paper.[13] Electronic media can be more environmentally friendly than paper. Acquiring news, music, movies, and books in electronic format is now possible because of the technological infrastructure and information systems in place. E-books (such as Sony's eBook reader) can reduce paper consumption. While the earlier e-readers are quite expensive, expect the cost to decline with time and volume.

9. http://www.techworld.com/green-it/features/index.cfm?featureid=3496

10. http://freeitathens.com/

11. http://www.freecycle.org/

12. http://www.time.com/time/specials/2007/environment/article/0,28804,1602354_1603074_1603109,00.html

13. http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/print.htm

Many cleaner technologies rely on an IS. The iPod (for music and movies) is backed by a sophisticated IS called iTunes. Amazon's Kindle (for books, magazine, and newspapers) is supported by a similar IS. The Toyota Prius, the world's most popular hybrid car, contains multiple computer chips to run its many information systems. It needs an IS to decide when the run the gas and electric engines, when to charge the battery, and what information to display to the driver.

### Organizational pollution prevention

Organizations can redesign their IT infrastructure to make it more energy efficient. A thin client, a lean PC that relies on a central server for disk storage and applications processing, uses less energy than a regular PC. Verizon, for example, reduced energy consumption by 30 percent by replacing personal computers in its call center with thin clients.[14] Germany's Fraunhofer Institute reports that, when comparing thin clients to personal computers, energy consumption is at least twice as low, even when factoring in the additional energy and cooling power required by the server associated with the thin clients. In addition to the reduction of emissions, e-waste is also reduced by switching to thin clients. A thin client contains significantly fewer components and has a longer life expectancy than a regular PC.

Server virtualization has become a popular energy saver. It makes the physical resource (i.e., the server) function as multiple logical resources (e.g., running multiple operating systems). Virtualization means doing more work with fewer resources, which in turn frees up data center space and lowers energy bills. Virtualization has existed in the computer industry for decades, but it is now getting a lot of attention because of its capacity to reduce energy consumption by increasing the utilization of excess or idle capacity possessed by existing hardware.

### UPS—"Brown on the outside, Green on the Inside"[15]

"Brown on the outside, Green on the Inside" has become the new slogan and business model for United Parcel Service (UPS), a service firm committed to the timely delivery of packages around the world. With a fleet of over 88,000 vehicles, including airplanes, it is currently impossible for UPS to become independent of fossil fuels. As a result, UPS has made considerable IS investments in finding ways to minimize their consumption. These initiatives save costs and advance UPS' "green" business strategy. A new project UPS is piloting is called "telematics"; it is clear evidence of how incremental changes across a large organization can have a major impact on the environment. Jack Levis, Director, Package Process Management at UPS, describes this project as a "data gathering and analysis project." The program was piloted in Georgia with a fleet of trucks employing technology that allows the engine to output codes to summarize the use of a delivery truck throughout the course of a day. The telematics "black box" records gathers data such as seatbelt usage during travel, harsh braking, delivery while idling, time spent reversing, speed, as well as routes taken by drivers using the built in GPS. The data from these devices is loaded into the UPS data warehouse in Mahwah, New Jersey. UPS uses a combination of heuristics and analytical tools,

14. http://www.businessweek.com/technology/content/may2007/tc20070514_656985.htm?campaign_id=rss_tech
15. Contributed by Alan Sher (University of Georgia)

with many algorithms developed in house, to mine these data to reveal trends in consumption, vehicle maintenance, and logistics. UPS was able to cut idle time by 24 minutes per driver per day, an estimated fuel savings of USD 188 per driver per year. With over 90,000 drivers, this contributes significantly to the reduction of UPS' carbon footprint. UPS has identified minimizing engine idling as a key opportunity for change, and it trained its drivers to turn on the engine as the last action before driving, a good energy saving approach for all drivers. UPS is continually looking for innovative ways to mine telematics data, in an effort to further increase efficiency. The telematics projects is clear evidence of the power of today's technology, and its ability to create cost savings, as well as a cleaner, greener, more sustainable environment for everyone. In October of 2008, UPS was the first shipping company to join the Environmental Protection Agency's "Climate Leaders" Program. This is an industry/government partnership that works with member companies in developing an all-encompassing sustainable business strategy. Partners are required to maintain an enterprise-wide inventory of greenhouse gas emissions, and set aggressive reduction goals. The progress and goal attainment is reported to the EPA each year. In 2008, UPS received the EPA's SmartWay Environmental Excellence Award for its "leadership in conserving energy and lowering greenhouse gas emissions." Sources: Mr. Jack Levis, Director, Package Process Management at UPS and www.sustainability.ups.com/environment/index.html

