INSTITUTE OF DISTANCE AND OPEN LEARNING

University of Mumbai

F.Y.B.Sc. (I.T)

SEMESTER - II

GREEN COMPUTING

SUBJECT CODE : USIT 205

Dr. Suhas Pednekar
Vice-Chancellor,
University of Mumbai

Prof. Ravindra D. Kulkarni
Pro Vice-Chancellor,
University of Mumbai

Prof. Prakash Mahanwar
Director,
IDOL, University of Mumbai

Program Co-ordinator : **Shri Mandar Bhanushe**
Head, Faculty of Science and Technology IDOL
University of Mumbai - 400098

Course Co-ordinator : **Gouri S. Sawant**
Assistant Professor, B.Sc. IT, IDOL
University of Mumbai - 400098

Course Writers : **Jyotsna Anthal**
Assistant Prof. Thakur College of Science & Commerce, Kandivali, Mumbai - 400101

: **Milind Thorat**
Assistant Prof. K. J. Somaiya Institute of Engineering & Information Technology, Mumbai - 400022

: **Priti Pathak**
Assistant Prof. Mulund College of Commerce, Mulund (West), Mumbai - 400080

: **Prachi Abhijeet Surve**
Assistant Prof. Ramniranjan Jhunjhunwala College, Ghatkoper (West), Mumbai - 400086

: **Sanketh S. Iyer**
Assistant Prof. Department of Information Technology, PTVA's Mulund College of Commerce, Mulund (West) Mumbai - 400080

April 2021, Print - I

Published by : **Director**
Institute of Distance and Open Learning ,
University of Mumbai,
Vidyanagari, Mumbai - 400 098.

DTP Composed by : Mumbai University Press
University of Mumbai, Vidyanagari,
Santacruz (E.), Mumbai - 400 098.

Printed by :

CONTENTS

*****

GREEN COMPUTING

F.Y.B.Sc. (IT)

Semester – II

SYLLABUS

Unit	Details	Lectures
I	**Overview and Issues:** Problems: Toxins, Power Consumption, Equipment Disposal, Company's Carbon Footprint: Measuring, Details, reasons to bother, Plan for the Future, Cost Savings: Hardware, Power. **Initiatives and Standards:** Global Initiatives: United Nations, Basel Action Network, Basel Convention, North America: The United States, Canada, Australia, Europe, WEEE Directive, RoHS, National Adoption, Asia: Japan, China, Korea.	12
II	**Minimizing Power Usage:** Power Problems, Monitoring Power Usage, Servers, Low-Cost Options, Reducing Power Use, Data De-Duplication, Virtualization, Management, Bigger Drives, Involving the Utility Company, Low-Power Computers, PCs, Linux, Components, Servers, Computer Settings, Storage, Monitors, Power Supplies, Wireless Devices, Software. **Cooling:** Cooling Costs, Power Cost, Causes of Cost, Calculating Cooling Needs, Reducing Cooling Costs, Economizers, On-Demand Cooling, HP's Solution, Optimizing Airflow, Hot Aisle/Cold Aisle, Raised Floors, Cable Management, Vapour Seal, Prevent Recirculation of Equipment Exhaust, Supply Air Directly to Heat Sources, Fans, Humidity, Adding Cooling, Fluid Considerations, System Design, Datacentre Design, Centralized Control, Design for Your Needs, Put Everything Together.	12
III	**Changing the Way of Work:** Old Behaviours, starting at the Top, Process Reengineering with Green in Mind, Analysing the Global Impact of Local Actions, Steps: Water, Recycling, Energy, Pollutants, Teleworkers and Outsourcing, Telecommuting, Outsourcing, how to Outsource. **Going Paperless:** Paper Problems, The Environment, Costs: Paper and Office, Practicality, Storage, Destruction, Going Paperless, Organizational Realities, Changing Over, Paperless Billing, Handheld Computers vs. the Clipboard, Unified Communications, Intranets, What to Include, Building an Intranet, Microsoft Office SharePoint Server 2007, Electronic Data Interchange (EDI), Nuts and Bolts, Value Added Networks, Advantages, Obstacles.	12

IV	**Recycling:** Problems, China, Africa, Materials, Means of Disposal, Recycling, Refurbishing, Make the Decision, Life Cycle, from beginning to end, Life, Cost, Green Design, Recycling Companies, Finding the Best One, Checklist, Certifications, Hard Drive Recycling, Consequences, cleaning a Hard Drive, Pros and cons of each method, CDs and DVDs, good and bad about CD and DVDs disposal, Change the mind-set, David vs. America Online **Hardware Considerations:** Certification Programs, EPEAT, RoHS, Energy Star, Computers, Monitors, Printers, Scanners, All-in-Ones, Thin Clients, Servers, Blade Servers, Consolidation, Products, Hardware Considerations, Planned Obsolescence, Packaging, Toxins, Other Factors, Remote Desktop, Using Remote Desktop, Establishing a Connection, In Practice	**12**
V	**Greening Your Information Systems:** Initial Improvement Calculations, Selecting Metrics, Tracking Progress, Change Business Processes, Customer Interaction, Paper Reduction, Green Supply Chain, Improve Technology Infrastructure, Reduce PCs and Servers, Shared Services, Hardware Costs, Cooling. **Staying Green:** Organizational Check-ups, Chief Green Officer, Evolution, Sell the CEO, SMART Goals, Equipment Check-ups, Gather Data, Tracking the data, Baseline Data, Benchmarking, Analyse Data, Conduct Audits, Certifications, Benefits, Realities, Helpful Organizations.	**12**

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Green IT	Toby Velte, Anthony Velte, Robert Elsenpeter	McGraw Hill		2008
2.	Green Data Center: Steps for the Journey	Alvin Galea, Michael Schaefer, Mike Ebbers	Shroff Publishers and Distributers		2011
3.	Green Computing and Green IT Best Practice	Jason Harris	Emereo		
4.	Green Computing Tools and Techniques for Saving Energy, Money and Resources	Bud E. Smith	CRC Press		2014

UNIT - I

1

OVERVIEW AND ISSUES

1.0 Objectives

After studying this unit, you will be able to understand:

- The concept of Green Computing
- Issues related to why to go green, toxins, power consumption and heat respectively.
- Necessity to measure Carbon footprints
- To learn about Expertising Projects and ways to reduce the occurring issues.

1.1 Introduction

The study of "Green Computing"(also known as green IT) refers to practice the use of computing and information technology related resources in an environmentally responsible manner. The concept of green computing teaches us to implement energy-efficient computing equipment and reduce the resource's as well as power consumption which leads to a proper electronic disposal. Green computing is one of the solution to tackle with hazardous e-waste problem (which is not just an issue in our country but now is a global issue).As much as GC is has various benefits there are still few issues that are hurdles to the fully green figuring selection which will be further on discussed in the chapter.

1.2 An overview and Issues related to it:

1.2.1 Problems :

- This isn't the first time you've heard about the need to go green as it relates to your IT infrastructure. But even though the message is out there, not enough organizations are acting on it.
- The reason is obvious—money. Although datacenter managers want to save the environment, they also want to save money.
- Although spending that money up front can be a hard pill to swallow, think of it this way—if we don't make meaningful changes, we're contributing to our own downfall.

1.2.2 Toxins:

- Toxins are those substances which can be hazardous and deadly / poisonous for living beings which are certainly present in hazardous waste in any chemical

- According to the U.S. Environmental Protection Agency (EPA), Americans throw out more than 2 million tons of consumer electronics annually, making electronic waste (also known as *e-waste*) one of the fastest growing components of the municipal waste stream. When these electronics break down, they release mercury and other toxins.

- Toxic substances can include:
  - Lead
  - Mercury
  - Cadmium
  - Polychlorinated biphenyls (PCBs)

- A major portion of this change is that e-waste is being handled separately from conventional garbage and recycling processes. There are lots of benefits to reusing equipment:
  - There is less demand for new products and their use of virgin raw materials.
  - Less water and electricity is used when reuse lowers the need for the production of new products.
  - Less packaging is used.
  - Redeployed technology is available to more sectors of society, because computers and other components are often more affordable.
  - Less toxins are going into landfills.

- The parts of computer that are dangerous for the environment are:
  - Lead in the cathode ray tube and solder.
  - Selenium used as a power supply rectifier in circuit boards.
  - Cadmium in circuit boards and semiconductors.
  - Chromium used as corrosion protection in steel.
  - Mercury in switches and the housing.

1.2.3 Power Consumption:

- Power usage is an especially relevant issue for operating a green information system—the more power that's used, the more money that's spent and the greater the carbon footprint.

- According to research from Intel, 80 percent of businesses have never conducted an energy audit and only 29 percent of businesses are investing in energy-efficient PCs.

- It's becoming more expensive to run an IT department, strictly from a power consumption standpoint. International Data Corporation (IDC) notes that ten years ago, around 17 cents out of every dollar spent on a new server went to power and cooling.

- There are two ways you can rely less on fossil fuel–based sources of electricity:
  - **Virtualization:-** Virtualization takes multiple physical servers out of operation and offloads their duties onto a single machine. Specialized software makes it possible to run dozens of servers on one physical machine, thus reducing the amount of power consumed.
  - **Generate your own power** Many companies are striving to be completely carbon neutral. One way you can cut your electrical bill and make a move toward carbon neutrality is to generate your own power.

1.2.4 Heat:

- The energy you consume to cool that equipment is also an issue. The more equipment you have (and the less efficient it is), the more heat it generates and the more electricity you use to cool that equipment.
- The crux of the matter is this: You need less equipment that is more efficient, and you need to employ a creative cooling strategies to make the least impact you possibly can. The Uitikon, Switzerland company started using the hot air removed from its datacenter to heat the nearby public swimming pool. What would normally be vented into the atmosphere, and thus wasted, is being utilized for a productive purpose.

1.3 How can the issues be solved

1.3.1 Equipment Disposal:

- Computers and other devices are routinely discarded once they become obsolete. Old computers don't need to be looked at like they're infectious materials. If they are disposed of improperly, they can be major sources of toxins and carcinogens.
- Electronic waste is a big problem. It represents 2 percent of American landfills, but it accounts for 70 percent of overall toxic waste.

1.3.2 The Recycling Process:

- E-waste processing generally involves first dismantling the equipment into these different components:
  - Metal frames
  - Power supplies
  - Circuit boards
  - Plastics

- Starting in 2004, the state of California added an electronic waste recycling fee to all new monitors and televisions to cover the cost of recycling.
- An electronic waste recycling plant found in an industrialized country is able to handle a lot of equipment and effectively sort the components in a safe manner. Material is fed into a hopper, which is then sent up a conveyor and dropped into a mechanical separator. The material is then screened and sorted.

1.4 Precautions to be taken and how to do it:

Can be done by Doing It Right:

- No one has a perfect grip on handling e-waste, but many countries need to be lauded for their efforts.
  - **The European Union:-** Europe has taken the lead in the world of e-waste handling. The first electronic waste recycling system was mandated by the Swiss in 1991. It started with the collection of old refrigerators. The movement has since snowballed, and since January 2005 it has been possible to return electronic waste to the sales point and other collection points free of charge.
  - **The United States:-** Americans are sort of stalling when it comes to handling e-waste. That said, the United States is certainly doing *some* things right. In recent years, some states have banned cathode ray tubes (CRTs) from landfills because of fear that their heavy metals would leach into the groundwater.

1.5 Company's Carbon Footprint:

- The term *carbon footprint* is thrown around a lot in green circles. Although we have a general idea of its meaning—one's impact on the planet. In some cases, it might refer just to carbon dioxide output; in other cases it means greenhouse gas emissions.
- Measuring your carbon footprint necessitates gathering a lot of information. You need to track such areas as:
  - Facilities
  - Operations
  - Transportation
  - Travel

1.6 Measuring and Expertising projects:

- Measurement is not a five-minute project. It will take time and expertise. You'll likely want to call in someone who specializes in this work.
- Four major steps are used to measure your carbon footprint:
  - Define what is included in your carbon footprint.
  - Set your baseline.
  - Track, calculate, and analyze your footprint.
  - Report your results to stakeholders.

1.6.1 Define your Borders:

- You first need to define what you are going to be measuring. You can be as liberal with this as you like, but realize that the more you decide to include in your measurement, the more difficult it will be.
- Also, that while tracking less data is certainly easier, you don't get an accurate accounting. In your calculations, you might consider both upstream and downstream events.

1.6.2 Set A Baseline:

- Take a look at any available data. You need to establish a baseline year by which your future progress will be measured.
- As you look at the existing data, be aware whether anything unusual was going on that year. For instance, were there newly established governmental guidelines that drastically changed your work environment? If so, you might want to look at a different year.

1.6.3 Track and Analyze your Data:

- Once you get the data tabulated, it's not only good as a yardstick by which you can measure future performance, but given the right data, you can use it to ferret out problems now. Look at the numbers critically and look for any anomalies.
- For instance, if you have three locations that are more or less similar in size, and one has an unusually large reading, you know something's wrong.

1.6.4 Report:

- In the end, you want to present your carbon footprint information to important stakeholders in your organization. This can be the CEO, shareholders, and employees.

- Based on the protocols, companies must decide how to account for both direct and indirect emissions:
  - **Direct emissions:-** These are from sources that your company owns or controls, such as factory smokestacks, vents, and company vehicles.
  - **Indirect emissions:-** These are generated as a result of your company's activities, but occur in sources owned by someone else. For example, if you contract work out or your employees travel, those emissions are generated by a third party, but because of you.

1.7 Other ways to reduce the occurring issues:

1.7.1 Hardware:

The biggest way you can reduce your impact on the environment and the amount of money

you're paying for hardware is to simply buy less equipment.

- **Taking the Steps, Reaping the Rewards:-** Vanderbilt's Information Technology Services organization is using server virtualization to reduce its energy use. By reducing the number of physical servers they're using, they save money and they do less damage to the environment.
- **Use What You Have:-** Although purchasing new, energy-efficient equipment is a good idea, it's only a good idea if you actually need new equipment. If you have old computers that can be repurposed, you've just administered a one-two punch. You don't have to recycle anything and you don't have to spend money on something new.

1.7.2 Power:

The issue of power consumption is important on two levels. First, consider your bottom line. The more power you use, the more money you spend. Next, consider the issue on an environmental level. The more power you use, the more fossil fuels the local electrical utility has to burn.

- **Desktops:-** An average desktop PC requires 85 watts just to idle, even with the monitor off. If that computer is only in use or idling for 40 hours a week instead of a full 168, over US$40 in energy costs will be saved annually from that workstation alone.

- **Datacenters:-** Consider a 24-port Ethernet switch. On the low end, it uses 250 watts of power (most switches use more) and it is in continuous use. Each 1U rack switch uses 2,190 kW each year. If the electricity generated to power this switch comes from a coal-fired plant, 1,780 pounds of coal are needed to produce the 2,190 kW.

1.8 Summary :

- Overview and issues faced :
  - Problems, Toxins, Power Consumption, Heat
- The issues / problems can be solved by implementing ;
  - Equipment disposal – computers and other devices can be routinely discarded once they are of no use.
  - Recycling process- the equipments can be dismantled / recycled into various components like metal frames, power supplies, plastics and as such.
- Precautions can be taken by and was initiated by various countries such as:
  - European Union
  - United Nations
- Company's Carbon footprint: it is a form of greenhouse gas emissions.

  To measure carbon footprint; facilities, operations, transportation , travel areas were to be tracked.

- Measuring of projects takes four major steps i.e. define what is included; set baseline; track, calculate and analyze footprint; report the results to stakeholders (direct and indirect emissions).

- There are other ways to reduce the occurring issues done by using / implementing : Hardware, Power

1.9 Self-Assessment Questions:

- What do you mean by Green Computing? Mention the pathways of green IT.
- Write a short note on :
    a. Toxin
    b. Equipment Disposal
    c. Carbon Footprint
    d. Team power
- What are the ways to avoid fossil fuel based sources of electricity?
- What are the four major steps of measuring carbon footprints?
- How does green computing affect the cost savings?
- How the environment gets affected by hardware deployments?
- Name the practical approaches to collect annual data.

1.10 List of references:

- www.researchgate.com
- www.cyrusone.com
- Republication

* * * * *

2

CURRENT INITIATIVES AND STANDARDS

2.0 Objectives

2.1 Introduction

2.2 Global Initiatives

2.2.1 StEP principles

2.3 Task Forces

- Policy and Legislation
- ReDesign
- ReUse
- ReCycle
- Capacity Building

2.4 Basel Action Network (BAN)

2.4.1 Functions

2.4.2 Involvement in Campaigns

2.5 Basel Convention

2.5.1 Application

2.5.2 Additional Regulation

2.6 European Union

- WEEE Directive
- RoHs

2.7 National Adoption

2.8 Asia

- Japan
- China
- Korea

2.9 Summary

2.10 List of References

2.11 Self-Assessment Questions

2.0 Objectives

After studying this unit, you will be able to:

- Understand the StEP principles of Global initiatives.
- Learn about task forces for e-waste management.
- Explain the Functions and campaigns of BAN.
- Know about the decisions of European Union and the National adoption.
- Understand the steps taken by some Asian countries for e-waste management.

2.1 Introduction

IT consumes natural resources just like all human activities causing negative impact on environment. These impacts can be verified by using hardware manufacturing of natural resources or consumption of electricity or various other methods. Due to which Sustainability has become the agenda of IT. Many changes can be adapted for the environment starting with the adoption of simple actions which can be sufficient to help minimize the negative environmental impacts of the activity. It need not only be done by specialized companies but can also be done by common corporations from various areas.

2.2 Global Initiatives:

- **United Nations:-** At the highest level of global governance is the United Nations. Seeing that e-waste is an international concern, it has stepped forward and implemented its Solving the E-waste Problem (StEP) program.

- **Solving the E-waste Problem:-** StEP is a program that is open to companies, governmental organizations, academic institutions, nongovernmental organizations (NGOs), and nonprofit organizations around the world. StEP's prime objectives are as follows :

  - Optimizing the life cycle of electrical and electronic equipment by improving supply chains
  - Closing material loops
  - Reducing contamination
  - Increasing the utilization of resources and the reuse of equipment
  - Exercising concern about disparities such as the digital divide between industrializing and industrialized countries

- Increasing public, scientific, and business knowledge
- Developing clear policy recommendations

2.2.1 StEP is based on five principles:

- Work is based on scientific assessments and incorporates a comprehensive view of the social, environmental, and economic aspects of e-waste.
- StEP conducts research on the entire life cycle of electronic and electrical equipment and their corresponding global supply, process, and material flows.
- StEP's research and pilot projects are meant to contribute to the solution of e-waste problems.
- StEP condemns all illegal activities related to e-waste, including illegal shipments and reuse and recycling practices that are harmful to the environment and human health.
- StEP seeks to foster safe, ecological, and energy-efficient reuse and recycling practices around the globe in a socially responsible manner.

2.3 Task Forces:

These task forces address e-waste issues at varying levels. These task forces focus on the research, analysis, and facilitation of pilot projects.

- Policy and Legislation:- The Policy and Legislation task force reports and analyzes the status of existing techniques and policies for managing e-waste. Specifically, the task force does these things:
  - Analyzes and evaluates national legislation and the international framework for controlling and enforcing trade of e-waste and electronic recycling. Specifically, it examines how the European Waste Electrical and Electronic Equipment (WEEE), Restriction of Hazardous Substances (RoHS), and energy-using products legislation, as well as the Basel Convention and other agreements on the national and international level.
  - Studies green purchasing schemes, especially how they apply to e-waste, in various countries and how that purchasing affects the trade of e-waste and used electronics products.
  - Examines how to manage the e-waste problems in industrializing regions such as Africa and Eastern Europe, Latin America, and Southeast Asia.
  - Serves as a resource for organizations in that it points out existing business models to support the sustainable use of Information and Communications Technology (ICT) in industrializing countries.

- ReDesign:- The group's main objective is to optimize the life cycle characteristics of EEE and their adaptation to specific end-of-life

conditions. The task force defines redesign as measures that support the optimal lifetime of a specific product through the optimization of design features. Specific tasks include the following:

- Identifying and assessing critical design aspects in the end-of-life treatment of EEE. This could include the material composition and toxicity, its design, or any other components that might impact a product's end of life.
- Comparing current industry approaches to product end-of-life to identify current economical, environmental, and regional design considerations.
- Developing and demonstrating new design solutions of various products.

- ReUse:- The goal of the ReUse task force is to define globally consistent reuse practices, principles, and standards for EEE products from business-to-business (B2B) and business-to-consumer (B2C) users that are economically. Specific goals of the task force include:
  - Developing a common nomenclature for definitions of reuse, refurbishment, EEE products, and other related topics.
  - Determining how equipment enters the "reuse" category.
  - Developing globally consistent environmental and business principles and guidelines for equipment recovery.
  - Designing a global standard and program for maintaining quality in environmentally sound practices, data privacy, and usage extension.

- ReCycle:- The goal of the ReCycle task force is to enhance global recycling infrastructures, systems, and technologies while realizing sustainable e-waste-recycling systems. Specific objectives include:
  - Gathering and assessing the most relevant environmental, economic, and social characteristics of e-waste recycling in the industrialized world.
  - Evaluating recycling systems, leading to recommendations for long-term development of eco-efficient resource cycles.
  - Analyzing transboundary shipments and logistics of e-waste and its underlying driving forces, dynamics, and regulations, as well as the constraints for sustainable resource cycles.

- Capacity Building:- The Capacity Building task force focuses on building infrastructures for sustainable, efficient, effective, and target group–oriented capacity building, covering relevant aspects of the entire life cycle of EEE in order to sustainably solve the ever-growing e-waste problem. Specific objectives include:

- Organizing mutual learning environments, including the identification of viable approaches adapted by different target countries and groups, and then testing and implementing these projects.
- Setting standards in the form of comprehensive guidelines for capacity building.

2.4 Basel Action Network :

It is a worldwide organization, focused on working with the human rights and environmental impacts of e-waste.

2.4.1 BAN performs these broad functions:

- Acts as a source of information on the waste trade for journalists, academics, and the general public. BAN's informational output includes its website (see Link 2-2), as well as an e-mail newsletter and electronic action alerts.
- Provides international policy advocacy. BAN is invited to participate in UN meetings and policy deliberations. BAN has also worked with the Organization of Economic Cooperation and Development (OECD) and the UN Environment Program (UNEP) Chemicals Program and Governing Council. BAN has also produced Model National Legislation on toxic waste trade for developing countries.
- Conducts field research and investigations in developing countries. It also provides photographic and video documentation of e-waste trade.

2.4.2 Involvement in Campaigns:

- Participates with NGOs around the world in campaigns to counter toxic trade.
- BAN is active on a number of campaigns, including the following:
  - **E-Waste Stewardship Project:-** A program to ensure that exports of hazardous electronic waste to developing countries are eliminated and replaced with producer responsibility via green design programs and legislation.
  - **Green Shipbreaking:-** A program that ensures hazardous materials have been removed from U.S. government ships prior to export.
  - **Zero Mercury Campaign:-** A program working toward an internationally binding treaty on mercury pollution to eliminate its extraction, use, trade, and recycling. To promote permanent storage and alternative uses, BAN is working particularly to eliminate surplus mercury trade to developing countries.
  - **Basel Ban Ratification:-** BAN promotes the Basel Ban Amendment Ratifications globally and works to prevent the weakening of this amendment.

2.5 Basel Convention:

The Basel Convention is an international treaty designed to reduce the transportation of hazardous waste between nations, especially from developed to less developed countries. The convention deals with minimizing the amount and toxicity of generated wastes.

- **Application:-** The Basel Convention applies various conditions on the import and export of waste, and it also applies strict requirements for the notice, consent, and tracking of movement of waste across national boundaries. The Basel Convention also prohibits the import or export of waste between parties of the convention and nonparties.
  This is especially relevant to the United States, because it is a nonparty to the convention, but has a number of similar agreements that allow for the shipping of hazardous wastes to Basel party countries.

- **Additional Regulation:-** The Basel Convention also calls for an overall reduction of waste generation. This is meant not to meddle within a sovereign country's boundaries, but rather to discourage the generation of e-waste, which might then be transported to other countries. The convention also calls for parties to adopt a protocol establishing liability guidelines and procedures for damages that stem from the movement of hazardous waste across borders.

2.6 European Union:

The European Union leads the world with its e-waste management WEEE and its RoHs directives. These laws manage not only the resultant recycling and handling of e-waste, but also its creation.

- **WEEE Directive:-** The Waste Electrical and Electronic Equipment Directive (also known as the WEEE Directive) is the European Union directive on WEEE and became law in February 2003. The directive sets collection, recycling, and recovery goals for used electronic equipment.
  It required all of the EU's member states to adopt it into national law by August 13, 2004. The only country to meet this deadline was Cyprus. One year later, all member states except for Malta and the United Kingdom had adopted at least portions of the directive.

- **RoHS:-** The Restriction of Hazardous Substances Directive (RoHS) was adopted in February 2003 by the European Union. The directive restricts the use of six hazardous materials in the manufacture of certain types of electronic equipment:
  - Lead
  - Mercury

- Cadmium
- Hexavalent chromium
- Polybrominated biphenyls (PBBs)
- Polybrominated diphenyl ether (PBDE)

2.7 National Adoption

Although the WEEE and RoHS Directives come from the EU, countries have to pass their own national laws. Because each country has adopted varying versions of the WEEE Directive, there are different rules and regulations across Europe. Table 2-3 details specific countries' laws.

Country	Legislation Date	Adoption Details
Austria	April 2005	Austria's WEEE ordinance requires that producers register, mark new equipment for the Austrian market, and finance the collection, recovery, and recycling of WEEE.
Belgium	2004	Belgium is one of three European nations that implemented electronic waste disposal legislation prior to the EU WEEE Directive, but changed its legislation to include the EU's mandates.
Cyprus	June 2004	Companies importing or retailing electronic equipment must register with the Environmental Service.
Estonia	April 2004	Regulations set requirements and procedures for marking electronic equipment, targets for collection, and recovery or disposal of equipment. Estonia has been granted a grace period through December 31, 2008 to meet collection deadlines.
France	November 2006	The French decree implements the concept of producer responsibility for WEEE, and imposes WEEE takeback and recycling obligations. The decree imposes requirements

		with respect to product design, collection, recovery, financing, marking, and reporting. All producers are responsible for the collection and treatment of household WEEE. The decree also establishes penalties for noncompliance.
Germany	March 2005	Producers or distributors of electronic equipment in Germany must register with a clearing house, a private institution operated and financed by producers.When registering, producers must provide a guarantee for the financing recycling costs and the type and quantity of electronic equipment that will be marketed, collected, recovered, or exported outside the European Union. The law requires manufacturers to use the best available treat
Greece	March 2004	Producers and importers must hold a "certificate of alternative management," which varies depending on the territory in which the products are being marketed. The Greek WEEE regulation varies from the EU directive with a directive that requires that costs for the treatment of WEEE must be clearly visible in all invoices issued throughout the distribution chain.
Hungary	August 10, 2004	Hungarian law requires producers to collect and treat an annually increasing percentage of the EEE they place on the market. Producers must reimburse local authorities if they provide separate collection of WEEE from households.
Ireland	August 2005	Irish law requires producers and distributors of electronic equipment to register with the WEEE Register

		Society and join a compliance scheme to help meet their collection, recycling, and reporting requirements. Producers are responsible for financing the takeback of WEEE.
Italy	July 2005	Italian law establishes a Supervision and Control of WEEE Management Committee that oversees a central Italian register and clearing house. Manufacturers fund the program according to their market share. Italian law also requires information to be supplied to consumers, such as the penalties for incorrect disposal. Producers must ensure recovery of at least 80 percent of end-oflife goods listed. Producers are required to register at their local Chamber of Commerce before placing equipment on the market. They must also provide a guarantee to ensure the financing of the proper disposal of EEE placed on the market after August 13, 2005.
Lithuania	November 2005	Lithuanian WEEE legislation requires producers to register with the Environmental Protection Agency. Lithuania has been granted a grace period through December 30, 2008, to meet collection and recovery targets.
Luxembourg	January 2005	Luxembourg law requires all producers to register and provide a bank guarantee to cover WEEE management costs.
Malta	August 2004	Maltan law requires producers to finance collection, recovery, and recycling of WEEE. It also requires providing information to consumers about treatment sites. Producers should be able to fulfill obligations individually or through a collective.

The Netherlands	July 19, 2004	The Netherlands requires that producers guarantee they will finance the management of WEEE from private households for EEE placed on the market after August 13, 2005. Producers also must pay the costs of WEEE management in proportion to their market share for products placed on the market before August 13, 2005.
Norway	January 24, 2005	Norway had enacted WEEE legislation in 1998, but amended its preexisting law with the EU's RoHS and WEEE. The law requires reporting obligations on manufacturers and importers. Producers and importers must be members of a takeback company that has been approved by the Norwegian Pollution Control Authority. Businesses can bring WEEE to dealers selling the same types of products, only if they make a new purchase. Businesses can also deliver WEEE to municipalities. Consumers can deliver WEEE free of charge to dealers selling the same types of products and can bring WEEE to municipalities, free of charge.
Poland	October 20, 2005	Polish law requires producers to register with the government. Fees are calculated according to a producer's annual net turnover. Producers also must keep data and information regarding users and treatment facilities. In Poland, point-of-purchase is considered when goods enter the Polish market, offering a narrower definition than under the EU WEEE Directive.

Slovak Republic	April 29, 2005	Slovak law provides for a recycling fund into which producers pay quarterly, based on the difference between the recovery target and their actual recovery rate.
Slovenia	November 2004	Slovenia was granted a grace period until December 31, 2007 to meet EU WEEE Directive collection goals.
Spain	February 25, 2005	Producers may fulfill their WEEE obligations individually or through a collective plan. Spain's WEEE law requires producers to design and manufacture equipment that is easier to dismantle, repair, and reuse.
Sweden	2005	Swedish law requires producers to register with the EPA, finance the collection, recovery, and recycling, as well as mark new equipment for the Swedish market.
Switzerland	June 2005	Switzerland had legislation in place in 1998. Its version differs from the EU's WEEE Directive in that buyers of EEE pay a recycling fee to finance collection and treatment. Retailers, distributors, producers, and importers are required to take back WEEE of the kind of goods they market, manufacture, or import.
United Kingdom	January 2, 2007	The law requires manufacturers to recycle and dispose of used electronic equipment. Plans include a national Distributor Takeback Scheme, with treatment facilities to handle recycling and keep producers informed of returned products.

2.8 Asia

Asia is a large dumping ground for the world's e-waste, and several countries are trying to minimize the impact on their environments. This section takes a closer look at what's going on in Asia to protect their environment.

- **Japan**

While the bulk of e-waste is shipped to countries in Asia and Africa for recycling, and while the West is getting its e-waste house in order, the Japanese have made great strides in managing their own e-waste problem.

- **Life Cycle**

  The Japanese approach to the issue is different from other countries. Whereas Western companies look at the issue as a three-step process—pay a fee, get old materials hauled away, and dispose of them along environmental regulations—the Japanese see the issue in another way. The Japanese look at the product's end of life as another stage in the product's life cycle. Japan's own WEEE laws took effect in 2001, and the taking back, dismantling, and reuse of materials has become an integral part of the supply chain to create new products. For instance, glass from old televisions is reused in new televisions. Plastic is also reused. This helps Japanese companies meet reuse standards.

- **Waste Management**

  Japan's version of the WEEE Directive came in 1998 with the Japanese Home Electronics Recycling Law. In it, manufacturers were warned to prepare for collection and recycling by 2001. Many manufacturers decided to pool their resources with the Japanese government to open a pilot recycling project while the WEEE legislation was still being tweaked. The pilot plant was an opportunity to gather important information on cost, personnel, and how to meet reuse targets. This, in turn, helped shape the legislation. By the time the legislation was passed, companies were already prepared. Japanese electronic waste goes, mainly, to two large, centralized recycling companies, each operated by a consortium of electronics manufacturers. Companies don't involve third parties, but send them to these operations instead. This helps save money, because the middleman has been eliminated from the equation.

- **China**

Although China takes its lumps for being a destination of much of the world's e-waste, the nation is working to get e-waste legislation in place. The Chinese regulation is normally referred to as China RoHS. Though it is similar to the European Union's RoHS, it does take a different approach. The EU's RoHS lists specific categories of products. Specific products are automatically included in those categories unless specifically excluded. China RoHS, however, contains a list of included products. That list is called the Catalog.

➢ **Products**

There is, naturally, overlap between the two directives. But many product types that are not within the scope of EU RoHS are within the scope of China RoHS. China RoHS includes the following:

a) Automotive electronics
b) Radar equipment
c) Medical devices
d) Semiconductor and other manufacturing equipment, components, and some raw materials
e) Some packaging materials

By the same token, some categories of EU RoHS are not within the scope of China RoHS, such as toys and home appliances. Products shipped to China must be marked as to whether the items are compliant or noncompliant. The Electronic Information Products (EIP) logo or other label is used to mark parts that do not have unacceptable levels of substances listed by China RoHS.

➢ **Materials**

Products that contain hazardous substances must be marked with the EIP logo and include an Environmental Protection Use Period (EPUP) value listed in years. Like the EU RoHS Directive, China RoHS bans the following:

a) Lead
b) Mercury
c) Cadmium
d) Hexavalent chromium
e) Polybrominated biphenyls (PBBs)
f) Polybrominated diphenyl ether (PBDE)

- **Marking**

  Requirements also differ from the EU RoHS. The initial requirement is for a mark and disclosure of any of the six aforementioned hazardous substances and their locations within the product. Labels must contain the following information:

  a) Whether the product contains any of the six hazardous substances. If they are present, the "Environment-Friendly Use Period" (EFUP) must also be determined and indicated.

  b) Disclosure of which hazardous substances are contained in the product and the component(s) they are present in.

  c) Packaging material must be disclosed on the outside packaging.

  d) The date of manufacture.

The regulations have not been implemented yet, being postponed in their formal adoption twice. There is no formal schedule for completion of the Catalog.

- **Korea**

In April 2007, Korea adopted its Act for Recycling of Electrical and Electronic Equipment and Automobiles, also known as Korea RoHS. The act includes four main requirements:

a) Restrictions on hazardous materials
b) Design for efficient recycling
c) Collection and recycling of WEEE
d) Recycling of vehicles at end-of-life

The act went into effect January 1, 2008. Under the act, producers and importers of EEE or vehicles must make efforts to facilitate the recycling of waste by reducing the use of hazardous substances and making them more easily recyclable.

Producers are required to take back old products when selling a new one, regardless of whether the product was made by them—including packaging—free of charge. Any products to be recycled must be dealt with in an approved manner, by the reseller, by an individual producer or importer, or by a Mutual Aid Association.

It's helpful to realize what laws might apply to you and your company, but in the next section we'll roll up our sleeves and see how you can start making some environmentally and pocketbook-friendly changes to your organization's use of power.

2.9 Summary:

- Global Initiatives:
  UN is the highest level of global governance , has implemented its Solving E-waste Problem (StEP)
  - StEP is a program open to companies, non profit organizations around the world and as such.
- It's prime objectives are:
  - Optimizing life cycle of electrical equipments
  - Closing material loops
  - Reducing contamination
- StEP's based on five principles
- Task forces like :
  - Policy and Legislation, ReDesign, Reuse, Recycle, Capacity Building
- Basel Action Network and its functions
- BAN campaign membership:
  - E-waste Stewardship Project, Green Shipbreaking, Zero Mercury Campaign, Basel BAN Ratification.
- Basel Convention , it's application and additional regulation.
- European Union :
  - WEEE Directive
  - RoHS

2.10 List of References:

- www.brainly.com
- Researchgate Publication
- www.britannica.com

2.11 Self-Assessment Questions:

- What does StEP mean in global initiatives? What are its principles?
- What is the job of StEP?
- Explain the functions of Basel Action Network
- Differentiate between BAN and Basel Convention
- Short note on:
  a. National Computing Recycling Act
  b. Electronic Waste Recycling Act

- Write a note on the steps taken in managing their own e-waste problems by the countries mentioned below:
    a. Japan
    b. China
    c. Korea
    d. India
- Explain any five e-waste laws of US and Canada
- Which green computing initiatives were taken by California?
- Mention any five laws of national adoption in favor of green computing.

* * * * *

UNIT - II

3

MINIMIZING POWER USAGE

3.1 Objectives

- To learn the Minimizing power consumption in green computing devices.
- To understand the how to reduce electricity & trimmed
- To learn the issue of power consumption & offer recommendations to reduce it.

3.2 Introduction

To save money and to help the environment in the process that reduces use of electricity. It shows electricity how much you're using and where it can be trimmed. The issue of power consumption and provide some recommendations to reduce it across your IT department's infrastructure, from servers to workstations.

3.3 Power Problems

Power is a huge issue for businesses. Forget for a flash that this book is essentially about minimizing your IT department's impact on the environment, and appearance at it from a price point of view. For no other reason than saving tons of cash, energy efficiency is vital. But even beyond saving the earth and saving money, you would like to save lots of power, because at some point, not have enough power to run your equipment.

Energy-Saving Action	Savings (kW)	Savings (%)
Lower-power processors	111	10
High-efficiency power supplies	141	12
Power management features	125	11
Blade servers	8	1
Server virtualizations	156	14
Cooling best practices	24	2
Variable-speed fan drives	79	7
Supplemental cooling	200	18

Table 1 The Various Ways You Can Cut Power and Costs

- Power isn't cheap. As if rising prices aren't enough, data centers use a lot of electricity. U.S. datacenter power consumption totaled 45 billion kilowatt (kW) hours in 2005. That's more than Mississippi and 19 other states.
- It's a business imperative to reduce power use wherever it is possible. It's not just for the planet. It's not just to save some money. It's for the sake of your business. There are sundry changes you can make in your organization to save power. Some changes are big whereas others are small. Table 1 shows how making corrections throughout your organization can help you save money.

3.4 Monitoring Power Usage

- Clearly, the server room isn't the only place where power gets used.
- The whole organization uses power, all the time.
- The place to start is with an overall evaluation of the power you use. If an IT professional, then only interested in the computers and network infrastructure, but this task to whatever level of granularity you choose.
- For instance, although reducing server power draws and minimizing PC power usage seem obvious, it might decide to implement a plan where lighting automatically turns off.
- A small as directing laptop and cellular phone users to disconnect their chargers from the wall when they're not using them. Although there's no device plugged into the charger, the charger still sips at the electrical current.
- The organization can study its power usage. This can be considered the costs involved with doing the testing and what it would cost to contract out the project.

3.5 Servers

- To monitor power consumption it must use power-monitoring software. Without knowledge of where to start out , it's impossible to inform what proportion of a

drag is? and to what degree fixes are helping. Several vendors offer tools that help monitor data center power. As an example, IBM's Power Executive provides the tools needed to watch and manage power consumption accurately.

- It can measure real-time power consumption and warmth emission by individual server, server group, or location.
- It allows for the optimization of energy use and therefore the lowering of power consumption when low utilization can provide cost savings.
- These power monitoring and management capabilities are a crucial tool in achieving energy efficiency within the data center.
- With the help of results should be able to do the following:
    1. Understand the datacenter's thermal traits.
    2. Locate overlapping areas of cooling capacity. This shows high density or mission-critical equipment because of its ideal cooling location.
    3. Consider "what-ifs" with the placement of the datacenter

3.6 Low-Cost Options

There also are some very low-cost solutions for checking power on your workstations and standalone devices.

Kill A Watt

- The Kill A Watt device may be a product that plug into the wall then plug to computer or monitor into the device.
- The results show ways much power your device is using.
- True, it's not really practical in an environment with many workstations to frolic and connect this device.
- However, assuming all the devices' settings are an equivalent , can measure a few workstations and make some easy assumptions about power usage.

Calculator

Tech Republic offers a free worksheet to assist, identify various costs for monitor power. It allows you to try to the following::

- Determine what proportion of electricity to power your existing monitors.
- Compare new LCD and CRT monitors to work out which option is a smaller amount expensive.
- Compare different models of an equivalent sort of monitor to work out which one carries rock bottom total cost, when power is taken into account .
- Compare an equivalent monitor under two different operating scenarios. For instance , see what proportion of cost savings could be achieved by implementing a monitor's sleep mode rather than leaving it running at full power when not in use.

3.7 Reducing Power Use

If we get an idea of how much power is consumed, it's time to take steps. There are a number of ways to cut your electric bill.

3.8 Data De-duplication

- "data de-duplication" may be a tool for reducing storage and bandwidth consumed from disk-based backup. By eliminating the necessity to constantly copy an equivalent file over and once again , backup storage consumption is reduced 10 to 50 times. Because less data is shipped across the network, overall bandwidth consumption is reduced by almost 500 times.
- The obvious benefit is freeing up space for storing , but there are energy implications that affect your corporate ledger.
- Reducing the amount of knowledge copies reduces storage capacity needs and storage power consumption.

- Further, once data storage has been reduced, snapshots and other copies from high-performance disks are often shifted to lower-performance, energy-efficient disks.
- The benefit trickles down once you consider your organization's remote sites. Because less data is being replicated, money is saved because network traffic and storage capacity aren't being overused.

3.9 Virtualization

- The biggest power draw to your IT infrastructure is from servers. In and of themselves, they will garbage down 50 percent of the facility coming into your datacenter. The simplest thanks to reduce this power usage is to scale back the amount of servers used.
- In the past, it needed a lot of servers to satisfy mission-critical tasks, by consolidating several machines into one and through virtualization, this is often illustrated in Figure 1.

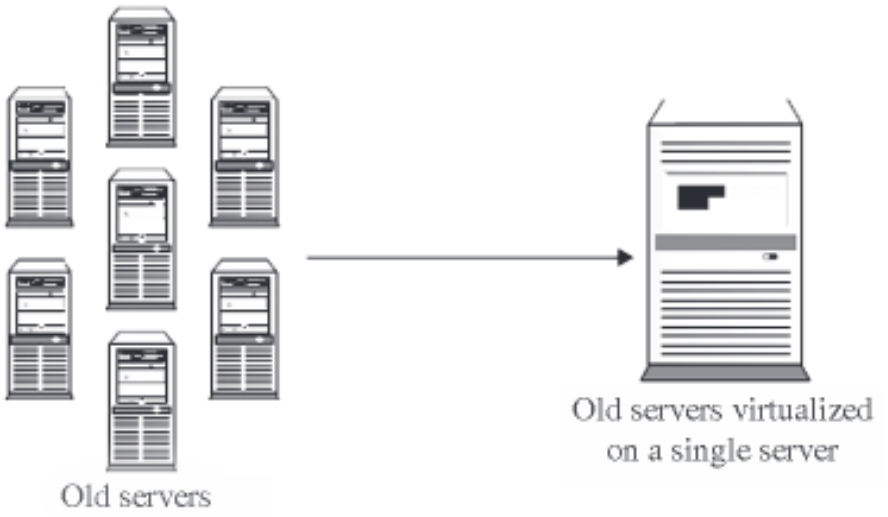


Fig. 1 Consolidating servers onto a fewer number of units conserves energy.

- Data storage is another massive consumer of power. Direct-attached storage can account for the maximum amount as 27 percent of your electricity bill. Direct-attached storage units fragment where data is stored within the organization. Also, each device must consume its own power.
- Clustering also involves identical hardware and operating systems to make sure a smooth rollover occurs within the event of tragedy. The prices add up, especially when one considers the value of the hardware and therefore the power draw especially from a largely unused device.
- If virtualized the servers, however, advanced clustering technologies allow them to act as traffic cops and move applications between servers and storage devices with precision. no matter what fails, Further, this causes a discount within the need for hardware, space, and energy usage.

Storage

- If an organization uses a lot of direct-attached storage, a huge power savings if we switch over to a storage area network (SAN). By removing file servers, it enables an instant reduction in power usage.
- A SAN also allows growth in a logical, efficient manner. With direct-attached storage, to add file servers to the network. The disks are added, which is considerably less expensive.

3.10 Management

- In many organizations, computers are used for just 4 hours each day. The extra 20 hours, those idle machines are still using energy while offline.
- The evaluation says that 65 percent of the energy used by computers and monitors is wasted because workers don't turn off computers when they leave for the day. In Addition, half of computers and monitors do not have a power management scheme applied, so more money is wasted when they fail to automatically switch off.

- A number of utilities are available that empower system administrators to easily manage power settings. These utilities normally enable sleep features built into prevalent operating systems and allow a computer to go into low-power-consuming sleep mode.

3.11 Bigger Drives

- Different technological blessing that can help to conserve power is to ditch all older, smaller hard drives and install a new, bigger one.
- Serial ATA (SATA) drives or storage devices use about 50 percent less power per terabyte (TB) than Fiber Channel drives. They are also higher in storage device density, which also helps reduce power consumption.
- For details, if HDD replaces 11 legacy drives with a modern, high-capacity drive, then get a 16 percent increase in capacity and use 81 percent less power. This saves 93 percent more floor space than with the other system.

3.12 Involving the Utility Company

To involve utility companies in our efforts to reduce power costs. They can offer power-savings tips as well as other services that can save money.

Monitoring

One way to monitor how much power is used is simply by contacting the utility company. They can provide historical information about how much power was consumed, and they can help figure out what currently is being used.

Sellback Opportunities

An organization is especially forward thinking and has turned to Mother Nature for its power needs. If that's the case or the idea simply piques interest that might be fascinated to know that those electrical lines running into your organization send power both ways. That is, if this generates more power than the using, it can sell it back to the power company,

as shown in Figure 2. The practice is called net metering, and most states have laws that direct utility companies to buy back power at the same rate they buy it from them.

Fig. 2 Net metering allows you to sell power back to the electric company.

If organization is examine relying on the sun for its power, and likely to sell back power to the utility company, they need a few things:

- Photovoltaic panels these panels absorb solar radiation. They are built of silicon and coated with tempered glass. Panels are typically climbed on the roof or on a free-standing pole.
- An inverter device controls the power and changes it to alternating current (AC).
- A meter is required that can run backward and can show how much organization is sending back to the utility company.

3.13 Low-Power Computers

- Computer manufacturers are starting to offer low-power models that consume less power than other computers.
- Of course, the workstations need or may not fall in line with the specs for these machines, but as more and more companies want to save money on power costs, look for more machines to be explained.

3.14 PCs, Linux

1. **PCs**

   Windows-based PCs are the backbone of industry. There are Macs and Linux boxes out there, but most companies run on Windows OS. There aren't too many models for low-power out there, but recent trends saw a variety of latest models introduced.

   Intel

   The new processor increases a PC's speed, reduces power requirements, saves on battery life, helps the environment, and comes in a smaller package for more designable and compact computer designs. With the arrival of the new processors, Intel will be offering a total of 32 desktop, laptop, and server processors.

   HP

   HP has initiated its own low-power PCs, including the rp5700. The PC praises a specialized design with additional cooling features. This enables it to be in higher temperature environments than most other PCs. Its energy efficiency brings from S3 power management, specialized Intel processors, and 80 Plus power supplies.

2. **Linux**

   Low-power Linux machines have mostly been like the OS itself homebrew devices.. But there are companies that enable their own low-power Linux options.

Example 1

The MicroClient Jr. boots from CompactFlash rather than a hard drive. Other features include:

- Fanless design
- 128MB SDRAM

- Input/output ports
- IDE
- 10/100 Mbps Ethernet
- 3 USB V1.1 ports
- Optional RS232
- CompactFlash slot for expansion
- 2.5-inch hard drive mounting

Example 2

The Bubba server was designed to be left on all the time, without using much power or generating a lot of noise. It draws a maximum of 10 watts. Bubba's hardware specs include :

- 200MHz ARM processor
- 64MB RAM
- 3.5-inch, 7200rpm 80GB, 320GB, or 500GB IDE hard drive
- 1 x 10/100 Ethernet
- USB 2.0 type A to printer or memory stick connection
- USB 2.0 type B to PC connection
- 7.2 × 4.5 × 1.7 inches
- 3.7 pounds

3.15 Components

- The big power draw is the server room, that's no secret. However, a number of other places within IT infrastructure can save little watts. the large numbers adding up like they do in the server room, but every bit helps.
- if this replicating a setting changes across hundreds or even thousands of workstations, those savings will add advantages.

3.16 Servers

- Reduce the amount of energy of servers used by deploying blade servers and by virtualizing these servers.
- Blades are entire computers contained on a card that can be inserted into a huge device. As such, rather than one server taking a whole rack, 20 blades can be installed into one unit.

Usage

Blade servers consume about 10 percent less energy than equivalent rack mount servers because multiple servers share common power supplies, cooling fans, and other components etc. Blades are popular because they not only minimize the amount of space needed, as Figure 3 shows, but also because they use less power.

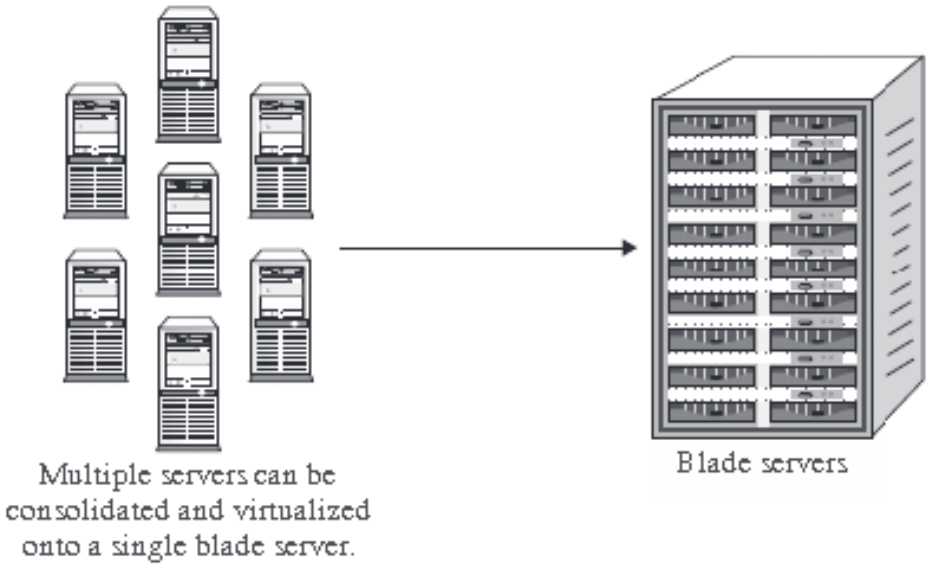


Fig. 3 The work of many servers can be offloaded onto one server

containing many blades.

- Numerous organizations have a large number of servers, each running one application. This separates us and isolates the units, and if there is a failure only that application is affected on the system. Even though there is some logic behind this setup, the presence is that each server only has a 5 to 10 % CPU utilization rate. This boils down to a bunch of hardware taking up a lot of space.

3.17 Computer Settings

- Although establishing policies to govern computers' monitor power settings is a great place to start, there are some other places where they make more precise changes for real savings.

Polling

- Periodic polling is that, the computer automatically checking to see if a given action has been taken draws power from idling computers, because it automatically wakes the computer up to check for a given event.
- Every time an application polls for something, the CPU wakes from an idle state and consumes power.
- Not be able to eliminate all polling tasks, but can manage them.

Turn Off Unused Devices

- This looks like a no-brainer. If a computer or other device is not going to be used in the certain future, turn it off.
- Failing that, at least set up the computer so that it hibernates after a certain period of nonuse of the device.