## Organizational product stewardship

Sustainability requires that we develop extensive recycling systems and we change our behavior to think of recycling as the first step when we dispose of items we no long want. In many cases, electronic goods are not recycled because organizations have not created the procedures and information systems to facilitate recycling. Most organizations have complex information systems for manufacturing, distribution, and sales to get their products into the homes of consumer, but few go the complete cycle. That is, they don't consider that they are responsible for taking back products that their customers no long want. A few forward looking companies, however, have created such full cycle systems. Dell, for example, allows its customers to recycle their old printers (if they buy a new one) by simply providing the new printer's service tag and scheduling a pick-up; customers accomplish both activities online via Dells's web site. Dell has created a simple and convenient process, assisted with an IS to track the movement of the products to be recycled. It can also gain by recycling some of the returned products, or parts of them, where this is possible.

## Organizationally cleaner technology

Humans prefer a face-to-face meeting over a telephone conversation on many occasions because of the richness of the interaction. Face-to-face meetings, however, can consume considerable energy when the attendees are scattered across the globe. Video conferencing is a good alternative, particularly with today's high quality systems. Video conferencing can transcend distance to replicate face-to-face communication. In the era of globalization and global climate change, organizations need to substitute cleaner technologies, such as video conferencing and electronic collaboration tools, to bridge the distance when a meeting's participants or a work team are scattered across different cities, countries, and continents. Electronic distributed meetings support communication without the carbon footprint of travel.

Organizations can also use cleaner technology (e.g., solar or hydro power) to run their data centers. Data center energy consumption is one of the most important green technological concerns because power and cooling account for up to 40 percent of a data center's costs.[16] Google, Yahoo, and Microsoft have located some of their data centers in the Pacific Northwest of the U.S., close to cheap hydro-electric power. Some organizations are looking at solar power for their data centers.

### Societal pollution prevention

Countries and economic regions can reduce pollution by encouraging a shift to technologies that produce less emissions. In the case of IS, the energy cost of exchanging data can be significantly reduced by moving from the postal system to electronic networks. Electronic Data Interchange (EDI), for example, supports the majority of electronic commerce transactions. Depending on which standard is in use (ANSI ASC X12 in North America and Edifact elsewhere), structured information can be interchanged between and within organizations, governments, and other groups. In a similar way, XML supports the electronic exchange of information through an open standard. Both of these technologies can reduce the use and manipulation of physical administrative documents (e.g., invoices, sales orders, etc.), and thus minimize pollution. They also, as is the case with most efforts to increase sustainability, greatly reduce an organization's administrative costs.

Traffic congestion is a major issue for most large cities. It wastes energy and increases pollution. Cities, such as Singapore and London, now levy fees for the use of particular city roads, with the help of information system, to reduce congestion. The US Department of Transportation employs the intelligent transportation system (ITS) to optimize public transportation by reducing congestion, improving road safety, and enhancing productivity. ITS is built upon a broad range of wireless and wire line communications-based information and electronics technologies. The US federal government is fostering widespread deployment of the system by integrating it into the transportation system's infrastructure. Current applications of ITS system include computer aided dispatching of vehicles, automatic vehicle location for public buses, and electronic toll booths that do not require driver to stop, and electronic freeway surveillance.

### Societal product stewardship

Governments can play an active role in encouraging, and where necessary forcing, organizations to become better product stewards. Legislation is being used to make recycling of electronic products mandatory. The California state government, for instance, introduced an Electronic Waste Recycling Fee in 2004 on all new monitors and televisions sold. California's Electronic Waste Recycling Act mandates that retailers collect a set recycling fee and pass it on to the Board of Equalization, which collects California's taxes. British Columbia in Canada has a similar policy. In 2003, the European Union enacted the Waste Electrical and Electronic Equipment Directive (WEEE Directive), which has become European Law, setting collection, recycling, and recovery targets for all types of electrical goods.