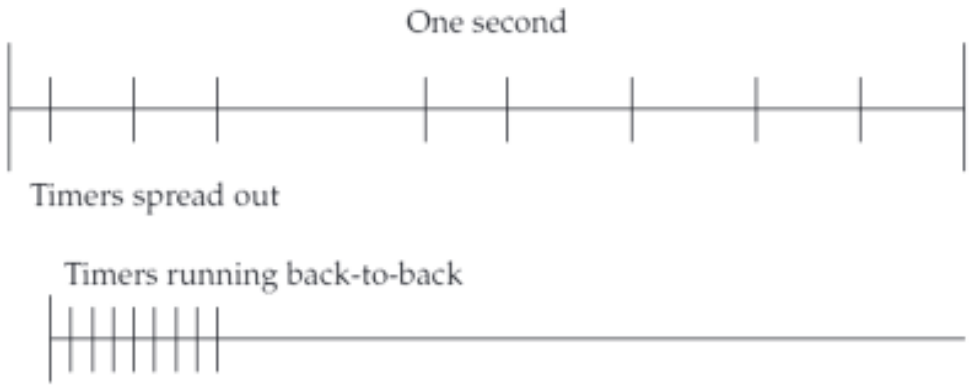


Fig. 3 Group your timers together so that they reduce the amount of time the computer has to be polled.

Use Large Buffers

- If any organization is one where media is played from a CD, DVD, or hard drive, make sure that applications' buffers are set large enough to store as much of the media in memory as possible.
- Doing this reduces the hard drive, DVD, or CD drive from spinning as much and thus saves power.

3.18 Storage

- Storage is another huge area in the realm of power consumption.
- To measure redundancy protecting your data, it's simply wasteful and inefficient to have hundreds of drives resolve away when a number of will do the trick.
- Organization's storage started in one, reasoning way, but has since become something else.

Green Drives

- Green hard drives are drives that lessen the amount of power they use through a collection of mechanisms, including unloading the heads during inactive time to reduce trim drag.

- Further, the drives calculate the minimum seek speed to use just the amount of power required.

MAID

- A large array of idle disks (MAID) is a system that employs hundreds or thousands of hard drives for near-line data storage. the power used to run them as well as minimizing the generation of heat, which in turn lesser cooling costs.
- MAID differs from RAID in that it has increased storage solidity and is much less costly, thus saving power and the need for cooling.
- MAID comes with some settlement, however, such as increased latency, lower throughput, and much lower redundancy.
- Although a MAID solution can be slow, data access can take a few milliseconds up to 10 seconds, it is much faster than tape drive, which can take 60 seconds or longer to access data. Drives that are designed for repeated spin-up or spin-down cycles are much more costly.
- The MAID architecture is developed because of the introduction of SATA drives that are invented to be powered up and down. In a large deployment, MAID allows a dense packaging of drives, and typically only 25 percent of the disks are spinning at any given time, as shown in Figure 4. It resolves the problem of throughput.

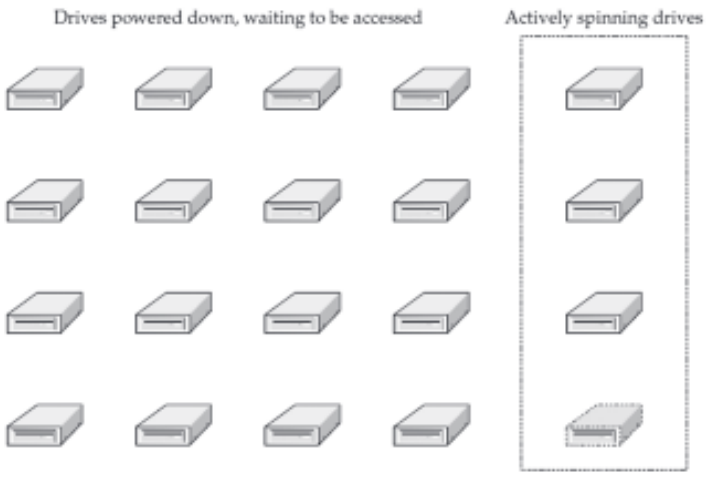


Fig. 4 In a MAID deployment, only a quarter of the disks are spinning at any one time.

Power-managed RAID

- The plan behind RAID has always been to safeguard your data. But employing multiple, always on drives jacks up the power consumption. To deal with this issue, a new form of RAID has been initiated.

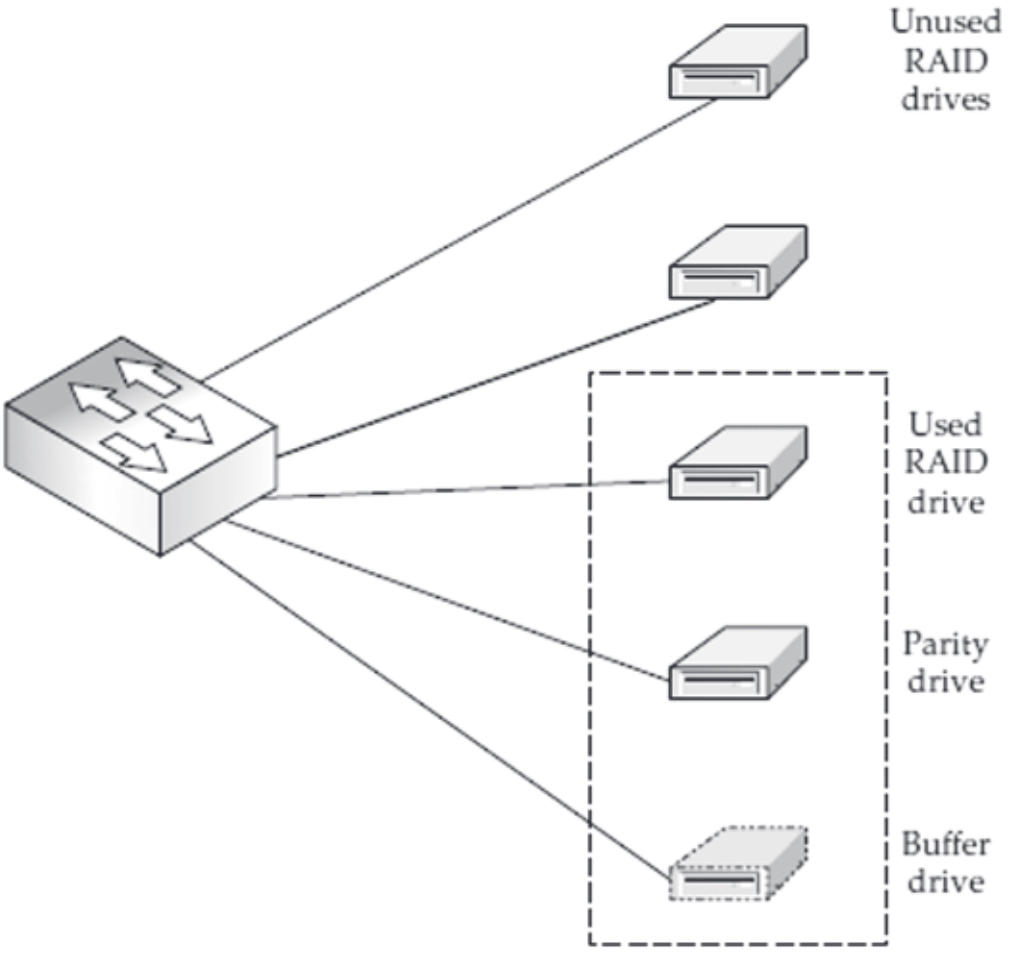


Fig. 5 Power-managed RAID only uses the drive where data is being stored and the parity drive.

- Power-managed RAID provides parity protection, but with just some of the RAID disks actually turned on. When data is written, only the parity and associated data drives are powered up. When data is read, only the disk being read must be powered up. this is often illustrated in Figure 5.

- No disruptive and sequential read/writes are accomplished by staging the info to an always-spinning drive, while subsequent drive is being powered up. The results that your organization can have many terabytes in storage during a single footprint.

3.19 Monitors

- Monitor is used 100 W of power while they are on. In sleep mode, they use 5 W or less. Adjusting monitors to automatically enter sleep mode after a period of nonuse device is a quick-and-easy way to reduce costs of power. LCD displays aren't required to be less power hungry than CRTs. It depends on the model. It's the best way to evaluate monitor power.

Settings

- The setting up monitors to turn off after a certain period of nonuse. subtle changes to your computers' settings that can reduce costs while they are turned on.
- Clearly, managing the colors on your monitor especially backgrounds can save money.

Color	Watts Used
White	74 W
Fuchsia	69 W
Yellow	69 W
Aqua	68 W
Silver	67 W
Blue	65 W
Red	65 W
Lime	63 W
Gray	62 W
Olive	61 W
Purple	61 W
Teal	61 W
Green	60 W
Maroon	60 W
Navy	60 W
Black	59 W

Table. 2 Different Colors Use Different Amounts of Power

- White and bright colors use max up to 20 percent more power than black or dark colors. Table 2 shows power colors. After multiplying that by the number of computers in the organization a huge difference will come.

The Power Switch

- The best way to save energy is to switch off the monitor. Some users don't know, but there is a power switch, located on the front or the side of the monitor. Turn it off when the computer's not going to be in use for a particular duration, and you get the ultimate saving i.e. zero watts of energy used.
- Another way is to use the Energy Star settings in Windows to turn the monitor off after a while, but those settings take little time to set in.

3.20 Power Supplies

- The components that enter your computers or other devices, use people who conform to the 80 Plus standard.
- This requires power supplies in computers and servers to be 80 percent or greater energy efficient at 20 percent, 50 percent, and one hundred pc of the rated load.
- The EPA finalized updated performance requirements for computers and servers that include the more efficient 80 Plus standards.

3.21 Wireless Devices

Wireless Devices or radios consume power for both transmitting and receiving. Most laptop adapters use their radios, even if they're not connected to an access point (AP).

WiFi

- Access Points announce their presence at regular intervals by sending a beacon packet.
- The default interval for many APs is about 100 milliseconds.

- The impact of the beacon interval is most noticeable when it's trying to seek out a network to accompany.
- This is shown in Figure 6. Association requires a WiFi radio to tune to every channel and listen for the AP to broadcast a beacon.
- The longer between the intervals, the longer the radio must serve each channel.
- In addition to the radio overhead, the downside of tons of broadcast beacon packets is that with some wireless adapters, the PC must begin power-saving idle states to process the packets.
- For laptops that are on the brink of the AP, you'll be ready to save a little bit of power by going into the executive page of the AP and increasing the beacon Interval.

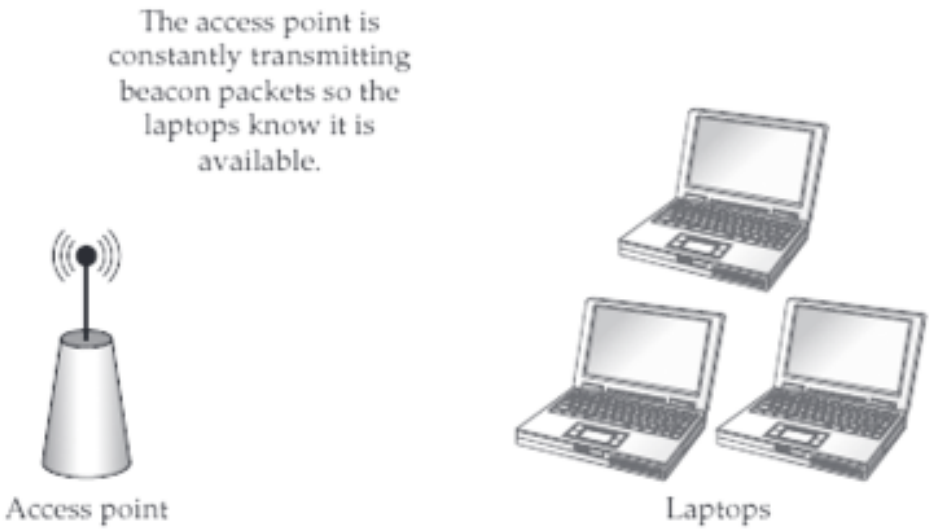


Fig. 6 APs regularly transmit beacon packets so that wireless clients can find them

3.22 Software

- Although it's possible to manage many power settings using Group Policy in Windows or a similar tool in Linux and Mac environments, some companies are making the process even easier and marketing power-saving software.

- As repeatedly stated, power consumption is a major issue. It affects the environment, it affects your bottom line. By using the mechanisms that should be able to see some appreciable cuts in your power usage. But even as optimal as a system is, it's still going to use power, and that power will generate heat.

3.23 Summary

- We analyze the power problem in today's world, how to monitor them.
- A small as directing laptop and cellular phone users to disconnect their chargers from the wall when they're not using them.
- Doing this reduces the hard drive, DVD, or CD drive from spinning as much and thus saves power.
- Reducing the amount of knowledge copies reduces storage capacity needs and storage power consumption.
- A large array of idle disks (MAID) is a system that employs hundreds or thousands of hard drives for near-line data storage. the power used to run them as well as minimizing the generation of heat, which in turn lesser cooling costs.

3.24 Reference for further reading

- Green IT, Velte & Elsenpeter, McGraw Hill, 2008

3.25 Unit End Exercises

1. Write a short note on Data De-duplication?
2. What is MAID? Explain Power-managed RAID?
3. Explain the Virtualization in Minimizing power usage?
4. What are low-cost solutions for checking power on your workstations and standalone devices.?

* * * * *

4

COOLING

4.1 Objectives
4.2 Introduction
4.3 Cooling Costs
4.4 Power Cost
4.5 Causes of Cost
4.6 Calculating Cooling Needs,
4.7 Reducing Cooling Costs
4.8 Economizers,
4.9 On-Demand Cooling,
4.10 HP's Solution,
4.11 Optimizing Airflow,
4.12 Hot Aisle/Cold Aisle,
4.13 Raised Floors,
4.14 Cable Management,
4.15 Vapour Seal
4.16 Prevent Recirculation of Equipment Exhaust,
4.17 Supply Air Directly to Heat Sources,
4.18 Fans,
4.19 Humidity,
4.20 Adding Cooling,
4.21 Fluid Considerations,
4.22 System Design,
4.23 Data Centre Design,
4.24 Centralized Control,
4.25 Designs for Your Needs,
4.26 Put Everything Together.
4.27 Summary
4.28 Reference for further reading
4.29 Unit End Exercises

4.1 Objective

- To examine cooling issues in the datacenter as well as where you can save money, and it provides some tips for adding cooling capacity without spending more money than need to.
- To understand that reduces how much power the datacenter consumes.

4.2 Introduction

- In this topic we learn strategies to reduce power that is used by the datacenter which consumes. With any amount of power comes heat, and if there's too much heat in the datacenter.
- Data center manager wants to keep things cool, but you don't want to walk in and see polar bears curled up on the floor shivering. Overcooling your datacenter is a very common problem.
- Data Center managers don't want their equipment to overheat, but they're spending money when they use too much cooling power.
- This examines cooling issues in the datacenter as well as where can save money, and it provides some tips for adding cooling capacity without spending more money.

4.3 Cooling Costs

- Some estimates state that cooling can account for upward of 63% of your IT department's power usage. That's obviously an enormous amount and not something that ought to be overlooked.
- If more cooling power is needed, rather than simply turning up the air conditioning, it's useful to figure out the quantity of spending and how much actually needs to be spent.

4.4 Power Cost

- Electricity is paid for per kilowatt-hour (kWh). This is a calculation of the hourly consumption of electrical power.
- For the purpose of easy math, let's use a basic electrical device: the household incandescent light bulb to determine how much electricity costs.
- A 100 watt bulb uses 100 watt hours of electricity in 60 minutes duration. like, ten 100 Watt light bulbs will use a total of 1 kWh of electricity per hour. But electrical power costs are different around the country.

- Electricity costs different amounts in different places. Table 1 compares the average price per kWh for each region and shows how much it has increased in one year.

Region	Commercial Power Cost in 2007 (Cents per kWh)	Commercial Power Cost in 2006 (Cents per kWh)
New England	14.79	14.66
Middle Atlantic	13.2	12.81
East North Central	8.62	8.18
West North Central	6.86	6.75
South Atlantic	8.63	8.42
East South Central	7.97	7.97
West South Central	9.37	9.33
Mountain	7.73	7.61
Pacific Contiguous	11.27	11.36
Pacific Noncontiguous	16.94	17.35

Table 1 Price per kWh Varies Around The Nation and Is Increasing

4.5 Causes of Cost

- Cooling is a major component of power consumption and by extension, IT budget.
- A number of issues extends power consumption and cooling costs, including the following:
    1. Increased power expenditure as more servers and storage devices are deployed.
    2. Increased heat solidity in the racks because of increased computing power in a confined space.
    3. Irregular heat load in the data center. This is irritated by poor planning for heat management as the topology of the data center changes.
    4. Increasing power costs across the different locations.
    5. A tendency to over cool data centers. The "flood-cooling impulse" leads data center managers to overcool their data centers by more than two and a half times what is needed.

Figure 1 shows where data centers are using electricity.

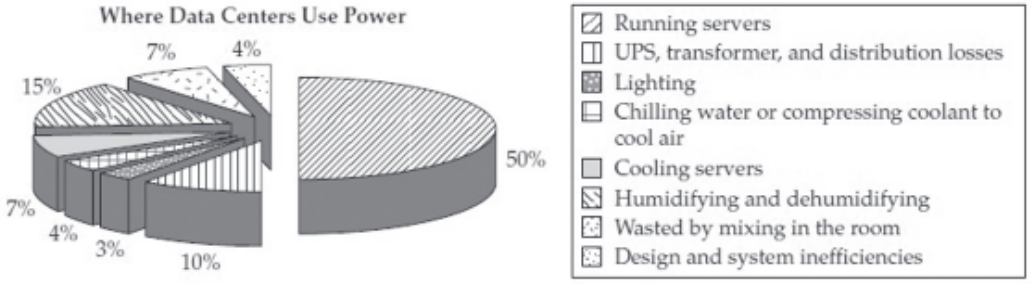


Fig. 1 data centers are using electricity.

4.6 Calculating Cooling Needs

- The requirement of cooling needs your system at the data center.
- All the equipment in the server room generates heat while running.
- All these sources of heat contribute or supply to the heat load of the server room.
- Generally. This number is expressed in British Thermal Units (BTUs) or kW. One kilowatt is the same as 3412 BTUs.
- Before buying any new cooling equipment, it's important to figure out how much is required.
- To find the heat load, must take into consideration a number of factors, not just the heat load of equipment.

The following points address these additional considerations.

- **Room Size**
  The room itself requires cooling. To calculate the cooling needs of the room, use this formula:

  Room Area BTU = Length (meters (m)) × Width (m) × 337

- **People in the Room**
  If people are located in the server room, the heat load goes up about 400 BTU per person.

  Here's the formula: Total Occupant BTU = Number of occupants × 400

- **Equipment**
  Clearly, most of the heat generated is from equipment. the equipment's power consumption in its documentation or on the vendor websites.

  Formula:
  Equipment BTU = Total wattage for all equipment × 3.5
  Lighting multiply the total wattage for lighting by 4.25, as shown in the following formula: Lighting BTU = Total wattage for all lighting × 4.25

- **Total Cooling Requirement**

  Total Heat Load = Room Area BTU + Windows BTU + Total Occupant BTU + Equipment BTU + Lighting BTU

4.7 Reducing Cooling Costs

- If the datacenter's cooling consumption cost may occur in a billing (or have been afraid to), there are some ways we can reduce costs.
- If you find a data center needs more cooling, it might be learned to deploy equipment that won't chow down a lot of power. Table 2 shows how much money different-sized data centers can save in different parts of the world.
- It also shows how much pollution can be cut when optimizing cooling. Here we learn about some equipment that can use and save money and help supplement your environment.

Datacenter Size (Wattage)	Small (1.5 MW)	Medium (3.5 MW)	Large (8 MW)
Cooling type	Air	Chilled water and air	Chilled water and air
Potential savings	40 percent	30 percent	20 percent
U.S. estimated annual cost savings (@ $0.11/kWh)	$578,000	$1,012,000	$1,542,000
Europe, Middle East, and Africa estimated annual cost savings (@ $0.15/kWh)	$788,000	$1,380,000	$2,102,000
Asia, Pacific, and Japan estimated annual cost savings (@ $0.24/kWh)	$1,261,000	$2,207,000	$3,364,000
Reduction in CO_2 emissions (metric tons per year)	5000	8780	10,000

Table.2 Cost Savings and Pollution Reduction Based on Cooling Optimization

4.8 Economizers,

- Nature, winter provides an opportunity to enhance the cooling system by using the cold outside air to cool things down.
- But it isn't as simple as opening a window to accomplish this. To do so, you need to employ what is called an economizer.
- There are two types: air-side economizers and waterside economizers.

Air:

- An air-side economizer regulates the use of outside air for cooling a room or a building. It employs sensors, ducts, and dampers to regulate the amount of cool air brought in.

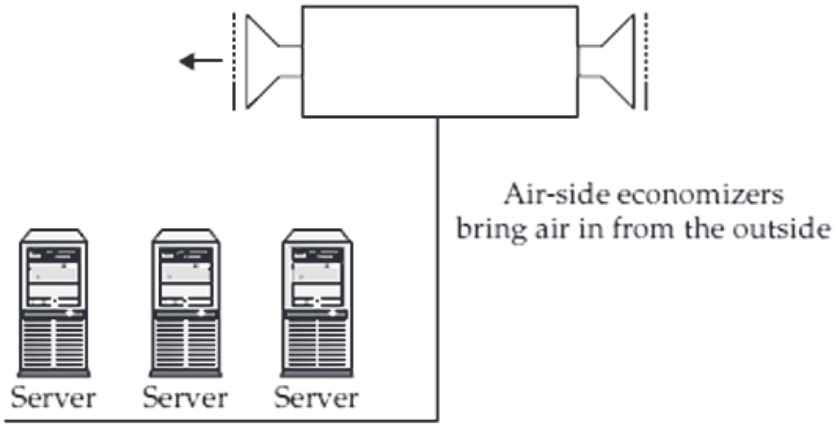


Fig. 2 Air-side economizers draw in outside air to cool the datacenter.

- The sensors calculate air temperature both inside and outside the building. If it notices that the outside air is suitably cold enough to cool the datacenter, it will adjust its dampers to draw in the outside air, making it the main source of cooling.
- This cuts or eliminates the need for the air = conditioning system's compressors, which provides a big cost savings. This is illustrated in Figure 2.
- Their main strength is over contamination and humidity levels. As long as the economizers are drawing air in from outside, pollution can potentially enter the datacenter.
- A larger concern is the change of humidity in the datacenter.
- If air-side economizers are something an organization wishes to employ, you should consider air filters and supplemental humidification.

4.9 Water-side economizer:

- A water-side economizer utilizes evaporative cooling, provided by cooling towers to indirectly produce chilled water to cool a datacenter when outdoor conditions are cool.
- This is best for environments with temperatures below 55 degrees Fahrenheit for 3000 or more hours a year.
- While using economizers, chilled-water-plant energy consumption can be cut by up to 75 percent.
- Using this it helps in reductions in maintenance costs, because the fluid-chilled cooling system allows drastically reducing, maybe even completely eliminating the need for chiller operation.
- Water-side economizers are beneficial, because not only do they save costs, but they don't allow contaminants or altered humidity levels into the datacenter.

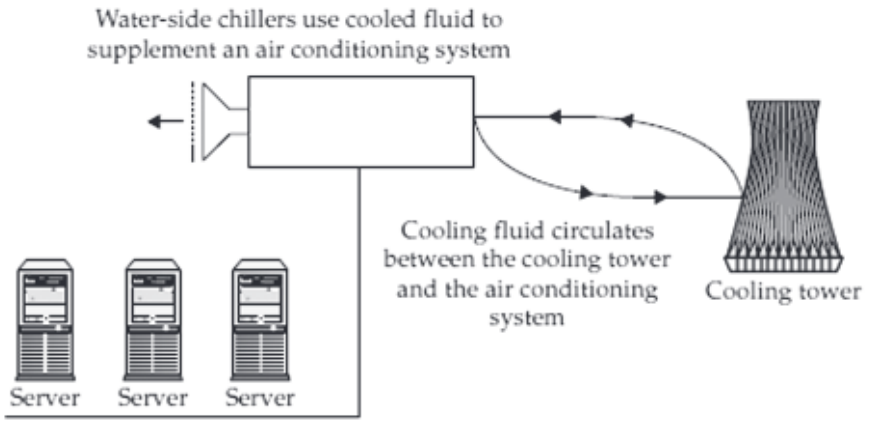


Fig. 3 Water-side economizers cool using a loop connecting to a cooling tower, evaporative cooler or dry cooler.

- Water-side economizers work with a cooling tower, evaporative cooler, or dry cooler to cool down the datacenter. This kind of economizer is normally incorporated into a chilled water or glycol-based cooling system.
- Fluid in the cooling system passes through a coil to cool the room, thus eliminating the need for the compressor to operate. A water-side economizer is shown in Figure 3.

4.10 On-Demand Cooling

On-demand cooling systems are becoming more and more common. These units are brought in to provide temporary cooling when central air is descending. They are also widely used in datacenters. There are two types of on-demand cooling systems, very similar in function to economizers:

- Air to air smaller air-to-air coolers can be wheeled into the room needing cooling. They use flexible ductwork to connect to a window, and then the generated heat is transferred out of the building. They can be plugged into a standard 110-volt wall outlet. Larger units can be mounted on the outside of the building, with cool air being ducted through a window. These units operate on temporary 208-to-230-volt circuits.
- Water based these are much larger units, where a standard garden hose is connected to the device so that water flows in, cools down the equipment, and then is sent through a second hose to run down a drain.

4.11 HP's Solution

- Hewlett-Packard offers a cooling technology that it says can cut an IT department's power costs by up to 40 percent. The system, called Dynamic Smart Cooling, uses sensors to regulate the temperature in specific areas of the datacenter. HP labs were ready to reduce the facility to chill a datacenter from 45.8 kW employing a standard industry setup to 13.5 kW.
- Dynamic Smart Cooling is an intelligent solution, and instead of turning the datacenter into a meat locker, the system allows air conditioners managed by specially designed software to manage the cold air delivered to an area supported the requirements of specific computers.
- Dynamic Smart Cooling uses the datacenter's air con system to adapt to changing workloads with sensors attached to the computers. If the system senses that a computer is warming up an excessive amount of , air conditioners will send more cool air.

4.12 Optimizing Airflow

- Exchange of air is important.
- To bring the precise cooling environment, air must be exchanged at a sufficient rate.
- In high-density data centers, air has to be exchanged 50 times an hour. If sufficient air is not exchanged, cooling air will heat up before it reaches the equipment and disaster could occur.
- Optimizing airflow reduces cooling costs. It helps minimize costs without you having to buy the newest product.
- That can help optimize the airflow around servers and other networking equipment.

4.13 Hot Aisle or Cold Aisle

- Equipment is typically described to draw in air from the front and then blow the exhaust out the rear. As Figure 4 shows, this enables equipment to be arranged to create hot aisles and cool aisles.

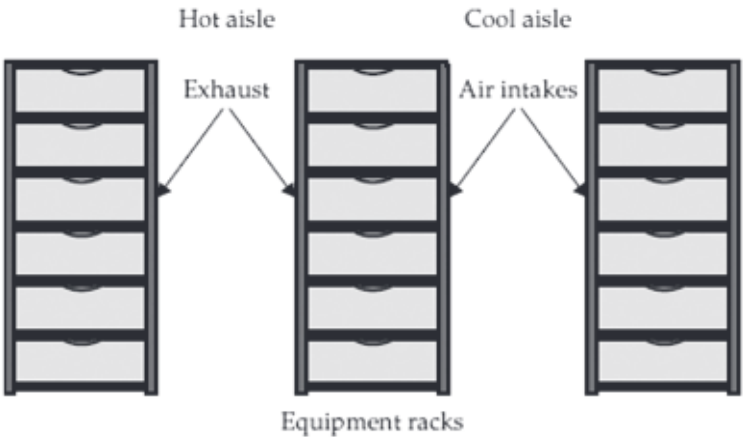


Fig. 4 Equipment can be configured in a hot-aisle/cold-aisle configuration

- In the above figure is that the cool sides of equipment are arranged together, whereas the hot sides of equipment countenance each other.
- This allows the equipment to attract cool air, instead of air that has already been preheated by the rack of kit ahead of it.
- The cold aisles have perforated floor tiles to draw cooler air from the raised floor.
- Floor Mounted cooling is placed at the end of hot aisles, but not parallel to the row of racks.
- This is because parallel placement can cause the hot exhaust to be drawn across the top of the racks and mixed with the cool air. It also decreases overall energy efficiency.

4.14 Raised Floors

- Data Centers are precisely constructed on a floor that is heightened 18 to 36 inches.
- The heightened the floor level, the more air that can be given out under the floor and the more air that can be used by the cooling system.
- There can be major interruption to day-to-day operations. Plus, the higher up build the floor builds, evidently, the closer to getting to the ceiling.

4.15 Cable Management

- Developing a good cable management system in conjunction with the hot-aisle/ cold-aisle design can equate to more energy efficiency.

- Whenever possible, it's best to route your cables under the hot aisle, as shown in Figure 5.
- This reduces the cool air's path to the equipment as it is drawn in through the perforated tiles and into the equipment's' cooling systems.

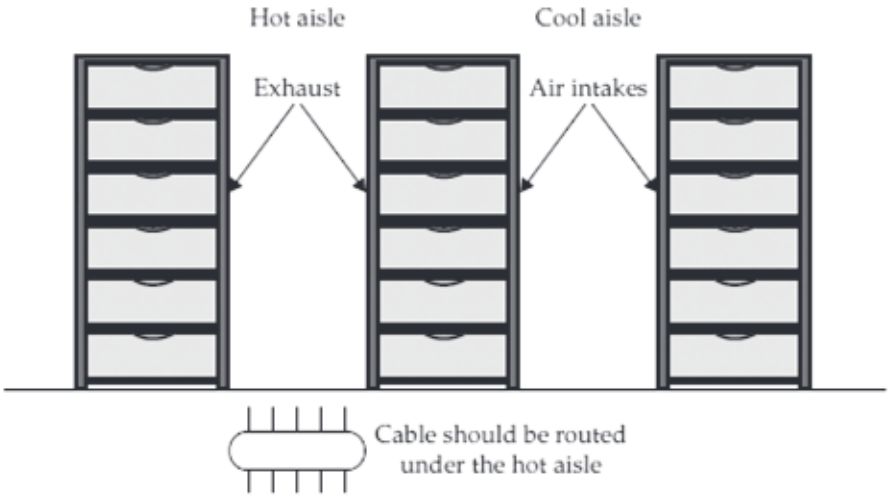


Fig.5 Route cables along the hot aisle whenever possible to avoid airflow problems in the cool aisle.

- Racks provide expansion channels that help with cable management and ease heat removal for high-density racks.
- Some organizations also are running cabling above or through racks, instead of under the floors, to scale back the interference with the flow of air from below.
- Further, some organizations are deploying advanced power strips to bring the facility load closer to the rack instead of running numerous cables through the datacenter.
- Messes of cabling that resemble a huge blue or grey spaghetti bundle. These bundles act like covering, trapping heat near the equipment and preventing cool air from passing through.

4.16 Vapour Seal

- It's also important to ensure a good vapor barrier in your datacenter, cutting it off from the rest of the building.
- If this has a poor vapor barrier, humidity will move into the datacenter during hot months and escape during the winter months.
- A good vapor seal reduces the costs to humidify or dehumidify.

4.17 Prevent Recirculation of Equipment Exhaust

The following are some simple steps that employ a datacenter to stop exhaust from being reabsorbed by other devices. These are illustrated in Figure 6.

1. Hot-aisle/cold aisle Employ the hot-aisle/cold-aisle design mentioned earlier during this chapter.
2. Rigid enclosures to stay exhaust heat from being sucked back to the device's cool air intakes.
3. Flexible strip curtains Use flexible strip curtains to dam the outdoors above your racks that are configured into a hot-aisle/cold-aisle layout.
4. Block unused rack locations with blanks Equipment typically draws in cool air from the front and exhausts it out the rear.
5. Design with cooling in mind Although most do, some equipment doesn't draw air in from the front and exhaust it out the rear. Some have top-discharge or side to-side designs. Configure your racks to make sure your equipment doesn't blow into the intake of other equipment.

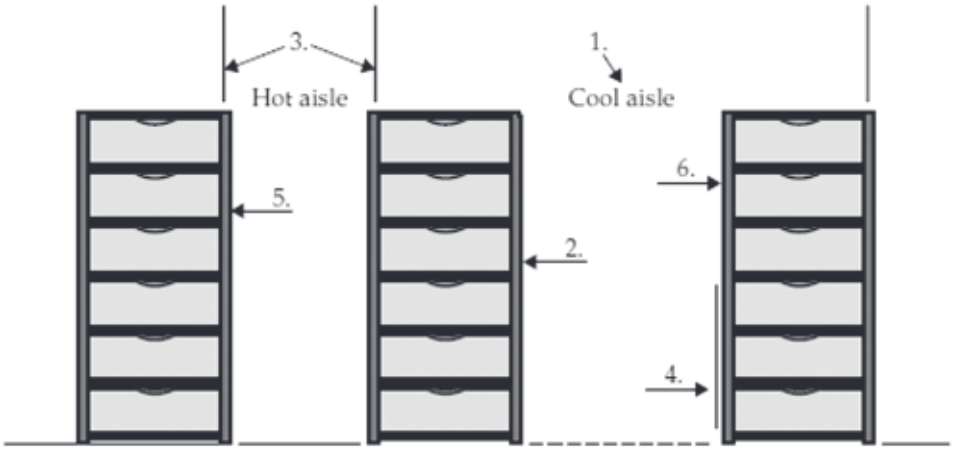


Fig. 6 You can prevent exhaust from overheating your equipment by following some simple steps.

4.18 Supply Air Directly to Heat Sources

To cool the entire datacenter, also can save money and cool down the devices generating heat. These idea can help:

- Use the correct diffusers The type of diffuser would use in an office is not appropriate for a datacenter. Select diffusers that deliver air directly to the equipment that needs cooling.

- Correctly place supply and returns Diffusers should be placed right by the equipment to be cooled. The direct cooling air at heat exhausts, but rather into the air intakes.
- Supplies and slotted floor tiles should not be placed near returns to prevent a cool air "short circuit."
- Lessen air leaks Systems that use a raised floor can lose cool air through cable accesses in hot aisles.
- Optimize air conditioner placement In large data centers, a computational fluid dynamics (CFD) model would be useful. This enables locate the best placement for cooling units. It also helps minimize the distance between air conditioner units and large loads.
- Use properly sized plenums Return plenums need to be the right size to allow a lot of air to flow through. Obstructions such as piping, cabling trays, and electrical conduits need to be taken into consideration when plenum space is calculated.
- Provide sufficient supply Under-floor supply plenums must be big enough to allow enough air to service your equipment. This considers the obstacles such as piping, cabling trays, and electrical conduits.

4.19 Fans

Fans consume a lot of power, mainly when a lot of them are spinning at the same time. Following are the tips to improve fan efficiency:

- For improvement we use low-pressure drop air handlers and ductwork. Make sure there is enough volume in your under-floor plenums to allow air to flow.
- Use redundant air handlers during standard operations It is more efficient to use auxiliary fans at a lower speed than a single fan at high speed.
- Power usage drops with the square of the velocity. In consequence, operating two fans at 50 percent capacity uses less power than one fan at full capacity.

4.20 Humidity

- Datacenter cooling systems must also be capable of adapting to exterior temperature and humidity. Due to these factors will change depending on where on the globe the datacenter is located along with the time of year.
- Datacenter air-conditioning systems must be able to adapt to these types of changes. Too much humidity can devastate datacenter equipment. little humidity can wreck your datacenter equipment.

Following are the tips to help keep datacenter at the right level:

1. **Setup a humidity sensor** calibration schedule Humidity sensors drift and require frequent calibration more so than temperature sensors. Wrong humidity sensors are less likely to be noticed than incorrect temperature sensors. As such, establish a frequent test and calibration schedule for your humidity sensors.
2. **Allow for sensor redundancy** Make sure you have enough sensors to keep an eye on your datacenter's humidity level. To establish a tight control, multiple sensors should be used.
3. **Control humidity** with a devoted unit if ventilated air is used control humidity with a single ventilation air handler.
4. **Lock out economizers** when needed, when using an air-side economizer, minimize the amount of air that's brought in when the dew point is low.
5. **Centralize humidity control** Each datacenter must have its own centralized humidity control system. Multiple systems wind battle each other, and the system becomes less efficient.

4.21 Adding Cooling

- If your datacenter is mostly "equipment dense," This needs to add some extra cooling capacity.
- The best way to cool devices or equipment is to make sure the cooling gear is as near as possible to the heat sources.
- Before using a cooling system, to know about what type of system to use (air or fluid based) and what type of design the system will use.

4.22 Fluid Considerations

- Fluid is beneficial to move heat from equipment (in this case, the engine) to keep it cool.
- Fluid-based cooling systems have no place in data center environments. If you need to use them, use them with care.
- Water is not only fluid used for cooling.
- Water is used only for floor-mounted cooling, due to safety concerns, R134a refrigerant is normally used when cooling is used closer to the equipment.
- This is because refrigerant turns into a gas when it reaches the air, so leakage doesn't constitute a threat to your equipment. Table 3 lists the advantages and disadvantages of both solutions.

- Fluid solutions engage microchannel coils for better efficiency, and a low-pressure system results in minimum operating costs.
- It can also provide energy efficiency savings of between 25 and 35 percent based on kilowatts of cooling capacity per kW of heat load.

	Advantages	Disadvantages
Chilled water	• Less expensive • Room sizes don't matter	• Electrical hazard • Less efficient • Fluid treatment may be necessary to prevent fouling • Limited overhead cooling options
Refrigerant	• No electrical hazards • Lower operating costs • Smaller piping requirements • More compact heat exchanges	• Potential compatibility issues with small rooms • More expensive

Table 3 Advantages and Disadvantages of Water and Refrigerant

4.23 System Design

- The cooling system's design is important to consider while getting close to the heat source.
- There are two common designs in data centers: open and closed.
- In a closed design, the electronics and cooling equipment are situated in conjunction in a sealed environment. This is the high-capacity cooling solution.
- This preferred only open design, because a closed solution offers little flexibility.
- This enables it to be much safer for both organization's data reliability as well as the hardware's physical health.

4.24 Data Centre Design

- For optimizing cooling, the data center needs to design.
- A number of issues can help to reduce the amount of cooling that need, and its fully depend on the design of datacenter and how cooling is deployed.

4.25 Centralized Control

- While designing a cooling plan, it's best to employ a custom centralized air-handling system.
- This type of system offers several benefits over the prevalent multiple-distributed unit system, including the following:
    1. Better efficiency.
    2. Surplus and redundant capacity.
    3. Work in conjunction.
    4. More efficient than water.
    5. Less maintenance.

4.26 Designs for Your Needs

- The data center's power needs rarely get the exact fit they need. They are usually loaded too light.
- It is important to get as close as with electrical and mechanical systems so that they can operate properly when under loaded, but are still scalable for larger loads. You can come close to this Zen-like balance, some issues are:
    1. Upsize the duct, plenum, and piping infrastructure. This reduces managing costs and allows a measure of future-proofing.
    2. Use variable-speed motor drives on chillers, chilled and condenser water pumps.
    3. Use cooling tower fans to help with part-load performance. This can be helpful when controlled as part of a coordinated cooling system.
    4. Examine efficient design techniques, such as medium-temperature cooling loops and fluid-side economizers.
    5. A small portion of energy consumption cooling tower energy used. This requires a larger cost up front and a larger physical footprint.

4.27 Put Everything Together.

Efficient cooling isn't just a problem of installing intelligent system / equipment. Organization type, considerations must be implemented, including design and decision-making issues. Such issues include:

- Use life cycle cost analysis.
- Involve all key stakeholders.
- Set quantifiable goals.
- Introduce energy optimization.
- Include integrated monitoring, measuring, and controls.
- Scrutinize and benchmark existing facilities and then track performance.
- Evaluate the potential for onsite power generation.
- Make sure all members of the facility-operations staff get site-specific training, including the identification and proper operation of energy-efficiency features.

4.28 Summary

- Examines cooling issues in the datacenter as well as where this can save money, and it provides some tips for adding cooling capacity without spending more money.
- Selecting a technology that can scale to future needs is a critical part of your considerations.
- Cooling system is such a huge portion of your datacenter that it really merits a lot of your attention

4.29 Reference for further reading

Green IT, Velte & Elsenpeter, McGraw Hill, 2008

4.30 Unit End Exercises

1. In the cooling system, how important is the design part?
2. What are the Advantages and Disadvantages of Water and Refrigerant?
3. What are the tips to help keep the datacenter at the right level?
4. How to prevent recirculation of equipment exhaust?
5. Write a short not on cooling cost and power cost?

* * * * *

UNIT - III

5

CHANGING THE WAY OF WORK

Unit Structure

5.0 Objectives

After going through this chapter, you will be able to :

- State what are the Old Behaviours of the Organization?
- Explain the steps that any organization needs to take before starting with Greening it and with process reengineering in mind.
- Analysed the Global consequence of Local Action using decision-making pyramid and its various levels.
- Specify the steps for water conservation, recycling of organizational waste products such as paper, glass, plastic, to reduce energy consumption, the sources of pollutants and in what way it can be managed.
- define telecommuting, outsourcing
- illustrate the steps for outsourcing

5.1 Old Behaviors

Various Industries are continually doing experiments with their business strategies. Generally in most of the cases, it is on trial & error basis. By doing this many industries gain the experiences, and come up with new ideas of doing business and improving it. They might not follow eco-friendly way or sometimes might not also be cost effective.

Now the time has arisen that industries must change their approach and move towards environment-friendly and also become cost effective.

5.1.1 Starting at Top

Before implementing green environment method in your organization, everyone from the Organization must be aware about its progressive results in future. If People are not aware about profits, they might not show interest & support to accept the changes required.

In business, Environment concerns are not new. If a recommendation for greening is coming from higher authorities, like CEO of a company, then it is easy to implement. Again investors of business can also ask about environment-friendliness.

Here, important thing is positive approach of all stakeholders towards environment. They must not be firm on conventional approaches of doing work.

So, it is very essential to present an environment- friendly changes plan in the organization with adequate research, uttering the benefits very clearly in front of all stakeholders.

5.1.2 Process Reengineering with Green in Mind

There are various ways available to bring in environmental-friendly changes into our organization. The Supply chain management is one area where we can implement environment-supportive activities. This is known as green sourcing. In the business world, using green supply chain offers momentum. If we have not yet employed green sourcing, we can make the changes by understanding a few problems related to it. They are as follows:

- **Know Your Needs**

First, we want to identify our existing supply chain plan carefully, study and understand in what way our organization employs and also its consumption patterns. If we don't understand, then it is for guaranteed that we can't make changes in it. Here, we need to understand the present state of our buying system and consumption of materials.

- **Make a Plan**

Once we understood the Supply chain, the next step is to develop a plan. Here, we need to form objectives and the system to track progress, as shown in below figure.

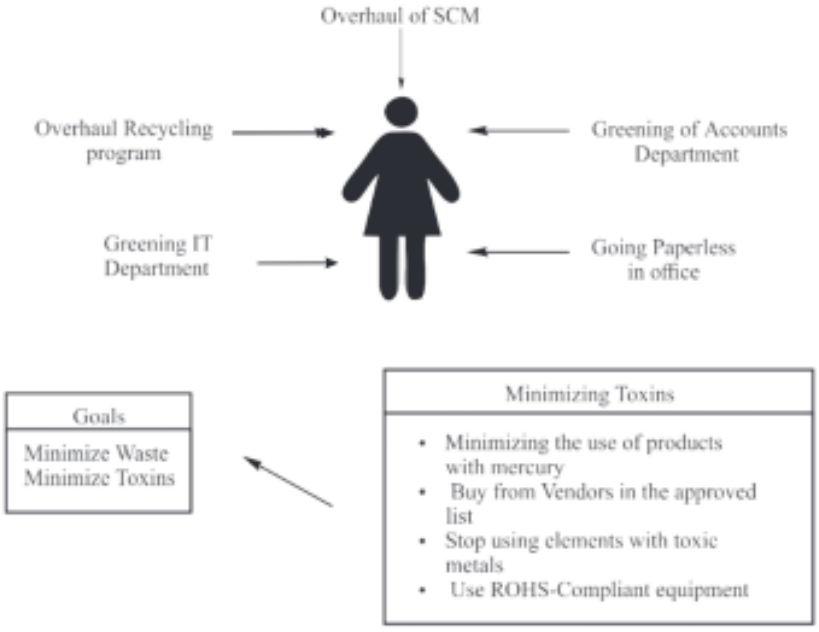


Fig: 5.1

For example, some electronics companies want to develop end-of-life management by increasing the lifetime of equipment by making it easier to swap out old components and deliver easy improvement paths. In this case, the electronics companies have multiple initiatives as the result of a single goal.

- **Internal and External Needs**

After settling up a plan, we need someone to manage the project. It is not enough to simply have a plan and except everyone in our organization need to identify their responsibility within the plan.

For administering and coordinating green efforts, we can appoint **chief sustainability officer,** this individual person will have different roles and functions in different organizations. It's important to have someone in places as a single point of responsibility.

We must need to inform our progress within our organization and also to our supply chain partners. We must need to get the people involved with our efforts. By communicating to everyone why our green efforts are being undertaken, what will be measured, and how we are working to get there, it gives others an detail understanding of what we are doing, for what and what we will achieve, make them involve in our plan.

- **Greening Your Procurement and Sourcing**

The sourcing and purchase system have the mask of being all about money, there is more to them than just cost. There are a number of non-cost factors involved in sourcing and purchase system and one of them is greening. When creating requests for proposals, make sure to include a green component as well as clear system for their measurement as part of supplier performance management. We must be as clear and comprehensive as possible about what we want. For example, we should prohibit the use of harmful chemicals in our organization such as the following:-

- ❖ CFCs- Chlorofluorocarbons
- ❖ HCFCs- Hydrochlorofluorocarbons
- ❖ Chlorinated solvents
- ❖ Cadmium
- ❖ Mercury
- ❖ Chlorinated or brominated flame retardants

We should also include semantic in our agreements that clearly states about approved and preferred materials, such as long lasting low mercury lamps as well as EPEAT and Energy Star rated equipment.

- **Know Your Suppliers**

When we are evaluating suppliers, changes can be expected from them, and for their level of environmental responsibility, we need to take care of the following things:

1. What are the supplier's environmental values? How are they measured and applied?
2. Does the supplier have its own EMS (environmental management system)?
3. Who is accountable for environmental performance? Is it just the supplier's environmental staff, or is it all employees?
4. Does the supplier comply with federal, state, and local environmental laws?
5. Is the supplier willing to understand and work with your environmental goals?
6. Has the supplier made efforts to design and manufacture products with the environment in mind?
7. How efficient is the supplier in using resources, materials, and energy, as well as recycling and pollution prevention?
8. Will the supplier reclaim its products or packaging at the end of their useful lives?

All the things stated above may not be followed by every supplier. But we can emphasis on our requirements, this will spread awareness among all the supplier. Also, we will come to know about supplier's efforts that meet our own green sourcing needs or not and how well they support our corporate culture.

- **Communicate with Your Suppliers**

During the sourcing process and monitor compliance and development, we need to clearly set and convey our expectation to our supplier. It is going to be good start and help us smoothe conduction of green sourcing.

We should make sure that suppliers know what they need to provide and how that will be measured at our place. This ensures that they are providing what we want and are driving in place the processes to achieve compliance.

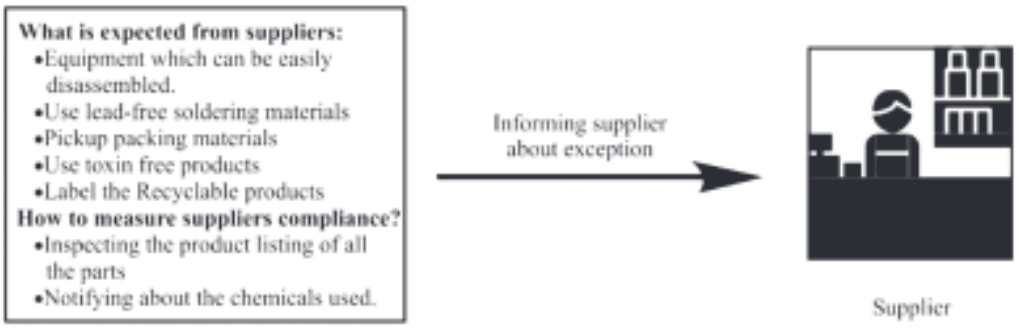


Fig: 5.2

For example, this can include specifying how suppliers are to recycle discarded materials, that they need to use less-toxic chemicals, and that they create products which are easily disassembled for less waste and easier recycling.

- **Keep Up to Date with Global Issues**

We must be updated with information about the global community as far as directive is concerned. The European Union's (RoHS) Restrictions of Hazardous Substances regulations and California's (EWRA) Electronic Waste Recycling Act are likely to impact our supply chain. For an instance, because of EWRA, it is restricted to sell devices in California banned by Europe's RoHS. This also includes monitors that contain the heavyweight metals restricted by RoHS. If we keep up on global regulation concerns, we can see how they disturb our own supply chain often for the better.

- **Keep Updated with New Technologies**

At present Green technologies are a making remarkable progress, and our industry may be making significant improvements. By keeping updated with what's going on in our

industry, we can find out where we can make the best changes. We have to maintain our reasonable edge. We must be active in our similar type of industry and organizations to make new friends for exchanging the information and idea about greening process.

- **Start Simply**

We need to make a plan first. We always have to consider about big things to achieve. But it does not implied that everything to implement at once. It's also impossible to achieve this way.

Instead, we can start progressively by identifying some things that we can do just immediately. These get us started, and they help as triggers to more intricate activities. Some easy things we can do include negotiating leasing or buy back options into electronics contracts, as well as ensuring hardware goes back again to the manufacturer for recycling. We could also label material types of our products so consumers know how they can recycle them.

5.1.3 Analysing the Global Impact of Local Actions

We all are aware about the slogan "Think Globally, Act Locally", there are many more messages present like this. Initially it attracts us, but later the message turns into an annoyance. The detail of the matter is that the actions individuals take can display into something that affects the entire planet.

Consider the pyramid presented in the following figure.