### Societal cleaner technology

An information society that consumes (e.g., downloading movies via the Internet rather than renting from a local store) and exchanges information electronically (e.g., emailing rather than posting a letter) is cleaner than a society in which information exchange is based on paper and the postal system. An information society can also organize

16. http://www.cioinsight.com/c/a/Trends/The-Greening-of-the-CIO/1/

for the production and distribution of electronic goods to be cleaner. The open source model is a very good example of a cleaner form of production and distribution. Software is developed without requiring the physical presence of workers in the same physical space, that is, an office building and its significant infrastructure and the environmental costs of daily commutes. Moreover, once developed, open source software can freely flow across borders at electronic speed, without the need for wasteful packaging and retail store shelf space. The footprint associated with both production and distribution can be much lower for information products.

Beyond information products, the information age needs to find many other ways in which it can deploy IS to minimize society's ecological footprint. We need a generation of innovation to create a sustainable society, and much of this innovation will involve IT and IS is a variety of ways.

## Organizational perspectives

Organizations are the major force for innovation in most societies, and corporations in particular are major change agents. As a result, we further examine some frameworks for promoting thinking about organizational sustainability.

### Strategic alignment

Nearly all major enterprises establish a corporate strategy that guides their major actions and set directions for the future. To achieve societal sustainability, we need the great bulk of major corporations to incorporate sustainability as part of their corporate strategy. As most of the major firms are global, we turn to a global strategic framework as the foundation for discussing how enterprises can approach integration of sustainability into their corporate strategy. Corporations who move faster and more effectively than those in their industry to create sustainable business practices should gain a competitive advantage. Eliminating waste increases profitability, and organizations need to learn how to operate in a world in which emission constraints are a part of doing business. Strategic issues can be addressed by from the perspective of aggregation, adaptation, and arbitrage, the AAA triangle (Ghemawat, 2007).

#### *Aggregation*

Organizations strategically seek economies of scale by **aggregating** development and production processes. The intention is to reduce costs by combing activities into optimal units for efficiency. From a sustainability angle, organizations also want to aggregate activities to reduce emissions and waste.

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### Wal-Mart's green supply chain

Through emphasizing a green supply chain, Wal-Mart plans to create less waste. It has taken strategic action to minimizing packaging. The idea is to reduce the size of products to save energy, shipping costs, and shelf space. It wants vendors to think 'small and mighty' by aggregating goods in the minimal space. It has, for instance, convinced vendors to replace bulky plastic jugs with condensed, slimmed-down containers for liquid laundry detergents. Toilet paper manufacturers have compacted their products so that a greater quantity can fit in a given volume. Through such initiatives, Wal-Mart aligns one of its key goals, low cost leadership in retailing, with sustainability because its movement in the direction of sustainable business practices reduce emissions, wastes, and costs

Source: httpwww.purchasing.com/article/ca6384869.html?title=article&spacedesc=news&q=wal+mart.

IS can be used to measure and monitor the costs, emissions, and waste of each phase of a supply chain and packaging alternatives. It is also a tool for coordinating and aggregating the many activities in a supply chain to minimize overall emissions. From an IT perspective, aggregation describes actions such as locating servers in a single data center to reduce energy costs. Virtualization can be thought of as aggregating several software systems onto one server to increase utilization and lower costs.

### *Adaptation*

Adaptation defines an organization's efforts to maximize its local relevance by being responsive to local stakeholders' needs and desires. Again, this can be done by exploiting in the power of IT and IS strategically. From an environmental perspective, this means adopting specific environmental initiatives that reduce emissions and wastes in the communities in which the organization operates.

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## Everything and Everybody Connected to the Network

Sun Microsystems Inc. is a global provider of network computing infrastructure solutions. Its corporate vision of 'Everything and Everybody Connected to the Network' is reflected in its desire to let 'everyone take part in opportunities and contribute to solutions regardless of their geographic location or economic situation' (company web-site). In this spirit, Sun created the 'Open Work' initiative, which consists of a solution suite of products, policies, and support tools that enable Sun employees to work effectively wherever their work takes them, may this be at the office, at home, on the road, or in drop-in centers. The company has about 43 percent of its workforce participating in this program, utilizing its 115 flexible office locations worldwide. Through its initiative, Sun thus fosters the use of cleaner technology through a program that is in alignment with its strategic orientation.