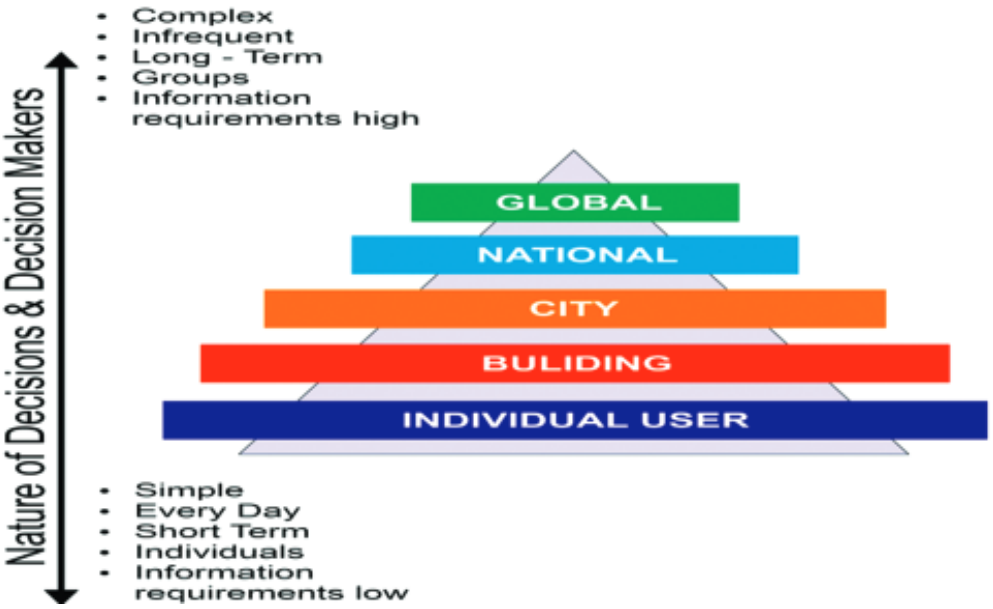


Fig: 5.3 The decision-making pyramid illustrates exactly how decisions of an individual can grow bigger and bigger

At the bottom level of the pyramid is the individual; the top represents the global community. The bottom level represents simple, everyday decisions, such as the decision to recycle a used beer can. As we move up the pyramid, we see that decisions made at a given level help influence decisions made at the next level. Also, the following developments become possible:

- ❖ Individual decisions are replaced by group decisions.
- ❖ Decisions become more complex and they include a broader range of issues.
- ❖ The amount and quality of information needed for decision-making increases.
- ❖ Short-term decisions advance into long-term decisions.

Decisions at both ends of the pyramid affects each other. Everyday choices made at the bottom level are made based on decisions that have been made at the global level. Information produced at the top-level of the pyramid is policy-oriented. Output at the bottom level of the pyramid is action-oriented.

Below **Table 5.1** illustrates what happens when an issue of the reduction of CO_2 emissions is handled at each level of pyramid. How the Issue of CO_2 Emissions is dealt with at different Levels of the Pyramid.

	Global
Actions:	International attention is paid to trends in CO_2 concentrations and how international trade is increasing CO_2 concentration. Scenarios are generated to understand the long-term impact of CO_2 Concentration.Plans are generated for individual nations to help arrest CO_2 Concentration levels.
Stakeholders:	UN and international organizations, universities, research institutions, and international NGOs.
	National
Actions:	National policies and programs to reduce CO2 levels are developed. This is manifested in the various form of rules, regulations, development and research, and financial support.
Stakeholders:	National governmental departments and ministries, universities, research institutions, industry and business associations, chambers of commerce.
	City
Actions:	Local governments and Cities apply programs developed at the national level to local issues. Objectives and Goals are reflected in local ordinances, regulations, and so forth. At the city level, those ordinances are combined with informational campaigns to inform members of the community.
Stakeholders:	Local governmental agencies, industry and business organizations, local chambers of commerce, financial institutions, NGOs, community groups, and local universities.
	Building
Actions:	At this levels, "real" action takes place. This is where action is taken on programs and ordinances from higher levels. At this levels, chosen materials, designs, technology selections, and building usage all play a part in reducing CO2 levels.
Stakeholders:	Individuals, clubs, NGOs, and management teams.
	Individual
Actions:	This level represents day-to-day use of a building. Individual choices at this level add up to have an impact for instance, reducing the amount of electricity used, minimizing water usage, recycling waste products, and so forth. These actions can be taken based on regulation by the organizations "Don't throw your cans in the trash—recycle them "or by an individual's own volition ("I know I should recycle this pop can.").
Stakeholders:	Individuals, clubs, NGOs, and management teams.

TABLE: 5.1: How the Issue of CO_2 Emissions IS Dealt with at Different Levels of the Pyramid

5.2 Steps

Other than IT department, we can conserve energy at many non-IT in an organizations. We can also go for water conversation.

5.2.1 Water

The usage of water is big issue that can be considered for greening process in our organization. How much we can in this regard depends upon how much water is used. **For example**, urban area offices generally use less amount of water, while in rural area water consumption is more as offices are beautified with surrounding grass lawns.

Following few guidelines will help us to control the usage of water:

1. Document your maintenance and upgrades to fixtures.
2. Monitor our water usage. Keep a log of meter reads on a weekly basis so that points in usage can be measured and repairs made in a timely fashion.
3. Install leak detection and water conservation tools, such as isolated meters and shut off regulators to each appliance or fixture. Rain shut-off devices are especially useful if you have grass to water.
4. Determine flow rates, flush volumes, and daily water use. Put a plan in place to decrease the amount of water that's used.
5. Install low flow fixtures. If we have already got low flow fixtures, keep up on their maintenance.
6. If we do have an irrigation system in place, think through these issues to avoid wastage of water.
7. Inspect our property for leaks on a daily basis. Repair leaks as soon as they're detected.
8. Check our irrigation systems on monthly basis and look for problems.
9. Sprinkler heads regularly break and can go unseen for months.
10. Regulate watering schedules to fit the needs of the plants.
11. Consider getting rid of lawn and installing plants.
12. Pick weeds early in the season. Grass and weeds are both huge water consumers.
13. If we have any tropical plants, be sure they are grouped with plants that have similar watering needs.
14. Annuals should be watered on a separate schedule. Their roots are thinner and need more frequent watering, but in lesser amounts.

5.2.2 Recycling

Many companies emphasis on recycling, but not all as we have previously taught some of the recycling measures. But sometimes recycling is misinterpreted, such as throwing cans of soda pop into separate bin. A few companies isolate plastic, different colors of glass and office paper. A few organizations are very strict about what they recycles. There is always a chance of recycling if tried to find.

Even if our organization is violent about recycling, still a few more tips come handy for the recycling approach.

- **Furniture**

It is always a good idea to rent the furniture for our provisional needs. Going for new furniture unnecessarily will harm the nature.

Fig 5.4 Renting to promote Reusability

- **Cooperative Buying**

Organization can take part in a cooperative buying program, it will help to decrease the amount of reusable business waste going into landfills. It also reduces our discarding costs and allows us to buy materials at a low price.

- **Environmentally Preferable Purchasing Plan**

Every organization must adopt an environmentally preferable purchasing plan. This creates environmentally aware policies guidelines for the sorts of materials we purchase. Some considerations include the following:

- **Paper:** We can purchase 35-percent to 100-percent post-consumer recycled paper. It used to be a distinctive item that only few suppliers have, but now bigger brand-name retailers such as Staples offer paper with up to 100-percent recycled content.
- **Supplies:** Many business supplies, such as clipboards, binders, post-its, folders, envelopes, notepads, notebooks, and calendars, can be purchased with different percentages of recycled contents. Many small and online vendors offer a great variety of products. Again, these items can be easily found at Office Workshop and Staples.
- **Paperless:** Make our work paperless maximum wherever possible. For example, send messages electronically, instead of using papers. We scan documents and send them electronically by using email attachments.
- **Janitorial (cleaner):** Organization must look for the products that are chlorine-free more than 35 percent post-consumer recycled contents for cleaning purpose.
- **Business cards:** Business cards also can be printed on recycled paper.

- ❖ **Food products:** Instead of Styrofoam cups, plastic silverware switch over to buy recyclable/compostable food service ware.
- ❖ **Bags:** Make use of paper bags only. Plastic bags are made of petroleum products and do not biodegrade and cannot be recycled.

5.2.3 Energy

In an organization there are few non-IT places where we can also reduce the amount of electricity use.

- **Appliances**

There are several applications that are used in offices, such as refrigerators. If we need to purchase refrigerators and other appliances, we must buy models that are Energy Star certified. Energy Star is the U.S. Environmental Protection Agency's program to encourage products that uses less power than noncertified products.

- **Rebates**

Without any purpose eco-friendly changes are not made. Wherever our business is located, we will get some rebate for changing the type of lighting we use, sometimes governmental organizations also help.

For instance, the San Francisco Department of the Environment, in partnership with the Pacific Gas and Electric Company, delivers free energy reviews, reports, technical assistance, and rebates for commercial customers in San Francisco. We just have to examine for this type of system in our area.

5.2.4 Pollutants

We can make use of proper material to have fewer Impact on environment. There are a few products available that contain fewer toxins than conventional materials.

- **Cleaning Products**

Generally, the janitorial cleaning products have some harmful ingredients that may cause damage to human health, indoor air quality and environment. Some ingredients in janitorial cleaning products can promptly burn the eyes, skin, and lungs. By selecting the least toxic cleaning products for our organization, we can reduce the impact on environment with also caring of our employee. We can find out which products have low levels of toxins substantial by observing the following:

- ❖ Reading the product label and Material Safety Data Sheet (MSDS) can help us to make this determination.
- ❖ Examine the list of recognized cleaning products that are certified by Green Seal as meeting its Standard GS-37 for universal cleaners and GS-40 for floor-care products.

- ❖ Refer the Janitorial Pollution Prevention website. This public service website has fact sheets on safe and effective cleaning practices for windows, carpets, restrooms, and other cleaning job.
- ❖ Call the manufacturers to ask about any less-toxic alternatives they offer. Many vendors have numerous product lines, one of which might contain less-harmful ingredients than the others.

- **Paint**

The paint can contain toxic heavy metals, whereas cleaning solvents can comprise of toxic and flammable petroleum-based products such as mineral spirits, toluene, and xylene that produce volatile organic compounds (VOCs), which can combine with other pollutants to create ozone. Buy and use latex- or water-based paints, finishes, and varnishes rather than oil-based paints. Also, buy zero- or low-VOC paints.

- **Carpet**

While buying a new carpet or replacing the old, choose carpets made with natural fibers, recycled nylon, or low VOCs. VOCs can vaporize and enter the atmosphere, thus contributing to indoor air pollution.

- **Aerosols (Sprays)**

Aerosol vapors can cause asthma and other breathing problems because they contain product and propellant made up of very small droplets that are easily inhaled into the lungs. Up to 40 % of the contents in an aerosol container can be propellants. The most common propellants are propane, butane, nitrous oxide, and carbon dioxide. Most propellants products are petroleum that are extremely flammable. Pump spray bottles are less possible to cause direct health hazards because they are not pressured. They lack propellants, and they deliver the product in larger droplets that are less able to penetrate the human lungs.

- **Fluorescent Lamps**

Make use of fluorescent lamps because many other brands contain mercury or lead. Be careful while choosing because some fluorescent lamps also contain mercury, select energy-efficient fluorescent lamps that comprise the lowest amount of mercury content. Also, consider installing motion detectors to light rooms only when persons are present, and use timers for other lights to avoid them being left on.

- **Paper**

If possible, try to make every work of office paperless. If entirely not possible, then we can make use of unbleached paper. The manufacture of office and janitorial paper products including paper towels, toilet paper, napkins, and toilet seat covers, can produce hazardous byproducts that are often discharged directly into surface waters such as rivers and the ocean. The use of chlorine-containing bleaching agents to turn paper products bright white can generate a toxic soup of various chlorinated pollutants. So always choice a brand that are unbleached or that are whitened using only oxygen, ozone, hydrogen peroxide, or another chlorine-free process.

- **Toner Cartridges**

As per an estimation every year, millions of post-used toner and inkjet cartridges are thrown away in landfills or burned. We need to purchase locally remanufactured toner and inkjet cartridges, and must be make sure to recycle our old ones instead of throwing away. Remanufacturers inspect empty cartridges for damage and then repair or change broken parts. They clean the reusable parts and fill-up the cartridge with new toner.

- **Rechargeable Batteries**

On an average, per year over three billion batteries are sold. If batteries leak, It can cause harm to the eyes and skin. But they can also pollute the environment. Batteries can contain:

- ❖ Cadmium
- ❖ Mercury
- ❖ Cobalt
- ❖ Copper
- ❖ Zinc
- ❖ Lead
- ❖ Manganese
- ❖ Nickel
- ❖ Lithium

These heavyweight metals may saturate in landfills, contaminate soil, and pollute surface water and groundwater. If these toxic chemical are burnt, then they released into the air. Whenever possible, choose products that operate without batteries or use rechargeable batteries.

The Nickel-metal hydride (NiMH) and lithium rechargeable batteries are preferable to nickel-cadmium (Ni-Cad) batteries because they are less toxic and can be more easily recharged without losing their power.

- **Ink**

The Printing ink can contain such heavy metals such as the following:

- ❖ Barium
- ❖ Cadmium
- ❖ Chromium
- ❖ Lead

They also can contain alcohol and toxic hydrocarbons. If ink is improperly dispose of, it can contaminate surface water, groundwater, and the soil. So always consider using vegetable-based inks as an alternative.

- **LEED**

A Leadership in Energy and Environmental Design (LEED) is a rating system devised by the United States Green Building Council (USGBC) to assess the environmental performance of a building and encourage market transformation towards sustainable design. This project started in 1998, and since in its origin LEED has grown to take in more than 14,000 projects in the United States and 30 other countries. If an organization meets LEED certification, it is allowed to use the LEED Accredited Professional (AP) acronym after its name, showing that it has passed certification.

The system must be credit-based, allowing projects to earn points for environmentally friendly actions taken during construction and use of a building. LEED was launched in an effort to develop a "consensus-based, market-driven rating system to accelerate the development and implementation of green building practices." The program is not strictly structure; not every project must meet identical requirements to succeed.

Because of the presence of environmental concern, LEED creates healthier work environments. It also leads to higher productivity and improved employee health and comfort. Though, these benefits do come with a cost. Green buildings normally cost more to design and construct when compared to conventional buildings.

However, these initial costs are lessened with cost savings over time, not to mention the reduced environmental impact.

LEED certification is granted to buildings based on a 69-point scale, as follows:

- ❖ Certified 26–32 points
- ❖ Silver 33–38 points
- ❖ Gold 39–51 points
- ❖ Platinum 52–69 points

LEED INDIA: It is effective in India from 1st Jan, 2007. It is based on professional reference standards like NBC, ASHRAE, and ECBC etc. Here, assessment is done by 3rd party assessors & USGBC. It is a voluntary, consensus-based and market-driven organization.

5.3 Teleworkers and Outsourcing

We can reduce the need for new computers and amount of electricity, by using telecommuting and outsourcing.

5.3.1 Telecommuting

Telecommuting is an arrangement of work in which employee works outside the office. It is also known as telecommuter or work-at-home or home-sourced. It helps to reduce our environmental impact. The major problem in make use telecommuting is to make the people to agree on its use. Here, the worker might be interested to use it but the management may hesitate to device it.

Telecommuting is often wrongly perceived as a vacation and workers not having to do their share of the work. But that it is not the fact.

The Research organization IDC stated that 8.9 million Americans worked at home at least 3 days a month in 2004. That's only a small increase from the 8.7 million people IDC reported as teleworkers in 1999.

Hewitt Associates, a human resource consulting firm, directed its own survey of 936 large companies. Its results presented that 32 percent of these companies offered telecommuting prospects in 2004. It was a 1 percent increase over the earlier year.

Sun Microsystems operates their own telecommuting program called iWork. With the help of **iWork** workers can work from home, or if they need to, they can drive to a flexible work center when they need an office. Around the world, Sun has 115 flexible office locations.

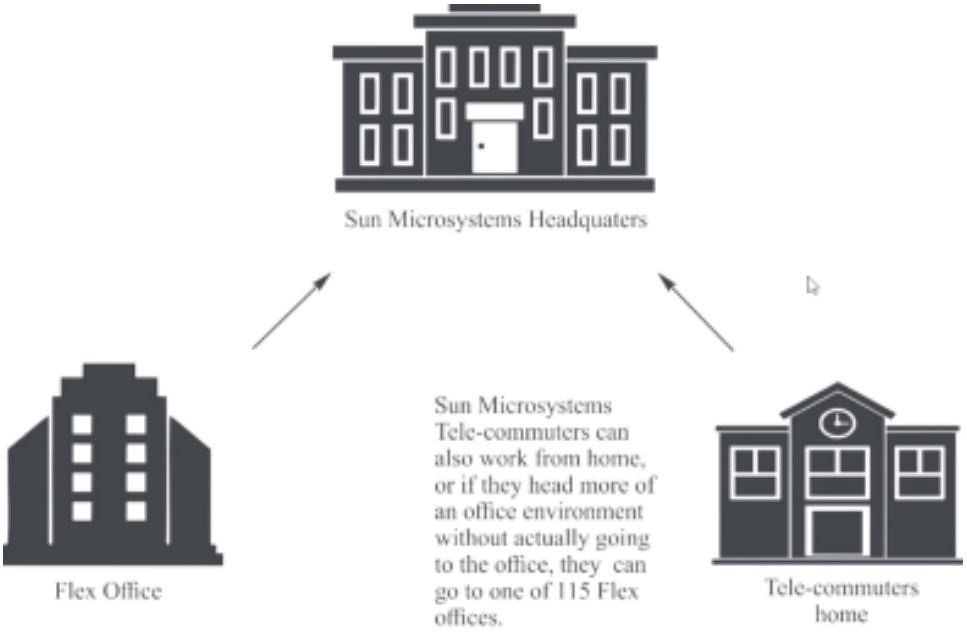


Fig. 5.5

Although this is a nice arrangement for employees, Sun isn't missing out on any cost savings. Sun states this setup has protected the company $255 million over 4 years. It has reduced its cost for real estate by eradicating 7,700 seats. The company also protects money by not having to pay so much for electricity and not having to upgrade computers.

It is not as such simple to telecommute like sending a worker home with a company-issued VPN client, a user name and password. For making it effective, companies need to define which job categories should be eligible; then guidelines and performance goals need to be recognized. The company also needs to decide what equipment it should provide and develop training for employees and managers.

- **How to Do It**

With some initial preparation, implementing telecommuting is very straightforward. Always it is better to have specific plan, goal and rule-setting preparations before sending employee home with laptops.

- **Assessing and Measuring Performance**

Performance standards must be recognized and should be the same as those for office-based employees who perform the similar duties.

We must have to give the same training to telecommuters as given to the office-based employees. The telecommuters are part of our company. Telecommuters should also get the same consideration as their office-based peers for personnel transactions, such as promotions, transfers.

- **Work Rules**

The work rules must be the same for telecommuters as with office-based employees. We cannot really monitor the telecommuters. But still the same rules must apply. Substance abuse and carelessness relating to work product or hours are significant. The work timings and work ethics may be the similar for all, which can be monitored.

- **Review Requests**

In an organization some employees may be interested in telecommuting; others may want to come to the office. To select the proper employee for the work the HR (human resources staff) should consider developing telecommuting guidelines and involve any unions or other employee organizations.

The telecommuting guidelines should include a three-step process:

❖ **Preapproval:** If an employee wants to telecommute, they fill out a worksheet that the organization can use to evaluate their suitability for telecommuting. Issues to consider in the preapproval worksheet include:

- Core work hours.
- Preapproval of the employee's workspace at home.
- Identification of an alternate work site in case the employee can't work at the first site.
- Assurance that the employee has the suitable equipment to safely perform their job without risk of injury. Safety guiding principle should be in place.

❖ **Approval:** If human resources thinks the employee is fit for telecommuting, the employee and organization complete an agreement that spells out the details of the telecommuting arrangement.

❖ **Ongoing monitoring:** The organization must regularly review each telecommuting arrangement to guarantee that the criteria initially well-known continue to be met.

Other issues that the organization needs to be aware of and that the employee should sign off on include:

- The company should pay for a dedicated telephone line for business drives. It should be understood that the company will review monthly bills. Typically, the individual's cell phone develops their business line while they are at home.
- Responsibility for extra costs related to starting the telecommuting operation (such as installing a broadband Internet connection, a second telephone line, and so forth) needs to be established upfront. The organization and employee need to be clear about who is paying for what.
- The employee should have homeowner's insurance universal legal responsibility coverage and deliver a chosen person at the agency with evidence of this insurance.
- The employer should conduct regular face-to-face meetings with the staff to bring people together. This might vary from once a week to once a month. For example, you might choice to conduct a monthly status meeting at non–rush hour times.
- We may want to make sure staffs do not become islands out there. Arm them with immediate messaging and perhaps videoconferencing capabilities. The technology is there, and costs are very low for a basic system.
- The company should inform the employee that it is their responsibility to inform their insurer about working from home. If there is an additional charge for that coverage, payment needs to be negotiated between the worker and the business.
- The organization needs to have written documentation of what business property is being located at the employee's home.
- If the telecommuter is working on a computer, a plan needs to be in place that spells out what will happen if the computer is down.

- **Monitoring**

Even when our business is working fine with use of telecommuters, we need to do regular monitoring to make sure things are going as we planned.

Following are some monitoring for it:

- ❖ Review all telecommuting arrangement at least once a year to make sure the criteria formerly established remain to be met.
- ❖ Conduct periodic site visits at least once per year to assess and ensure minimum safety requirements are being met. If there is a problems, the telecommuter should correct them as per our agreement.
- ❖ If site visits are directed, they must be performed by a competent safety/ ergonomic expert who can conduct an ergonomic assessment.
- ❖ Get annual certificates of insurance coverage from each telecommuting employee.

- ❖ In the event of an injury, the business should gather as much specific information as possible. This information will help the worker's compensation adjuster regulate whether the injury was work related.
- ❖ If a third party experiences damage, the business should gather as much information as possible to determine whether the damage is work-related.

5.3.2 Outsourcing

An Outsourcing is a practice in which an individuals or company perform tasks, offers services or manufacturers products for another company. Outsourcing sends all work to another company. Unknowingly, all work of our organization is not given to a contractor, also the company's core duties will be intact. Only few selected tasks, such as customer service, can be given to another specialist company.

Fig. 5.6 Outsourcing

- **Monetary Savings**

Outsourcing can save plenty of money of an organization. In 2005, expert services firm McKinsey & Co. stated that offshore outsourcing can cut an organization's cost by up to 55 %. But at the same time, Gartner reported that most customer-service outsourcing will fail and end up costing companies one third more than keeping the employees in house. Our success or failure with the usage of outsourcing will depend on how well we prepare, how well we select an outsource service provider, and how well they'll challenge our project. If done right, the cost savings are there.

- **Lost Jobs**

We want to be environmentally responsible and also to save money, but don't want to put people out of jobs. Many Americans hate outsourcing because it costs Americans their jobs, but not in the actual insight.

According to a study by the Information Technology Association of America (ITAA), outsourcing actually creates jobs. In fact, ITAA estimates that by 2010, 337,000 jobs will be created, in addition to those lost to outsourcing. According to a various study lead by economic analysis firm Global Insight Inc., more jobs are created because outsourcing lowers costs to U.S. companies, therefore permitting them to spend money on new workers. Additionally, it increases the efficiencies of the U.S. economy, resulting in higher salaries. The ITAA study also estimates that outsourcing will save companies billion in near future.

- **Environmental Impact**

Company handling our outsourcing must not be environmentally irresponsible. This we make sure before signing the outsourcing contract. We can ask service providers to follow more stringent environmental standards.

In 2007, 43 percent of companies that were first-time outsourcers included green factors in their decision-making process. Of the whole field of respondents, 88 percent said that environmental issues would influence their decision-making process.

The private organization are not considering outsourcing at the same rate as publicly traded companies. The various study also found that 94 percent of executives in publicly traded companies intend to add green clauses when they renegotiate their contracts. Only 36 percent of privately owned companies are considering such a move.

By investing in green companies, investors have faith in the companies that it will flourish, and therefore making their standard go up. But also, socially responsible businesses can gain an advantage against their competition because of cost reductions, quality improvements, increased profits, and entree to new markets. Environmentally responsible companies also face less risk of environmental liability.

5.3.3 How to Outsource

Outsourcing becomes more popular, because it save a lots of money. It is also an environmentally friendly way to do business. When we need to add computer and staff capacity for a project, or as part of a rising business, we face the issues of buying equipment, paying for its cost of operation, and so forth. Outsourcing takes that burden off your shoulders and gives it to a company that already has the staff and equipment in place. To outsource a project, we have to recognize the issues surrounding the process.

- **Planning**

In outsourcing, we become the client. In order for an outsourcing project to be successful, we need to carefully explain what we want and the outsourcing service provider to achieve. Before looking for an outsourcing service, we want to understand the following things:

- ❖ The scope of the work
- ❖ The level of effort expected
- ❖ The schedule

- ❖ The performance goals

  It's always better to plan in advance and set some milestone for project, because they start deliverables along with deadlines for each deliverable. This will take more work, however, because a viability and scoping study must be complete that creates the full scope of the work, the milestones, and the budget.

  It may be costly, but there are definitely benefits, such as the following:

- ❖ Project requirements and specifications are clearly recognized before any work begins.
- ❖ The project can be settled as per the budget.
- ❖ If it turns out the project is not feasible, it can be cancelled before too much time, money, and effort are committed.

Generally, projects fail because specifications were not determined before the work began.

- **Success Strategies**

We want to be successful in our attempt, as well as need to be productive. Don't expect cost savings immediately from an outsourcing project. Sometimes, we have to support duplicate efforts until the transition is complete.

Don't forget that some another company is performing the work we have deputized. It is a different organization, not an extension of our company. As such, that company might not have the same background our company has. It's best to work with the outsourcing service provider as flexibly as possible.

Mistakes and performance problems are going to happen. There's no way to avoid it. We must be able to correct the mistakes in an expert manner.

There are many monitoring systems available that will help us to track the progress of our project that is outsourced. For example, for call center, we can use live call monitoring system. This allows someone from our organization to listen in on work that is being done. Outsource service providers are less likely to misbehave or do careless work when they know they might be listened to.

- **Payment**

The billing and payment will vary based on the project, the size of the outsourcing service provider, and the work. Following table compares the sizes of companies and how billing and payment normally works.