Sun Microsystem's "Open Work" initiative, expands the definition of local and enhances its employees' abilities to work locally while competing globally. At the same time, reducing the need for employees to travel to work locations and reducing Sun's employees' overall carbon footprint.

Source: http://www.sun.com/aboutsun/globalinclusion/brochure.pdf

### *Arbitrage*

Arbitrage, the third global strategy, is the exploitation of differences between different markets. Considering the etymology of the word arbitrage, its French origin defines it as 'rendering judgment'. The underlying idea of this strategy is to achieve absolute economies through judging (and selecting) the very best alternatives. In the context of an environmental IT and IS initiative, this can viewed as achieving the most environmentally friendly product by selecting the least polluting vendors.

### Cradle-to-cradle design at Herman Miller

Herman Miller, the international designer, manufacturer, and distributor of furnishings and interior products, follows an arbitrage strategy. Given that sustainability is one of its core values, Herman Miller has taken many green initiatives to distinguish itself from its competitors. One of these is the development of a cradle-to-cradle design into its products, such that all constituent components in a given product can be put back into service. This initiative led to the creation of an IS (the Design for Environment system, DfE), which allows Herman Miller to assess the extent to which a final product meets the goal of the cradle-to-cradle ideal, that is, made from 100 percent biological or technical nutrients. With DfE, Herman Miller can thus assess the components it acquires from its suppliers, and if a component does not meet its cradle-to-cradle metric, Herman Miller either helps the supplier to make needed formulation changes in its component, or, if the supplier is unwilling or incapable of making such changes, seeks an alternative supplier. In other words, Herman Miller is changing its supply chain to include only the suppliers that can contribute to the achievement of its sustainability goal. Thus, Herman Miller's goal of product stewardship is consistent with its values and is addressed by an arbitrage strategy.

In summary, the most successful sustainability initiatives will be those carried on by organizations aligning their green IS initiatives with their overall strategies, in ways that will achieve their business goals while simultaneously reinforcing their environmental goals, i.e., the reduction of pollution, product stewardship, or cleaner technology.

## Three approaches to ecological thinking

Organizations strive to sustain their existence, and the notion of corporate sustainability incorporates ecological thinking and three different approaches to it: eco-efficiency, eco-equity, and eco-effectiveness. We now discuss each of these idea

### *Eco-efficiency*

Eco-efficiency combines traditional efficiency goals with ecological considerations, and is defined as, 'the delivery of competitively-priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the earth's carrying capacity' (DeSimone & Popoff, 2000, p. 47) Quite simply, it means consuming non-renewable materials more productively. Under eco-efficiency, financial goals still remain foremost in management's mind, but it should be mindful of the need to pursue sustainable practices where they do not interfere with financial considerations.

All waste products are a cost that a company has to bear, unless it can externalize them and make the community pay. For example, a carpet manufacture that has chemicals left over after production is legally required to dispose of these in a in a manner that does not damage the environment. This can be a costly process, and the carpet manufacturer would be more profitable if he did not have to dispose of these chemicals. The ecological approach is to switch to chemicals that don't harm the environment and thus avoid high disposal costs, or even better, the firm finds a way that requires no chemicals and thus avoid the costs of buying the chemicals.

Unfortunately, in too many cases industry passes on the costs of its eco-inefficiency to the community. It 'externalizes' its costs. A company that pollutes a stream with its waste products forces society to deal with the costs

of environmental degradation. If the company were forced to bear the full cost of its polluting activities, it would have a strong incentive to be eco-efficient.

### *Eco-equity*

Eco-equity aims for the fair distribution of natural resources between current and future generations. One group in society should not consume so much that it denies other members of its generation their fair share of that resource. Similarly, one generation should not over consume a resource to the point that it is unavailable or degraded for a future generation.

There is limited knowledge of the Earth's total stock of critical resources such as oil and water. Before we can start to implement eco-equity as a societal goal, we first need to know what resources we have and how rapidly they are being consumed. We need a data base for the full range of global resources with details of available stocks and depletion rates. Then, we need to develop methods for determining equitable distributions between and across generations. We cannot achieve eco-equity if we have insufficient data to determine what is equitable.