Outsource Service Provider Size	Billing and Payment Terms
Large	Normally work under advance payment arrangements. They usually require 15 or 30 days' worth of payment in advance.
Mid-size and small	Billing normally done weekly with payment due after a week. Rates are based on production time, which is defined as the time a customer service agent actually spends logged onto the phone system and can take calls. A payroll hour usually provides about 45 minutes of production time.

Table 5.2

Here, one thing we must consider before selecting a service provider, if we select cheaper option, it's more likely the provider will hire poor-quality staff or that the turnover rate will be high. Ultimately, we get what we pay for.

- **Maintenance**

When there is a plan in place, provider is selected, everyone has been trained, and the program is in motion, we need to keep everything running smoothly. It is possible by having proper communication between stakeholders.

The provider must call us each morning to check in. Even if there's no news to report, we can at least guarantee we have consistent information coming in, and we will be able to keep up on arising issues.

Here, reporting is important, especially if you have metrics that are granular sufficient to show the work of specific agents. If the metrics look rare, we can investigate and find out what's going on. Ensure that the service providers has an action plan in place in case problems arise.

- **Finding a Service Provider**

To select proper service provider as per our need, we can make uses of the following steps.

- **Research, research, research**: We can take recommendations from other companies. We can also ask potential providers for client references. We can then talk to these references and find out how effective the companies are.
- **Pursue compatibility:** Find a best fit company that understands our project needs. Develop a contract that allows you to weak the agreement as changes occur.
- **Set your standards:** Establish standards by which the other company will behave. List these details in the contract, and check up on the service providers from time to time to make sure they're being followed.

- **Don't get caught with your pants down:** Have a backup plan ready in place in case the service provider can't carry through on their end of the bargain. If they fail or things fall through, we won't be in trouble.

In an organization, greening is possible at all sorts of levels. It is not important to supervise any other parts of our organization that can be altered and fine-tuned for greening.

5.4 Summary

Companies do lot of things simply because that's how they learned to do business, if they don't see a benefit, there's no incentive for them to get behind your plan. A number of business processes can be changed with an eye toward environmental responsibility. To make a plan considering Internal and External needs, ways for procuring and sourcing, communication with suppliers so many changes should be made in a company. Green technologies are a moving target, by keeping up with what's going on in an industry, they can find out where they can make the best changes. Water use can be a big consideration in any organization. At some places, recycling simply means throwing a soda pop cans into a separate bin. Other companies also separate out plastic, different colors of glass, and office paper. By participating in a cooperative buying program, we help decrease the amount of reusable business waste going into landfills. Toxins are everywhere whether it is paint, carpet and fluorescent lamps, ink, rechargeable batteries. Aerosol mists can trigger asthma and other breathing problems whereas using Pump spray bottles are less likely to cause direct health hazards because they are not pressured. Telecommuting and Outsourcing is another good option to help decrease your environmental impact, like the paperless office which is getting people to sign onto it. Performance standards should be recognized and should be the same as those for office-based employees. Hence, changing the way we work can improve productivity and lessen harm to environment.

5.5 List of Reference

1. Green IT, Toby Velte, Anthony Velte, Robert Elsenpeter, McGraw Hill, 2008.
2. Green Data Center: Steps for the Journey, Alvin Galea, Michael Schaefer, Mike Ebbers, Shroff Publishers and Distributors, 2011.
3. Green Computing and Green IT Best Practice, Jason Harris Emereo.
4. Green Computing Tools and Techniques for Saving Energy, Money and Resources, Bud E. Smith, CRC Press, 2014.
5. The Green Computing Book: Tackling Energy Efficiency at Large Scale, Wu Chen Feng, and CRC Press.
6. Harnessing Green IT: Principles and Practices, San Murugesan, IEEE IT Professional, January-February 2008.
7. http://www.epeat.net/
8. http://www.greenci.org/
9. http://practicas.communidadesfomin.org/sites/practicas.communidadesfomin.org/files/documents/Green_IT_RAEE_FOMIN_2012.pdf

10. http://www.step-initiative.org/
11. http://www.ban.org/
12. http://www.rohscertification.co.in/
13. http://recycle-help.com/

5.6 Unit End Exercises

1. Explain Process Reengineering with Green in Mind.
2. Which things are necessary to evaluating suppliers for their level of environmental responsibility?
3. List and explain decision-making pyramid with its levels.
4. What are the steps that can be taken to control usage of water in the organization?
5. Write a note on Recycling.
6. Which things are necessary to environmentally preferable purchasing plan?
7. How to reduce the amount of electricity use at non-IT places?
8. How to find out which products have low levels of toxins?
9. Write a note on LEED.
10. What is Telecommunicating? Explain how it can be achieved?
11. List and explain telecommuting guidelines.
12. What are the ideas used for monitoring telecommuter?
13. Explain outsourcing.
14. What are the different issues involved in Outsourcing a project? Explain.
15. Give Comparison between different types of Outsource Service provider size and also explain how billing and payment works in it.
16. How to select proper service provider as per need ?

* * * * *

6

GOING PAPERLESS

Unit Structure

6.0 Objectives

After going through this chapter, you will be able to:

- define paper problems and its impact on environment and increased cost for manufacturing it.
- Specify the profits of going paperless for organization, reducing cost and its effects on environments.
- define and explain organizational approach for going paperless, scanner types, hardware & software requirements, pdf, paperless billing, and unified communications.
- Outline the term intranet and also understand different components used for constructing it.
- Understand the features and uses of Microsoft office Share point Server 2007.
- Describe the concepts of EDI and its interconnections with green computing.
- explain Value Added Network and its benefits.

6.1 Paper Problems

The production and use of more papers has adverse impact and causes harm to environments as well as its cost more to the organization. There are many places where paper is used in organizations which can be avoided.

6.1.1 The Environment

The trees are the source of oxygen, which are cut for paper production. The energy used in paper industry releases harmful gases. The distribution of paper also causes harm to environment due to the fuel consumption by air, rail and road transport distributing quantities of paper. The fuel is also burned for sending paper documents via ground and air courier services.

6.1.2 Cost

A research Survey has been conducted in 2010, and it was estimated that nearly 400 million lots of papers were consumed, among of it half was consumed in Europe and North America. The Prediction is that almost 500 million loads of paper will be used in 2020. The multiple copies of the same documents are used on daily basis. The papers also need filing arrangements in the offices. Many a times several documents are misplaced and the same copies need to be printed again which in turns results in rise in expenditures.

On the other hand, if we decide to go for electronic document, then it has following advantages:

- These documents do not consume physical space because they are stored on a server.

- We can easily locate an electronic document quickly through a file search.
- Electronic documents are shared electronically via email, shared servers, posted on web sites etc.
- If necessary, we can print the electronic content.
- High level of security can be realized with electronic documents rather than paper.

If we go for paperless, then following goals are achievable:

- Saving the cost associated with paper, printers, copiers, fax machines, ink and toner cartridges.
- Removing filing cabinets and reducing office space.
- Quick responses to customers can be achieved by directing business in a mobile environment.
- Increasing efficiency of our staff by eradicating the time spent searching for and distributing the documents.
- With mobile computing solutions, an expert image to our customers can be presented.
- Our working speed will increase by removing the time wasted on receiving paper signature on agreements and forms that requires hand delivery.
- Backup of documents can be done securely and on regular basis.
- We can achieve real time updates and delivery of documents.

6.2 PAPER AND OFFICE

It is essential for an organizations to become paperless which will surely help in achieving cost saving and also environment saving.

6.2.1 Practicality

Let us consider an example. You are in an interview and asked for your degree certificates and you forgot it at home. By the time you will bring them from home for verifications your interviewer might have chosen another candidate in place of you. You might lose your job.

Again, let us consider the same example with another approach. You are in an interview and asked for your degree certificates. Without any issue, you can use your laptop, and take a printout of your degree certificate which is scanned previously by taking permission to access by interviewer's wireless network. Using your corporate VPN connection, you log onto your mail server. In moments, you have got the document on the laptop screen.

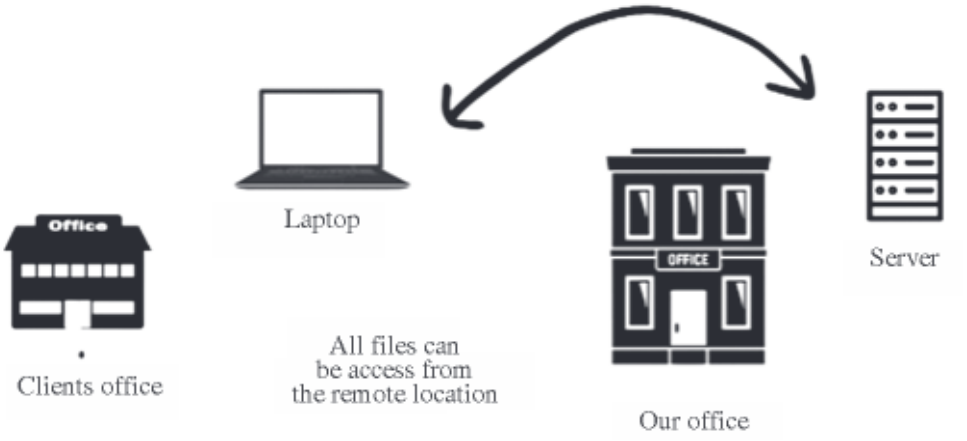


Fig. 6.1: Remote Access

6.2.2 Storage

Usually in offices, lots of papers are misplaced and lying around unused. These documents are present on the shelves, or tucked away in filing cabinets. If we use less paper, we will be able to free up office space, filing cabinets can be removed and also save the expense of buying new filing cabinets.

We can calculate how much we spend on paper storage by counting the number of filing cabinets we have. Then, measure how much floor area they occupy. The many filing cabinets are of size 2.5 foot. For opening drawers multiply that amount by the value of your floor space, and get how much that filing cabinet costs to maintain.

If paper consumes 2000 sheets per foot, and each drawer has 1 foot of file space, then a four-drawer cabinet could contain 16,000 sheets of paper. It's probably only at 75 percent capacity, or 12,000 sheets. That equates to 24 reams of paper. Which is really a costly affair for an organization.

The storage cost and the paper price combined gives overall paper cost, The cost may not look big, but when we start adding up all these little costs, the total gets to be pretty large.

6.2.3 Destruction

Generally, maximum number of used and unused papers are thrown into trash. It is expensive for an organization and also cause adverse impact on environment. Also if we are using shredder to destroy sensitive documents, then it consumes more electricity and thus increases the cost and has harmful impact on environment.

Approximately 200 million tons of regular compact waste is produced annually, in the US, out of which 2 percent is paper which increases the burden on dumping grounds.

6.3 Going Paperless

With a Proper plan we can be paperless or at least able to reduce the paper use easily. With an organization we need to take a specific approach for going paperless.

6.3.1 Organizational Realities

There are many ways we can adopt in an organization for going paperless, it is not just the scanner that will do the work. Every stakeholder of an organization must be agree to adopt the approach. Once we decided to go for paperless, we need to take care of the following things:

- **It won't happen overnight:** The execution of going paperless cannot be implemented at one go in an organization. We need to start slowly by scanning old papers. Then we can go for incoming paperwork as paperless.
- **"Paperless" isn't an absolute:** Sometimes we may require a hard print of papers. Some of our clients or business partners will still want their interactions done some via paper. Also, there will likely be some tax documentation that needs to be maintained as hard copies.
- **You have to sell it:** The idea of going paperless might not be easily accepted by all. We need to convince our people by explaining them effectively about benefits of the new system. For employees it might be hard to change. The best thing we can do is inform them about the benefits of being paperless, and understand that it will take some time for everyone to come around. Give it time.

  Going Paperless will save money in the cost of printing, mailing, shipping, and storage. But as we proceed with the system, there are other advantages also:

❖ It takes less time for finding for lost paperwork.
❖ It provides the ability to access most documents in seconds.
❖ It gives the ability to access all our documents from home or satellite offices.
❖ It saves the space in our office as filing cabinets are moved out.

6.3.2 Changing Over

Once we are having a paperless scheme in place, we can deal with every aspects related with it. Here, all we need is to scan our paperwork and save it to our network. A good scanner and a system for storage are the keys to success.

- **Hardware**

Presently, we generate the documents in an electronic format and use them for printing. Most of the documents are created using spreadsheets, e-mail, word processing, or database applications. We need to maintain the electronic format for as long as possible. We must have a good scanner in place. We can purchase standalone models, or we can get a printer with built-in scanning capabilities.

The device we are purchasing for scanning must be fast enough to scan and also able to scan on both sides of the page. We should consider scanners that include copies of Adobe Acrobat Standard or another PDF creator. The selection of scanner also depends on organizational needs and budget.

Following table compares some popular scanner models.

Scanner	Resolution	Color Depth	Scanner Type	Features
Xerox DocuMate 252 XDM2525D WU	600×1200 dpi	48 bit	Fast Duplex sheet-fed	Scans 50 images per unit. Include one touch scanning
Fujitsu fi-5120C PA03484-B005	600×600 dpi	24 bit	Duplex	High reliability.
Xerox DocuMate 510 XDM5105D WU	600×1200 dpi	42 bit	Fast single-pass	Converts scans to PDF at 10 pages per minute. Holds 50 pages in document feeder.
HP Scanjet 8300 L1960AB1H	4800 dpi	48 bit	Flatbed	Optional100-sheet document holder.

Table 6.1

Obliviously the scanned documents take some place on our electronic storage. But it is not a big issue. A scanned PDF file consumes about 250KB per page for black-and-white documents, and 500KB for color. If we store only black-and-white documents, we will be able to save 4000 pages per 1GB of drive space.

- **Software**

A good scanner should come with drivers to make it work with whatever computer systems you have in your organization. The driver should allow for the management of the following:

- ❖ Resolution
- ❖ Color bit depth
- ❖ File type
- ❖ Default folders

We need an application that can perform Optical Character Recognition (OCR) on scanned documents, and that will combine the text with the original image in a PDF file. At the Windows desktop level, a very common application is Adobe Acrobat 9 Pro. The Mac users can use Acrobat or an application such as Read Iris Pro.

- **PDFs (Portable Document Formats)**

For going paperless, the PDF software is considered an important tool as it is a great digital format standard.

Server	Price	Comments
Apache	Free	It is very popular. More than 50 percent of the Internet was served via apache. It also run on both Windows ans Unix/ Linux.
Internet Information Server (IIS)	Comes with Windows XP or Vista	Only runs on Windows machine, which may be more common in many corporate environment

Tables 6.2: Intranet

The PDF is the best option for storing our digital documents because it is:

- ❖ **Standard:** We can save all kinds of files as PDF files like Microsoft Word, Excel, and so on. Once our documents is in PDF format, then it can be easily read and made available to whoever needs access to them.
- ❖ **Open format:** Adobe has submitted the PDF format to the ISO to have it formally declared a standard.
- ❖ **Accuracy:** For easy searching we can also add a layer of digitized text in Adobe PDF files.
- ❖ **Searchable text:** Text can be searched within a PDF file for easy information location.
- ❖ **Small:** PDF files are much smaller than other formats, which saves our hardware space and makes them easier to send online.
- ❖ **Secure:** There's as a whole spectrum of security for PDFs files available to us when using PDF software such as Foxit Phantom PDF. We can select the whole thing from using no security at all to applying various levels of passwords security, encryption and even rights-managed protection.

The more flexibility is offered by Searchable PDF format for becoming paperless and it also minimizes the risk of losing valuable information.

- **Work Smart**

Below are some recommended practices that should be followed by everyone in an organization:

- ❖ **Be realistic:** Keep only the essential and main documents. We must recycle what we don't need.
- ❖ **Naming:** After scanning, every document should be labeled as descriptively as possible so that it can be searched easily by name only.
- ❖ **Set up a filing system:** Use proper folders to store the information in a categorized manner and also try to keep it in hierarchical manner on the computers.
- ❖ **Shredding and recycling:** After finishing the scanning of all the documents, only keep a few really important documents and shred rest of the documents as it may contain sensitive information.
- ❖ **Know your limits:** Going paperless is not one night work. If we have to scan thousands of papers, it is not possible in one sitting. So set smaller goals to achieve it.

- **Faxing**

The fax machine is also a source of paper. Here, we never know who is going to be send what. There are a number of applications and services to which we can subscribe that will automatically take whatever is being faxed, convert it to an email, and send it to us. Once we have an electronic version of the fax, we can decide whether or not we want to keep it.

6.3.3 Paperless Billing

The majority of companies these days are offering paperless billing as an option for their customers. We just need to log on to a website like the one shown in the following figure and can pay the bill of each month.

Fig. 6.3: Paperless Billing

Rather than print and mail monthly statements, companies just send a reminder e-mail to customers, who can then pay their monthly charges online.

Sometimes it is not possible for an organization to go for complete paperless billing as sometimes we need to send a paper bill. According to a study 28 percent of customers want paper bill.

Going paperless not only save money and environment but it also saves our valuable time. Many organizations spend a lot less time on the task of billing because they don't have to go through the effort of physically mailing the bills.

Still many companies have not decided for going for paperless billing. The study revealed that, on average, three employees spend 106 hours per month generating and mailing bills. The time it takes to generate the invoices accounts for 15 percent of that time. The remaining 92 hours are spent on printing, envelope packing, addressing, and mailing the bills, as shown in next figure.

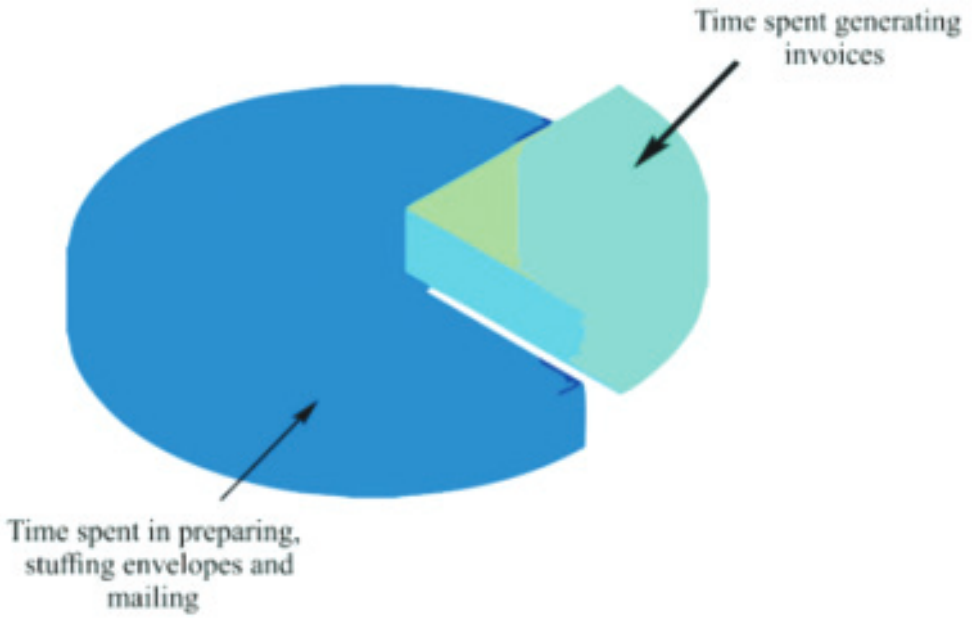


Fig. 6.4: Time Spent with Paper-based Billing

Another study shows that if every U.S. household person pays their bills online, 16.5 million trees a year would be saved. Beyond paper, bills involve envelopes as well as trucks and planes to transport them all over the world.

6.3.4 Handheld Computers vs. the Clipboard

The clipboard is a small board with a spring clip at the top, used for holding papers and providing support for writing. It has traditionally been related with office work. When a delivery comes to our office, the delivery person has a clipboard. When the expert goes out to work on our car, he picks up a clipboard. Now it is changing.

Now instead of clipboards, the personal Digital Assistants (PDAs) and tablets PCs are used. With PDAs your order will be written on a PDA, which transmits it straight back to the desired place.

- **PDAs**

PDA is a term used for a small, mobile, handheld device that offers computing and information storage and retrieval capabilities for business or personal use, frequently used for keeping schedules, calendars and address book information handy. This devices also comes with memory card slots for data storage, and a wireless connection.

PDAs can be used for distributing a package, the delivery driver might ask us to sign us to sign for the package on his PDA. The PDA typically run a version of Microsoft Windows Mobile for Pocket PCs or with the palm OS.

- **Tablet PCs**

A tablet PC is a portable PC that is a hybrid between a Personal Digital Assistant (PDA) and notebook PC. It is equipped with a touch screen interface, a tablet PC typically has a software application used to run a virtual keyboard. Though, many tablet PC's support external keyboards.

Tablet PCs have built-in Web browsing capabilities, several connectivity alternatives, capacitive touch screens and multimedia- including High Definition (HD) provision. Tablet PCs are also equipped with accelerometers, which permit users to view display screens in portrait or landscape mode. Generally, they come with Microsoft Windows XP or Vista OS.

6.3.5 Unified Communication

Using paperless approach we can also change some business processes. Our work will be more streamlined, more productive. Our communication can become effective. The IBM and Cisco have presented their own visions for a complete communications system in an organization. This system has come under the wide term known as Unified Communications. In this model, all types of communication phone, messaging, e-mail, faxes, etc. are supported so that they can be sent around the office.

- **New Phones**

The Microsoft has given preference to use of telephones as part of its Unified Communications initiative by providing call transfer facility. Microsoft introduced a set of business software that will improve office tasks. The new products included in its Unified Communications push include the following:

- ❖ Microsoft Office Communications Server 2007
- ❖ Microsoft Office Communicator 2007
- ❖ Microsoft Office Live Meeting
- ❖ A service pack update of Microsoft Exchange Server 2007
- ❖ RoundTable, it is Ethernet-connected, 360-degree videoconferencing VoIP system

- **Using the Internet**

The Unified Communications targets traditional business private branch exchanges (PBXs). These are parts of telecommunications equipment that serve an entire office. Microsoft notes that when an employee gets a new PBX-based telephone system, it costs the business a week's worth of lost time and some money also. In Microsoft's vision, the less-expensive option is to use the Internet via Voice over IP (VoIP).

Basically, the Unified Communications system treats voice like e-mail. Outlook is organized so that it shows the employee's phone numbers and at which one they can be contacted. When a call (or message) comes through, the employee can decide whether to take the call or to route it to voicemail. Moreover, Microsoft sees Round Table as a way to reform conference calling. For example, a conference leader can highlight a specific member or call up a PowerPoint presentation.

- **Smooth Working**

This system also gives convenience for communicating with others using different types of technologies. We can use text-to-speech expertise for reading the emails. We are also able to check our voicemails and update our calendar. This offers us a central system approach of communication. For example, if we're on the road and we need to check our e-mail, we can call our inbox and have the e-mail read to us, using text-to-speech.

6.4 Intranets

By using intranet of our organization, all employees can access their documents from anywhere in the office. We also not need to reprint the manual book; just send out an email to our employees that the change has been posted to the manual.

Intranets lessen the amount of paper that is used in-house. The files stored on the public Internet are accessible to anyone, files on our private intranet are only accessible to us and our coworkers.

6.4.1 What to Include?

The use of Intranet must be effectively done. We can store anything what we need on Intranet. Following are some examples contents we can store on intranet.

- Frequently asked questions about the organization.
- Regularly-used brochures, prototypes, and proposals that can benefit to prepare a project.
- Company bulletin board, where employees can share messages.
- CEO Blog, to serve as an informational line to the organization.
- Personal skills, including Staff directory.
- Company calendar, with employee birthdays and upcoming events.

Other than the above stated content, we can store anything that we need on intranet storage. There are several more important data issues we should consider before broad casting them on the intranet as given below:

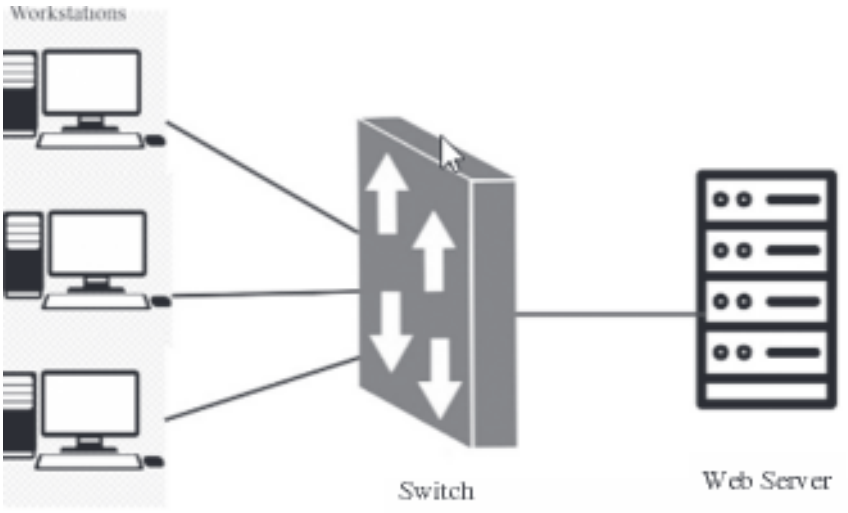
- **Security:** If sensitive document is stored on intranet, then it must be password protected.
- **Usability:** Design the intranet site in such a way that, employees will be able to use and navigate it easily.
- **Publishing rights:** Decide the author level for putting the content on the intranet.
- **Ownership:** Delegate the responsibility for posting and maintaining the information on the intranet.
- **Backup plan:** Always backup the information on regular basis.

6.4.2 Building an Intranet

If we devise a plan for an organizational intranet setup, it needs some specific hardware and software.

- **Parts**

The following four components for intranet setup as shown in the below figure are required:-



❖ **Local area network (LAN):** We need to use LAN architecture to set up intranet.

❖ **Web server:** Intranet is nothing an internal website. For running the website, we need a web server. Also we need to host our website locally on web server. The two most popular web servers we can use are Apache and Microsoft Internet Information Server (IIS). Following table compares these two. Also we can outsource our web hosting which is less costly and a lot easier. Often, providers supply easy-to-use security and other tools and templates so we can set up a secure intranet quickly.

Server	Price	Comments
Apache	Free	It is very popular. More than 50 percent of the Internet was served via apache. It also run on both Windows and Unix/Linux.
Internet Information Server (IIS)	Comes with Windows XP or Vista	Only runs on Windows machines, which may be more common in many corporate environments.

Table. 6.2: Intranet

- **Web browsers on client PCs:** To access the intranet website we need web browser software, such as Internet Explorer or Firefox.
- **Web page development software:** We must develop a website using HTML and supportive web technologies.

Installation of Apache web server is simple but after installation it requires a lot of configuration to be done. For better management of web servers we can refer the manuals for both the web servers.

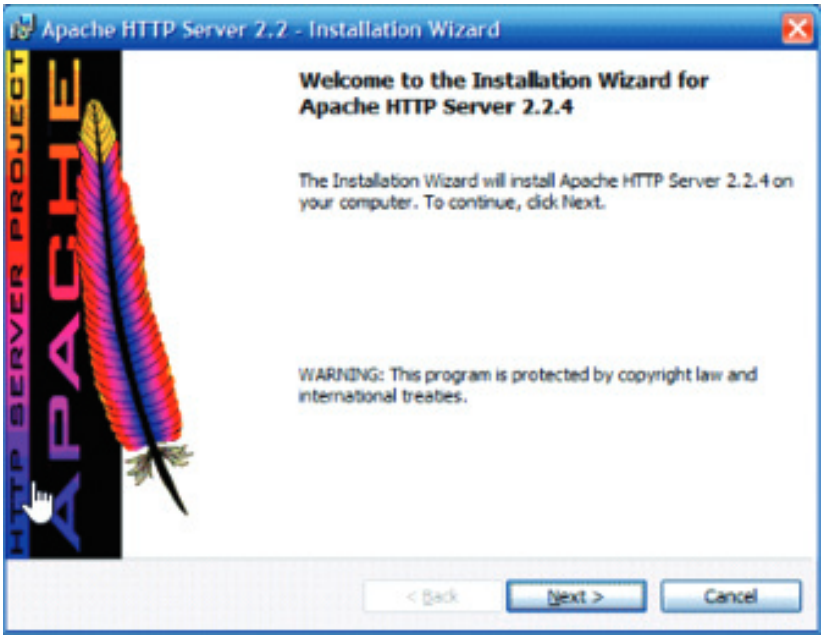


Fig.6.6: Apache web server

The intranet in this form is great for local users, but it can also be retrieved remotely for the people who are working from home for our organization. We can achieve this by using a virtual private network or a secure WAN connection.

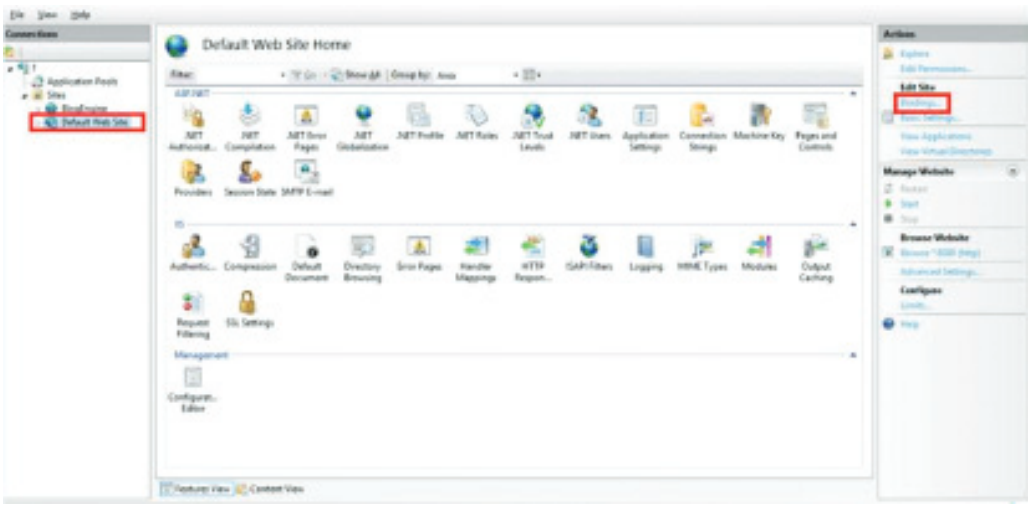


Fig. 6.7

- **Content Management Systems**

The websites or intranet are the dynamic entities. We should install a Content Management System (CMS) to easily add, delete, and update content. A CMS makes intranet maintenance much easier and can be done by someone with a very limited background with HTML, opening up the role of content management to an extensive range of users. Among other things, a CMS enables the following:

- ❖ Addition of new content
- ❖ Removal of old content
- ❖ Better organization of the data on the site
- ❖ Managing text, articles, documents, files, and other communications
- ❖ Managing images and other elements

There are many free CMS solution for both Windows and Linux. The Windows CMSs include Community Server and DotNetNuke.

Below figure represents DotNetNuke:-

Fig.6.8: DotNetNuke

The Linux supports a variety of well-known CMS solutions such as Drupal, Joomla, Mambo, Moodle, Post Nuke, and Xoops. Following Figure shows Joomla interface.

Once our website is set up, we need to explore it to our users for its usefulness. We need to take regular surveys to find out what people find most useful and what helps them to be more informed and effective.

Fig. 6.9: Joomla interface

6.4.3 Microsoft Office SharePoint Server 2007

A (MOSS) Microsoft Office SharePoint Server is a robust solution as a CMS. Using it, we need to centrally manage our organization's information and maintain it. It is accessible through web browser for our employees. It supports all intranet, extranet, and web applications in one platform, thus eliminates need of multiple small systems. It also improve overall efficiency by simplifying everyday tasks.

- **Features**

The MOSS is used to work with Microsoft Office applications, e-mail, or web browsers in organizations. Some of the functionality of MOSS includes:

- ❖ **The ability to control access:** It allows us to create customized document management procedures to control access rights. Access can be managed at a per item basic; we can also manage the retaining period and expiration actions.
- ❖ **Central management:** It helps to store and manage all our documents and content in one crucial location. This helps with locating documents.
- ❖ **Content management:** It includes Master Pages and Page Layouts, which include templates allowing us to give our content a consistent look. We can also publish content from one area to another.
- ❖ **Work across the organization:** The content created in one part of the organization can be simply incorporated into the system and stored in document libraries or web services. By doing this, we avoid repeating effort and making errors from having to manually reenter that data.

- **Better Business Operations**

The MOSS also helps us for overall, day-to-day business operations. It helps to create our own portals that access and display the information we require. Other features include:

- ❖ **Search features:** It provides Enterprise Search feature for searching people, business data, documents, and web pages to get latest information for our business.
- ❖ **Security-minded sharing**: We can share information very precisely and in a secure manner. For example, interactive Excel spreadsheets can be seen in a browser and they can be set up to show just the information we want to share and not any exclusive data.

- **Collaboration**

The MOSS also helps for our organization's collaborative efforts. We can also work with people at a partner company. Some features include the following:

- ❖ **The ability to integrate partner data**: We can collect business information from customers and partners and integrate it with our system. This allows us to include their information in searches. It also improves our working relationship with clients, partners, and suppliers.
- ❖ **The ability to work remotely:** The Microsoft Outlook is use to work with MOSS, which allows us to access our organization's data from anywhere.
- ❖ **Personalization**: Users can identify how they interact with MOSS using a tool called MySite.

- **MySite**

The MOSS feature, **MySite** permits users to produce a site so they can store, present, view, and manage content. The sites can be used to present business information about the user, including skills, roles, colleagues, managers, work groups, and so forth.

The MySite includes a public view and a private view. Privacy settings allow a user to establish whether their colleagues, manager, or everyone in the organization can see their information. The information that can be observed includes the following:

- ❖ **Workspaces:** This shows workspaces to which a user has access. It saves wasted navigation time.
- ❖ **MyLinks:** It shows a list of personal links for the user.
- ❖ **Personalization sites**: The content is modified based on a user's role in the organization.
- ❖ **Colleague Tracker:** It allows users to track changes in their colleagues' MySites.
- ❖ **Outlook e-mail**: It displays a user's e-mail and calendar information from Exchange.
- ❖ **Distribution groups:** Using the public view, we can see the distribution groups that we belong to.

6.5 Electronic Data Interchange (EDI)

Fig. 6:10 Traditional Data Interchange approach without EDI

The EDI system is used by organizations for managing their supply chains or deal with vendors and other companies. It helps businesses, governmental entities, and other organizations for exchanging entire documents. The EDI allows the electronic exchange of business documents, such as purchase orders, invoices, ship notices, and over 250 others in a consistent format. Following are some advantages of using EDI:

- ❖ Major savings with lesser EDI costs
- ❖ Improved staff efficiency
- ❖ A safe environment
- ❖ Better efficiency through the ability to send and receive any type of file.

Following figure shows organizations sending orders to other companies via EDI, thus speeding up the process over conventionally mailed requests.

Fig. 6.11: EDI speed up the procedure of working with B2B partners.

6.5.1 Nuts and Bolts

The EDI uses technologies such as Extensible Markup Language (XML) and the World Wide Web for its working. The EDI format is used more for e-commerce transactions.

There are four major sets of EDI standards, each with a specific market:

- The UN/EDIFACT standard is the only international standard and is used largely outside of North America.
- The U.S. standard ANSI ASC X12 (X12) is the largest standard in North America.
- The TRADACOMS standard, developed by the Article Numbering Association (ANA), is the major standard in the UK trade industry.
- The ODETTE standard is used within the European automotive business.

The above standards were first introduced in the mid-1980s and are used to explain formats, character sets, and data elements. Organizations using EDI can communicate though they want to exchange data.

6.5.2 Value Added Networks

A VAN is a private network provider hired by a company to facilitate Electronic Data Interchange (EDI) and/or provide other network services such as message encryption, secure email and management reporting. A Value-Added Network (VAN) streamlines the communication process by reducing the number of parties with which a company needs to communicate. The VAN achieves this by acting as an intermediary between business partners that share standards based on proprietary data. VANs may be functioned by large companies for well-organized supply chain management with their suppliers, or by industry groupings or telecoms.

Below are the benefits for using a VAN:

- The attentive system VANs can alerts organizations to broadcast issues or delivery receipts.
- The archival storage VANs can store critical business data for extended periods of time.
- Audit trails Information including setup, configuration, and document transmission events can be examined.
- Real-time data delivery, data can be distributed in real time, rather than in batches, hence permitting earlier response to transmissions.
- Reliable and secure transmission VANs guarantee that a company's data is securely transmitted and is received by the recipient.

6.5.3 Advantages

- The EDI is a major cost saving solutions.
- It is also easy and efficient to use.
- It reduces data- entry errors, reduce labour costs, and increases the timeliness of transmitted information.
- With the usage of EDI, the document can be sent computer-to-computer, thus eradicating a lot of the steps where trouble can happen.
- EDI reduces the time it takes to receive and handle the order from a few days to a few seconds.

- It also saves labor hours, it also allows companies to better manage their inventory through speedy replacement.
- Improved customer service.

6.5.4 Obstacles

Because humans are not easily agreed for change, it becomes the biggest problem for using EDI in our day to day work. Also, the cost for employment of EDI is more. The expense comes from implementation, modifying the system, and training employees. At longer run, EDI simplifies our work and also records cost saving.

Fig. 6.12

Likewise, Perception is also a problem for EDI. Many organizations think that EDI allows our vendors or business partners to have their hands in our network. Also the suppliers can have open access to their data within our network. However it is not the truth. We can securely archive the work with EDI. It is essential for smaller companies to use EDI if they want to do business with larger trading partners.

Usually, people hesitate for going paperless as they are used to be with papers. We should not implement it all at once. We can introduce new paperless techniques as they arise which means making one business stream paperless at a time. As first, we can do billing process paperless. Also proper implementation of it, we can go for use of intranet and so on. We have to make the transition in smooth, easy and effective manner.

The message is clear —— going paperless helps our company save money, and it helps and protects environment too.

6.6 Summary

Using so much paper, across the organization, is taking its toll. It costs a lot of money to print a bill and mail it. Being completely paperless might be not easy. Each year the U.S.

alone consumes around 200 million tons of wood products, and this number increases 4 percent each year. Although the U.S. has less than 5 percent of the world's population, it consumes 30 percent of the world's paper. The process of deforestation has released about 120 billion tons of carbon dioxide into the atmosphere, so losing trees and forest land isn't the only problem. And for each piece of paper that goes into the trash, we pay from our pocket, and the environment pays in destructive ways. Maintaining a paperless office isn't an imaginary concept, given that thousands of pages of documents can be backed up onto a CD-ROM, Drive, SD-cards. A good scanner should come with drivers to make it work with whatever computer systems you have in your organization. Although E-mail has removed the need for many interoffice memos, company announcements, and mails, but there is still enormous amount of paper being filed in organizations around the world? Intranets, PDAs, Faxing, PDFs are a great way to reduce the amount of paper, EDI permits the electronic exchange of business documents in a standardized format. The paperless office brings benefit such as lower paper costs, less pollution and energy use, Smaller waste disposal cost etc. Complete paperless billing simply might not be feasible for any business, but it isn't just money and paper that is saved by paperless billing. We are securing our future by taking measures to protect our nature.

6.7 List of Reference

1. Green IT, Toby Velte, Anthony Velte, Robert Elsenpeter, McGraw Hill, 2008.
2. Green Data Center: Steps for the Journey, Alvin Galea, Michael Schaefer, Mike Ebbers, Shroff Publishers and Distributors, 2011.
3. Green Computing and Green IT Best Practice, Jason Harris Emereo.
4. Green Computing Tools and Techniques for Saving Energy, Money and Resources, Bud E. Smith, CRC Press, 2014.
5. The Green Computing Book: Tackling Energy Efficiency at Large Scale, Wu Chen Feng, and CRC Press.
6. Harnessing Green IT: Principles and Practices, San Murugesan, IEEE IT Professional, January-February 2008.
7. http://www.epeat.net/
8. http://www.greenci.org/
9. http://practicas.communidadesfomin.org/sites/ practicas.communidadesfomin.org/files/documents/ Green_IT_RAEE_FOMIN_2012.pdf
10. http://www.step-initiative.org/
11. http://www.ban.org/
12. http://www.rohscertification.co.in/
13. http://recycle-help.com/

6.8 Unit End Exercises

1. Where can we avoid the papers in office?
2. Which things are needed to go paperless in an organization?
3. What are the organizational realities for going paperless in an organization?
4. What are the benefits of having paperless office?
5. Write a short note on hardware and software with respect to going paperless.
6. What is the use of Portable Document Format?
7. Explain the term paperless billing.
8. Write a note on PDA and Tablet PC.
9. Write a note on Unified Communications.
10. Explain the term intranet.
11. How to build an intranet?
12. What is Content Management Systems? Explain its different features.
13. What is the use of Microsoft Office Share Point Server 2007? Give its features.
14. What is Electronic Data Interchange? Explain how green computing is maintained using EDI?
15. What are the obstacles in implementing EDI?
16. What is Value Added Network? Give its benefits.

* * * * *

UNIT - IV

7

RECYCLING

Chapter Structure

7.0 Objectives

Recycling and its importance

- In this section we will discuss recycling and its importance.
- We will see various available alternatives used for recycling.
- Recycling is not only about proper disposal of old equipment but we will also see about the safety of vital and confidential information stored on old computers.
- Recycling focuses on how to reduce levels of polluting emission and waste generation thereby protecting or improving the environmental quality.
- It also looks after how to use raw materials and energy more efficiently.

- Recycling encourages utilization of residues, recyclable waste and local materials as raw materials for conversion processes.
- It provides local employment.
- It also enhances the quality of life.

7.1 Problems

- We all know that computers contain harmful toxins, and when they are disposed of improperly, the environment pays the price.
- Poisons from computers first affect the people who are stripping them down for precious metals and after that, the air and groundwater can become contaminated.
- This is a big problem in countries like China and Africa as a lot of computers come to end-of-life here.
- In this section, we'll take a closer look at just how big a problem e-waste has become for China and Africa.
- We'll also talk about the toxins that are in computers that make responsible recycling so important.

7.1.1 China :

- Up to 80% of E Waste created by America has been shipped to China.
- In addition to the U.S., Canada,Japan, and South Korea send their e-waste to Guiyu, China.
- E-waste recycling is big business in Guiyu.
- It is responsible for the employment of 80% of the town's families.
- On average, workers make between US$1 and US$3 per day.
- The process they follow for recycling is as follow:
  - Ë% Copper,gold and other materials from the almost 15 million tons of e-waste dip motherboards into acid baths.
  - Ë% grind plastic casings from monitors
  - Ë% Grill components over open coal fires
- All the above process results in making Guiyu some of the largest dioxin levels on the planet.
- NOTE: Eighty-two percent of children in the Guiyu region under 6 years old in the area have lead poisoning.
- After disassembly, one ton of computer scrap yields more gold than 17 tons of gold ore.
- Circuit boards can be 40 times richer in copper than copper ore.
- Guiyu started scrapping computers in 1995.
- In 2001, the Basel Action Network made a video about the city and its e-waste issues, but by 2008 very little has changed.

7.1.2 Africa:

- In Africa recycling problems are also similar like China.
- In the Ikeja Computer Village, near Lagos, Nigeria, thousands of vendors are packed into the market, where all kinds of electronics can be purchased.
- Up for sale are computers, fax machines, cellular telephones, and other devices that have been repaired.
- Although Nigeria has a good repair market, it lacks a system to safely deal with e-waste.
- Most of it winds up in landfills and unofficial dumps.
- When plastic cases are burned, they churn carcinogenic dioxins and polyaromatic hydrocarbons (PAHs) into the air.
- It is estimated that 500 shipping containers filled with used electronic equipment pass through Lagos each month. Each container can be packed with a load equal to:
    * 800 computer monitors
    * 800 CPUs
    * 350 large television sets
- Local officials estimate that between 25 and 75 percent of this material is irreparable.
- So,even assuming the low end of this range, Lagos landfills could be home to 100,000 computers and 44,000 television sets per month.
- African importers don't mind dumping useless materials into landfills; with the few items they can remanufacture and sell, they still turn a tidy profit.
- For example, a working Pentium III computer sells for about US$130 and a working 27-inch television sells for US$50.
- Also, any working components can be sold separately.
- **NOTE**: Sometimes an unknowing exporter might put a Cisco router worth $15,000 into a shipping container filled with mixed electronics.
- Those are known as **"lottery tickets."**

7.1.3 Materials:

- Computers contain a lot of components and a lot of toxic materials.
- Effective recycling and disposal is important because you want to prevent the following hazardous materials from getting into the environment:
    * Lead Used in glass in TV and PC cathode ray tubes as well as solder and interconnects.
    * Older CRTs typically contain on average 4 lbs of lead (sometimes as much as 7 lbs), whereas newer CRTs contain closer to 2 lbs of lead.
    * Mercury Used in small amounts in bulbs to backlight flat-panel computer monitors and notebook displays.

* Brominated flame retardants Used in plastic cases and cables for fire retardancy.
* Cadmium Was used in Ni-Cad rechargeable batteries for laptops and other portables.
* Newer batteries (nickel-metal hydride and lithium ion) do not contain cadmium.
* PVC Used in wire and cable sheathing.

7.2 Means of Disposal

See, you can't just throw your computers in the dumpster, slam down the lid. Different areas have different requirements for the disposal of end-of-life technology. Recycling is one way to get rid of old devices. Also there are other strategies to deal with old equipment.

This section talks about what we can do with all the computers you need to get rid of.

7.2.1 Recycling:

- Computer recycling involves breaking down the computer to recover metals, plastic, and glass for reuse.
- It also aids in keeping hazardous materials from tainting the environment.
- Computers are one of the most complex things to recycle,because there are over 1000 different materials in a computer.
- Computer recyclers are normally large companies or government programs.
- They need to handle high volumes of recycling materials to make their business profitable. They look for components containing precious metals, such as gold, silver, and platinum.

  Some reasons not to recycle old equipment include:

  Ë% Not knowing how to properly dispose of equipment.
  Ë% The slim chance the equipment might be used in the future.
  Ë% The possibility that the equipment can be given to another organization.

- Earth911.org can help you locate local sources for recycling, donating, or disposing of end-of-life equipment.
- Another resource is the EPA's eCycling program, which helps put your business in touch with recycling for your electronics.
- The eCycling website is located at www.greenitinfo.com/links under Link given in the following table.

- Most computer recyclers remarket working parts and entire computers because they are able to recognize higher profits than through shredding and smelting to recover materials.
- Following Table lists some of the biggest recycling companies and their websites where you can go for more information.

Company	Website	Comments
Noranda/MicroMetallics Corporation	Link 7-2	Emphasizes its accountability in computer recycling. Has three recycling facilities, in Ontario, Tennessee, and California.
Waste Management	Link 7-3	America's largest recycler. Member of Sony's Take Back recycling program.
IBM Credit Corporation	Link 7-4 (Select Asset Recovery Solutions from the left navigation menu.)	Offers online buyback for up to 250 computers. Offers a disk overwrite service to protect data.
Metech International	Link 7-5	Recycling sites in Massachusetts and California capable of handling 50 tons of recycling per day. Also operates sites in Thailand and Malaysia. Employs accountability in disposal of material.
UNICOR Federal Prison Industries	Link 7-6	U.S. government recycling organization employing inmates. Offers nationwide coverage.

Some of The Major Recyclers

7.2.2 Refurbishing:

- Recyclers use means to completely dispose of computers.
- However computer refurbishers recondition discarded computers to get them in working order.
- This work is most often done by commercial refurbishers such as Dell Refurbished, IBM Refurbished, and Amandi Services.
- There are also noncommercial refurbishers, which are usually nonprofits or school programs.
- When an refurbisher receives discarded computers, it tests them, extracts usable parts from computers that are not repairable, and then fixes the ones that can be fixed.

- Generally speaking, one working computer can be built from two or three discarded machines.
- Non Working computers are sent to a recycler.
- An important part of refurbishing is wiping, or simply reformatting hard drives to remove existing data and installing the appropriate operating system.
- It costs about US$105 to refurbish a computer.
- These costs include labor, parts, and e-waste disposal.
- The field is broken into two parts—noncommercial refurbishers and commercial refurbishers.

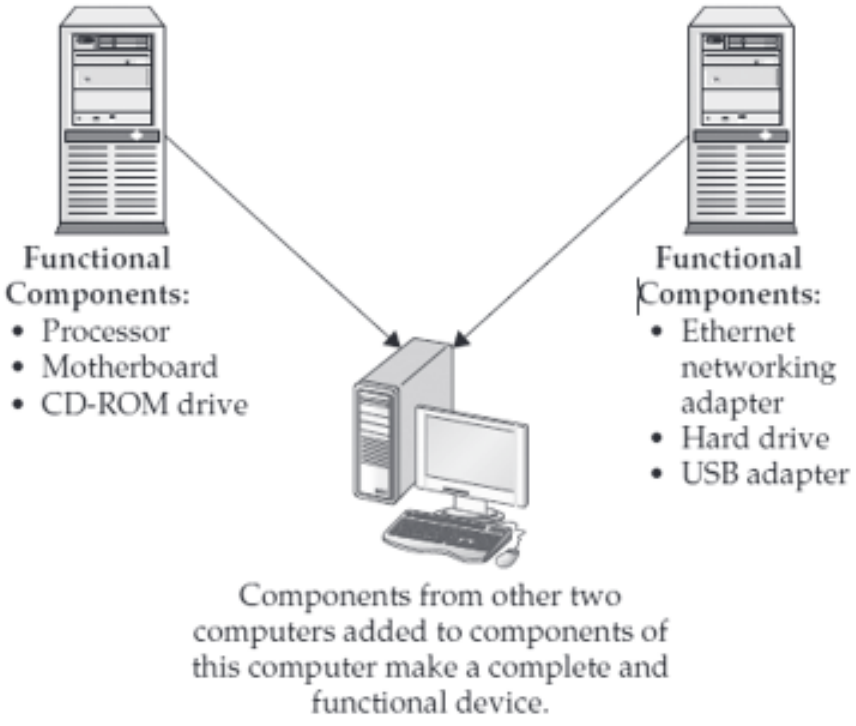


Figure: Generally speaking, it takes the components of three computers to make one,
functional computer.

Noncommercial Refurbishing

* This field is composed mostly of nonprofit and school-based programs doing computer training.
* This market turns around reused computers and provides them to low-income families.
* More than 70 percent of noncommercial computer reuse is sent to schools.

CompuMentor an organization that helps provide PCs and other technology to low-income individuals estimates that there are as many as 500 programs in the U.S.,with an average capacity of 200 computers per year.

Commercial Refurbishing

* You may want to take matters into your own hands and sell your computers (either individually or in lots and with or without the hard drives) on eBay.
* Of course, this will necessitate assignment of resources to manage the process, but it's certainly an option.
* However, most major computer companies have their own divisions for repurposing computers—companies such as HP Financial Services and IBM Global Asset Recovery Services.
* There are also hybrids of the noncommercial and commercial programs out there.
* RECONNECT (www.reconnectpartnership.com, or Link 7-7) is a partnership between Dell and Goodwill Industries.
* Computers can be brought into Goodwill locations, Dell will refurbish them, and then the repurposed computers are sold with the proceeds going to Goodwill Industries.