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## CePort's building automation system conserves energy[17]

Twenty percent of all energy used in the United States can be linked to commercial buildings. The energy footprint of a commercial building is largely dominated by lighting, heating, cooling, and ventilation systems. As the US population increases, building energy consumption is expected to rise; new solutions that deal with reducing commercial energy use must be developed. A potential solution is the creation of an information system that can analyze data from various building systems and manage all systems as if they were one.

CePORT, a start-up technology firm based in Skokie, Illinois, has created such a system. It has developed the CePORT Building Services Portal (BSP), which is an open source technology platform geared towards revolutionizing the building management industry. BSP uses information technology to integrate data from multiple existing building systems into a streamlined interactive browser-based control interface. The high functionality of this system allows for organizations to improve not just energy efficiency but use building data to improve the management of people, time, and space.

With the right sensing technologies, BSP can provide information at the room level, regarding: air quality levels, temperature, humidity, energy usage, and occupancy. Based on the organizations needs, BSP can fully integrate and automate these systems, minimizing energy usage and costs. Furthermore, BSP can be used to manage building events. Using a master calendar BSP can manage various aspects of event planning, from reserving rooms for meetings, reporting which rooms are currently unoccupied, and indicating when the building will open and close. When reserving a room for a meeting, BSP allows employees to plan ahead and set the temperature of the room, adjust light settings, and send meeting invites and reminders through email, sms messaging,

17. Contributed by Tyler Williamson (University of Georgia)

and voicemail systems. This improves the efficiency of employees, increases communication, and allows for better workspace management.

BSP is different from other solutions in the market because of its commitment to stay technology neutral. This framework allows CePORT to avoid many limitations when integrating with existing building systems. This reduces cost and makes BSP a more economically viable and scalable solution. Another advantage of BSP is the ability to send a live data feed to: websites, PDAs, touch screens, IPTV, and many other interactive technologies. With this capability an organization can choose to make information, such as a master building calendar, or the amount of energy each employee is using, available to all employees.

From an environmental view, BSP can help save energy, improve a building's LEED rating, and educate employees on their energy habits through live reporting. These benefits will help an organization lower costs, improve workplace efficiency, and above all help our environment.

Source: http://ceportbsp.com/ and personal conversation with John Greenwell of CePORT

### *Eco-effectiveness*

Eco-effectiveness means that we end current practices that result in ecological degradation. We need to mimic nature and create ongoing healthy systems where the waste products of one process become inputs to other processes. For example, a tree's dead leaves become food for insects and nutrients for the soil. Natural systems have had millions of years to evolve. Initially, waste products might have remained unused for eons until a species learned, or evolved, that could use the waste as its food. An eco-effective conversion cycle creates minimal waste.

In the industrial world, we can use information systems to accelerate the matching between output and input. We need to create information markets where the producers of the waste from one process can find a buyer, who will use the waste as input to another process. Eco-effectiveness requires a highly efficient information exchange so that the waste market continually clears. Attaining eco-effectiveness means that toxic dumps are no longer required and that landfills are a historical oddity that reminds future generations of their profligate forebears.

## Summary

Sustainable development 'meets the needs of the present without compromising the ability of future generations to meet their own needs'. Information systems, as the major force driving productivity growth in the last half century, should have a critical role in creating sustainable business systems. Green IT is mainly focused on energy efficiency and equipment utilization. Green IS refers to the design and implementation of information systems that contribute to sustainable business processes. There are several frameworks for identifying Green IS opportunities. First, the information drives (ubiquity, uniqueness, unison, and universality). Second, sustainability options (pollution prevention, product stewardship, and clean technology) by action levels (individual, organization, and societal). Third, strategic alignment (aggregation, adaptation, and arbitrage) of IS with the enterprise. Fourth, ecological thinking (eco-efficiency, eco-equity, and eco-effectiveness).

## Exercises

1. What could your university do to increase its sustainability? How might students help?

2. What personal actions could you take to reduce energy consumption? What behaviors are you likely to change on an ongoing basis?
3. Thinking of a business process with which you are familiar, such as a stock ordering system, using the U information drives, outline how IS might improve sustainability in that process?
4. Using the U drives model, evaluate the public transport system in your city or town. How well does it meet the four information drives? How might information systems be improved to increase utilization of the transport system.

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