7.2.3 Make the Decision

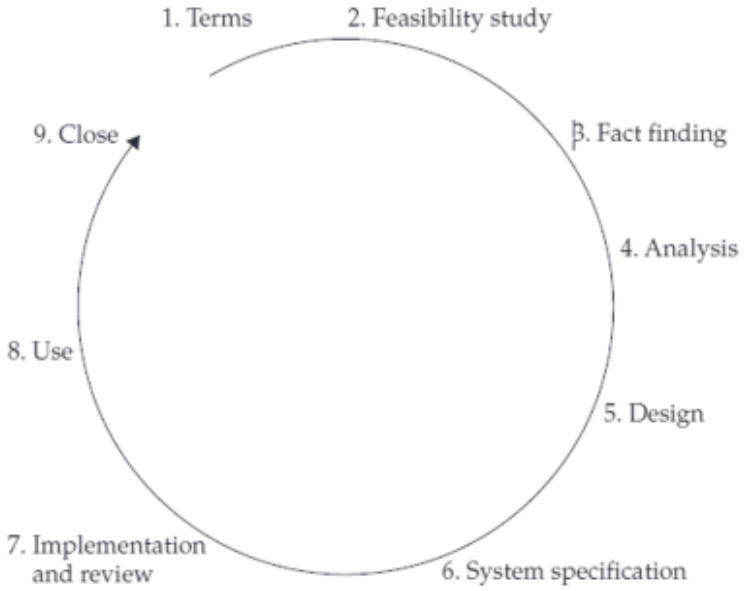
* Whether you choose to recycle or reuse is a decision you have to make to keep all your end-of-life PCs from filling every cabinet, closet, nook, and cranny in your organization.
* you have to define clear objectives for what you want done with the equipment and what the final place will be for them.
* If you want the systems destroyed, you should consider a recycler.
* You might consider donating or repurposing your equipment.
* If you have decided on donating computers for reuse, you should think twice,
    - First, you need to think about the age of the computers. If they are too old (more than 5 years) they may not be able to run the same software that other computers do.
    - Also, will the recipient be able to use the equipment or refurbish it for use? If it is too old, it might not be economical for the recipient to pay to bring the machines up to working order.
    - Finally, make sure any sensitive personal or business information has been removed from the computers.

7.3 Life Cycle

Planning for the end of the computer is something you should have done when you thought about buying them.
Establishing a system's life cycle gives Information Resource managers a tool to control budgets and respond to management with a business case for the new machines, their operation, and how you will ultimately phase them out of the organization.

7.3.1 From Cradle to Grave:

Let's take a closer look at what is involved in the product life cycle, from the very beginning to the very end.
A product life cycle takes all parts of the computer's life into consideration.



The Systems Development Life Cycle

Terms

* At the outset of a life cycle, you must determine what your overall objective will be through the development of a new system.
* That is, what capabilities and objectives will be served by the new system.
* For example, if you are going to be replacing your organization's computers with new ones, identify why they need to be replaced.
* Are they not performing up to your standards? Are they failing?

Feasibility Study

* The next step is a feasibility study, which asks whether the concept for a new system is achievable and realistic in terms of money, time, and the end result.
* As an outcome of the study, you may find that all you need to do is update components of your existing system rather than completely replace it.
* This saves you money, and it also prevents a computer from having to be recycled.

Fact Finding

* Monitor your staff and ask them how they use the system.
* It's a good idea to watch them so you can get a realistic idea of how they use the system.

Analysis

* At this stage, you get the chance to think up your ideal system, taking into consideration the needs identified in the "Terms" section.
* Design your system without giving any budget limitation.
* Design Now come back to reality and, using the model you made in the previous section, start building your real model.
* Use whatever elements you can from the "Analysis" section.
* At this stage, you produce a document that describes the system, but it need not contain specific brands or models of hardware or software.

System Specification

* Now that you have general hardware and software packages in mind, it's time to figure out which specific products will be purchased.
* At this stage, you choose exact models, brands,and identify suppliers.

Implementation and Review

* Set up the new system, train your staff to use it, and then monitor it for initial problems.
* Make any changes necessary to the system to improve performance.
* Once the new system is working as you want it to, you can get rid of the components of the old system.

Use

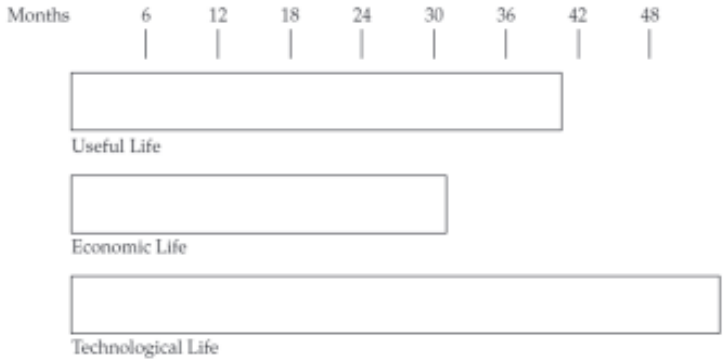
* Use the new system for day-to-day operations.
* Be sure to maintain and update it as needed.
* Part of usage is tuning your system for optimal functionality, so be sure to figure ongoing maintenance and monitoring into your life cycle plan.

Close

* In this stage you put the system in its final resting place (at least final as far as your organization is concerned).
* You can close the system and migrate data to a more modern system.
* At this stage, you decide what you will do with your data and think about how the machines will be disposed of.

Life

* The life of your system is a complex thing.
* You want to keep it around for several years to justify its acquisition, but the fact of the matter is its usefulness will end at some point.
* A system's life is based on three factors.Whichever of these factors arises first will determine how long the system's life actually is:
    - **Useful life**
      This expresses the equipment's lifetime, in which eventually the equipment wears out and it is not feasible to repair it anymore.
    - **Technological life**
      A system may become impractical to maintain even though it can still be repaired and maintained. For example, it might not be possible to find the right type of memory chips for the system because they are no longer made.
      Another way to look at this is obsolescence.
    - **Economic life**
      A system might still be functional, but it costs too much to use. It might also be that newer systems can be purchased that have lower operating costs so that the payback period of making that purchase is short.



A system's life is based on economic and technological factors.

You can always at least estimate the lifetime of a system up front by taking these factors into consideration.

7.3.2 Cost

- Cost is an important factor when evaluating your system's life cycle.
- You must consider the cost requieto pay for the electricity to power it ,maintenance costs, and the like along with the purchase cost of the computer.
- So when figuring out cost, you must include a number of factors like:
    * **Initial purchase price**
      The typical balance IT managers face here is deciding whether to pay a higher upfront purchase price in the hope that lower operating costs can be realized.
    * **Energy costs**
      The power it takes to run your machines can be a significant part of overall costs. The more "high performance" a computer is, the more likely it will need additional cooling, which also adds to the overall power cost.
    * **Maintenance**
      If you buy especially inexpensive computers, you may find yourself paying more in maintenance costs. Cheap computers are great at first, but when hard drives fail and NICs don't work properly, you'll spend money fixing these computers.
- Whereas the preceding are costs you can expect for the physical machines, there are other costs associated with your system that you should also add into your cost estimates. These indirect costs include the following:
    * **Interest**
      Maybe the largest indirect cost to your system is the interest you pay on borrowing money to make the initial purchase. As such, you should figure your interest costs into any life cycle cost considerations.
    * **Administrative costs**
      These costs will vary from organization to organization, system to system. And they're likely to be somewhat of a moving target as well as somewhat fuzzy. These include costs for arranging and administering service agreements, tracking equipment with property tags, and so forth.
    * **Staffing**
      Depending on your system, you may find that you need more (or in some cases fewer) people to run it. That might mean you need to adjust the size of your IT staff. Plan the impact of those salaries into your life cycle cost estimates.
    * **Downtime**
      If the system is down—either on purpose for updates or because of unreliability—those costs manifest themselves in the form of reduced productivity. You should be able to predict how often you'll have to take the system down and what that impact will be on the overall organization's productivity.

7.3.3 Buy or Lease

The decision will depend on your organization, what you're expecting of the equipment, and what you want of a computer purchase deal.

Leasing

There are a number of benefits to leasing your equipment.

Benefits are as follows:

* **Keeping your equipment up to date** Because computers become obsolete quickly, you pass the financial burden of their obsolescence on to the leasing company.
* **Predictable monthly expenses** You'll always know what you're spending on your machines, because you've already hammered out a deal and you know what you're paying.
* **Low (or no) upfront costs** Most leases don't require an upfront payment. So if your organization has trouble with cash flow, likely you'll be able to avoid a down payment.
* **Staying competitive** leasing allows you an option to get the latest and greatest equipment with regular rollover.

But leasing isn't all perfect. Let's talk about the downsides of leasing.

Cons are as follows :

* **Paying more**, overall Leasing is more expensive than outright buying. For instance, if you spend $2000 for one computer upfront, you would pay $2880 if that same computer was leased for $80 per month for 3 years.
* **A deal is a deal** With a lease, you still have to pay for the equipment even if you don't use it anymore. If your business changes or leased equipment is no longer needed, you're still obligated to make the monthly payments.

Buying

Buying equipment also comes with its own set of pros and cons.

Pros are as follows:

* **Ease in comparison** to leasing Rather than mess with agreements and having to return equipment at a certain date, when you buy your equipment, you go out, you buy it, and it's yours.

* **Maintenance is up to you** Leases usually require you to follow a maintenance schedule established by the leasing company. When you own the computers, you can decide when to defragment hard drives, install operating system updates, and so forth.
* **Tax deductibility** If you buy the computers, you can write off the price from your taxes. If you lease, you can only write off the monthly cost.

There are also negatives to buying equipment:

Cons are as follows:

* **High initial outlay** If you buy your computers, you'll have to spend that money up front. You may have to use a lot of your credit lines to make the purchase or dip considerably into the company coffers. That money could have been used to build the business through marketing, advertising, or something else.
* **You're stuck with it** With a lease, when the lease term is over and the machines go back to the lease company, disposal becomes the company's problem, not yours. However, when you own the computers, you have to figure out how to recycle or repurpose the machines.

7.3.4 Green Design:

An important area you should keep in mind in your life cycle considerations is designing your system with environmentally responsible use, retirement, and disposal. When designing your system, keep these thoughts in mind:

* **Design for repair** Some equipment is not designed so that it can be repaired (at least not easily) and is simply seen as disposable. Include as many elements as possible that can be repaired.
* **Design for upgradability** This goes hand-in-hand with the notion of being reparable. Build systems that can be upgraded, rather than having to replace entire components when needed.
* **Design to minimize power consumption** As mentioned before, the less power you use, the less money you'll spend and the less electricity that will have to be generated.
* **Design for recycling or a clean disposal** This means designing systems with material types that are easily recycled or can easily find a second life when you're done with them. It can also mean including elements that are less toxic, such as using RoHS-compliant equipment or EPEAT-rated equipment.

In conclusion, including green considerations into the life cycle process involves considering the end of the system's life when performing the initial design.

7.4 Recycling Companies

While choosing an environmentally friendly approach for recycling you should consider a few things before making any selection.You need to find a company that is accountable and
maintains good records about what they did with your old machines.
In this section, we talk about factors to consider when selecting a recycler.

7.4.1 Finding the Best One:

- The quality of electronic recyclers will vary from company to company.
- The EPA recommends selecting recyclers who do the following:
    * Maximize reuse, refurbishment, and recycling over disposal and incineration.
    * Take precautions to reduce emissions and exposures to workers and the environment.
    * Provide special handling of components that may contain substances of concern.
    * Ensure that exported electronic products are being sent for legitimate reuse, recycling, or refurbishment.
    * Ensure that downstream recycling, refurbishing, and disposal facilities follow management practices that are consistent with the guidelines.

7.4.2 Checklist :

- The EPA utilizes a checklist for federal agencies to help evaluate potential recyclers.
- The checklist is a good tool for your company. It can also help you evaluate the following:
    * **Collectors and haulers** Those who collect end-of-life electronics and generally work under contract with another business.
    * **Repair shops** Those who repair computers for resale and remove operational components for the highest level of reuse.
    * **Electronics demanufacturers** Those who take electronics apart for reusable components and also for scrap value.
    * **Private asset recovery operations** Those who specialize in providing the highest return on discarded computer equipment. They usually work with large-scale businesses.
- **Here are some questions to ask when considering a recycler:**
    * *Can the electronics recycler give a general description of its business?* This type of information may include point of contact, number of employees, years in business, and ownership history.
    * *Does the electronics recycler accept the products you want recycled?*
    * *Does the electronics recycler service your geographic area and type*

of organization?

* *Can the electronics recycler clearly describe its fees for various types of equipment?*
* *Can the electronics recycler offer additional services that you may require?*
  Additional services may include onsite collection support, transportation support, product reuse or refurbishment, hard-drive erasure/destruction, product tracking, and recycling guarantee or certificate.
* *Can the electronics recycler identify its federal, state, and local environmental agency contacts?*
* *Can the electronics recycler provide information on its compliance history?* This type of information should include recent criminal (past 5 years) or civil (past 3 years) violations, and how they were, or are, being addressed.
* *Does the electronics recycler have environmental and/or health and safety management systems/plans in place?*
  Management systems and/or plans may include an environmental management system (EMS), environmental risk management plan, hazardous materials management plan, emergency prevention, preparedness, and response plan.
* *Can the electronics recycler provide a description of its processes?*
  An electronics recycler should be able to provide an overview of its procedures for demanufacturing, reuse/resale/donation, secure destruction, disposal and waste handling, product manufacturing, and storage.
* *Can the electronics recycler provide a description of what it does with the electronic equipment it receives?*
  An electronics recycler can utilize a variety of processing methods, including brokering (matching buyers and sellers), resale of whole units, remanufacturing, demanufacturing, material recovery (physical separation to capture plastics, metals, glass, and so on), material processing (shredding and grinding), and donation (school systems, nonprofit organizations, and so on).
* *Can the electronics recycler provide the names and/or locations of the downstream businesses to which it sends equipment or components?*
* *Does the recycler export equipment outside the U.S.?*
* *Does the electronics recycler audit its end-markets either via audit, questionnaire, or other measures?*
* *Does the electronics recycler send materials for disposal in landfills or for incineration?*

* *Can the electronics recycler supply you with documentation or certification of final disposition?*
* *Does the electronics recycler maintain appropriate insurance/ assurance?* Types of insurance/assurance may include general liability insurance, environmental liability, insurance, and financial assurance (for example, bonding).
* *Will the electronics recycler allow you to verify this information through an onsite evaluation?*

The EPA has more information about managing electronics recycling and refurbishment. Although the site is geared for governmental agencies, your organization would certainly benefit from the information it provides.

7.4.3 Certifications :

You should also take a potential recycler's industry certifications into consideration.

Certifications include the following:

- Institute of Scrap Recycling Industry's (ISRI) Recycling Industry Operating Standards (RIOS) certification
- International Association of Electronic Recyclers (IAER) certification
- International Organization for Standards (ISO) ISO 14001 certification

Certification achievement is totally voluntary, but it is a good sign of the recycler's commitment to quality service.
On the other hand, if a recycler doesn't have any of these certifications, it doesn't mean they won't provide quality service.
However, because it takes a lot of work to earn these certifications, you can almost be guaranteed that the recycler disposes of materials in an appropriate manner.

7.5 Exercise

1. Write a short note on Refurbishing.
2. Give advantages and disadvantages of buying equipment's.
3. Explain commercial and non-commercial refurbishing.
4. List and explain different phases of product life cycle.
5. Give advantages and disadvantages of leasing equipment's.
6. Explain the recycling problem in China and Africa.
7. How to determine the system's long life? Explain.

* * * * *

8

RECYCLING - II

Chapter Structure

8.0 Objectives

Over time, there is a need to change or throw drives because they go bad, and others get too small, so you replace them. But you can't just throw away a hard drive or drop it off at a recycling center. These drives may contain personal data, and you need to deal with them carefully to ensure that no one can recover your information.The hard disk drive is probably the most important component to your computer.

Before donating or recycling your computer, you need to completely wipe or remove the hard drives. By doing so, you will ensure that the data on the hard drives will be completely erased and untraceable by data thieves.

This section is all about what you can do to keep your organizations' hard drives from giving up their secrets. In this chapter we will also discuss the effects of using CDs and DVDs without giving much thought to its purpose. This section is focused not only on the bad side of misusing equipment but being optimistic , it also gives information about different available options to recycle it effectively.

8.1 Hard Drive Recycling

It is important to have a thought that sensitive information you've tried so hard to protect can be up for grabs once your computers leave your company, destined to be recycled or repurposed.

Hard-drive decommissioning is the act of removing data from the hard drive before it is sent for recycling or repurposing.

Unfortunately, this is often done incorrectly and, especially if you're sending hundreds or thousands of computers out of your organization,it can be costly.

And most important thing to take into consideration is that data in the wrong hands can be even costlier.

The cost can be measured in lost company information, trade secrets, and the like, as well as potential damage to your company's reputation should the company be required to disclose the loss under one of the numerous data breach laws in effect around the world.

To top it off, loss of certain types of data could be a civil and/or criminal liability for company officers.

8.1.1 Consequences:

- Breached data can bring public relations, legal, and business repercussions.
- Data confidentiality is highly regulated by the U.S. Government.
- For example, the healthcare industry has Health Insurance Portability and Accountability Act (HIPAA) guidelines in place that put rules on confidential personal data.
- If that data gets out, the organization that lost it faces strict penalties.
- U.S. businesses and their employees and partners suffered huge losses after financial misdeeds by officers at Enron and Tyco International.
- As such, the Sarbanes-Oxley legislation places rules on financial data.
- In the past, it was just a good idea to keep data secure. Now it's the law.
- As a result of these laws, it isn't just a customer or client who suffers if data is leaked.
- Now, companies can face huge financial penalties.
- Even more sobering, company officers and directors can face prison time.

Following Table will illustrates potential penalties if the laws are violated.

	Sarbanes-Oxley	Fair and Accurate Credit Transactions Act of 2003 (FACTA)	HIPPA
Directors and Officers	$1,000,000		
Institution	$5,000,000	$11,000	$50,000 to $250,000
Prison	20 years		1 to 10 years

Potential Penalties If Confidential Data Is Not Protected

8.1.2 How to Clean a Hard Drive:

- Most of the time when selling an old computer, returning it after a lease, or recycling it, you simply reformat the drive or delete the files.
- When this is done, users tend to think that the data is gone, **but it's not**.
- The truth of the format is that even though the data can't be seen on the computer once it has been formatted, that only means it can't be seen by the operating system.
- Quick formatting just writes to a portion of the disk, but most of the old data is still there and is readily accessible using fairly common recovery tools.
- Even disks that have been completely formatted can be partially or completely recovered.

Not to be scared of this more. Just we need to be more vigilant while formatting or dispossing our disks. You can safely decommission your old hard drives using several methods. Let's talk about the pros and cons of each one.

Deleting

Pros:

* Deleting data is the most common way for a user to remove information from the hard drive.
* The problem is that nothing is actually deleted.

Cons:

* When a file is deleted, the file system's pointer to that file is removed, but that doesn't remove the file itself.
* The only way the file will be completely removed, using this method, is if data overwrites the area where the file resided.
* The data remains on the hard drive and it can be recovered with the right software.

Overwriting

Pros:

* Software overwriting is a method in which the hard drive is completely written over with
* random data three times.
* The U.S. Dept. of Defense (DoD) actually requires drives to be written over three times because there may be problems with the following:
    - Ineffectiveness of the overwrite procedures
    - Equipment failure, such as a misalignment of read/write heads
    - Inability to overwrite bad sectors of tracks of data in inter-record gaps
* This is an appealing solution because there are plenty of applications you can buy to do this. It can be done in-house.
* Additionally, overwritten drives can be used again.
* They can be used within your organization or you can sell them.

Cons:

* Software overwriting is a time-consuming process.
* It can take several hours to wipe one drive.
* This can cause a loss of productivity, especially in an organization that is overwriting hundreds or even thousands of hard drives.
* Sometimes cost can also be an issue.
* Some software requires a separate licensing fee for each hard drive that's being overwritten.

Degaussing

Pros:

* If you remember VHS videocassettes, you may also remember the warning labels on them to keep them away from magnets.
* A powerful enough magnetic force could erase a videocassette.
* This is also known as **degaussing**.
* Degaussing uses a machine that produces a strong electromagnetic field and destroys the information stored on a hard drive.

Cons:

* Degaussing was done in the past with weaker magnets; however, the magnetically shielded hard drives of today call for a stronger electromagnetic field.
* Although the zap from the electromagnet is quick, it also destroys other components of the hard drive, leaving them inoperable.
* As such, they cannot be reused and you don't know for sure if all the data has been erased.
* You also have to take care when using a degaussing machine.
* While wiping one hard drive, you run the risk of destroying other machines that might be in the area.
* Degaussing is typically outsourced.
* Third-party companies buy the degaussing equipment and perform the work, but this can lead to chain-of-custody issues.

Mechanical Shredding

Pros:

* Mechanical shredding is what it sounds like.
* Old hard drives are fed into a shredder and they're torn into a gazillion pieces.
* The benefit is that someone would need tweezers, a microscope, glue, and a lot of patience to get the hard drive back together.

Cons:

* The downside is similar that we need to outsource to a degausser
* It leads to chain-of-custody issues.

Secure Erase

Pros:

* A technology called Secure Erase was introduced in 2001.
* ATA and SATA drives contain the technology to erase the data contained on them.
* But it has been disabled by most motherboard BIOSs probably because of concerns that a user might accidentally destroy data.
* NOTE There is no way to recover from Secure Erase.
* There's no way to recover from Secure Erase.

* In fact, the National Security Agency and the National Institute for Standards and Testing have given Secure Erase a higher security rating than block overwriting software.
* Secure Erase is approved to erase all kinds of data.
* You can employ Secure Erase by downloading a Secure Erase utility that Dr. Gordon Hughes (from the University of California at San Diego's Center for Magnetic Recording Research) helped develop.
* To use it, follow these steps:
    1. You need to know how to create a DOS boot disk and load the extracted HDDerase.exe onto the bootable floppy disk.
    2. Boot the computer from the floppy.
    3. Make sure the boot priority setting is currently applied in your system's BIOS.
    4. Type hdderase at the system prompt.
    5. All ATA hard drives connected to the system will be displayed.
    6. Make sure the jumpers on the hard disk are correctly configured—that is, don't set the jumpers to CS (cable select). They should be set to "master" or "slave."
    7. Complete the utility.
* If it is likely that your computer does not have a floppy drive. If that is the case, burn HDDerase.exe to a CD-ROM and boot from there.
* Secure Erase takes some technical know-how, but it is a less-expensive method and takes less time.
* You also don't have to worry about chain-of-custody issues.

Following table will summarize all above discussed methods Pros and Cons of Hard Drive Erasure:

Requirement	Software Solutions	Degaussing	Shredder	Third-party Providers	Secure Erase
Destroys data beyond forensic recovery	No	Maybe	Maybe	Maybe	Yes
Control of the process	Yes	Maybe	No	No	Yes
Certification and audit trail	No	No	No	Yes	No
Easy to install and use	No	No	No	No	No
Reformat for reuse	Yes	No	No	No	Yes

Pros and Cons of Hard Drive Erasure

8.1.4 Which Method to Choose and When ?

- Each method presented so far has its pros and its cons.
- Some are speedy, some are thorough, and some are inexpensive.
- But also some are slow, some are unreliable, and some put your organization in the kind of danger you want to avoid.

You'll need to weigh the pros and cons depending on your organization's needs and what you are prepared to protect your data.

- Although you run the risk of losing control over your hard drives when you outsource their decommissioning, that doesn't mean you shouldn't do it.
- Many companies pride themselves on their security and discretion.
- When you consider a third-party to decommission drives, you need to be confident you are picking a company that will do what it's being hired to do in an effective and reliable manner.
- After all, what your company does today could be twisted around and used against you in the future.
- You should pick a vendor based on your confidence in that vendor, the vendor's technical capabilities, its organizational integrity, and its staying power over the long haul.
- Companies such as IBM Global Financing's Asset Recovery Solutions not only can sanitize your hard drives, but can also provide remarketing services so you can sell your decommissioned drives.

8.2 CDs and DVD

In 1983 CDs were introduced to a music media.
It makes it possible to have music released on 120 mm × 1.5 mm plastic and aluminum discs, rather than on 12-inch record albums.
The sound was perfect, and you didn't have to worry about the CDs wearing out or getting easily scratched.

8.2.1 Advantages of using CD and DVDs

- It was possible to write to CDs, and they became an attractive medium for removable data storage and archiving.
- In the mid-1990s, DVDs were introduced.
- Initially DVDs were used for movies,but soon they were started to be used with computers.

- Gradually with the developments in the automobile, computer, and cellular phone there is increased use of the CD's.
- The main reason to make CDs and DVDs so much popular is their size.
- These things were designed to be small.

8.2.2 Disadvantages of using CD and DVDs

- The real problem concerns recycling.
- Considering that Americans dump an average of 45 tons of CDs and DVDs each year, you can see the environmental problem (Worldwatch Institute, 2008).

- According to the Worldwatch Institute:
    * In 2000, more than 700 compact disc factories were operating worldwide.
    * In 1983, when CDs were first introduced in the United States, 800,000 discs were sold. By 1990, this number had grown to close to 1 billion.
    * The European market for music CDs has expanded rapidly, with almost 2.9 billion compact discs produced in Western Europe in 1998.
    * Each month, more than 45 tons of CDs become obsolete—outdated, useless, or unwanted.
    * Each year, more than 55 million boxes of software go to landfills and incinerators, and people throw away millions of music CDs.

There's good news and bad news in the world of CD and DVD disposal.

8.2.3 Bad News about CD and DVDs disposal

- CDs and DVDs are made from different kinds of lacquers, aluminum, and sometimes gold.
- Most of their composition is made up of polycarbonate plastic, which doesn't readily break down and will be around for hundreds of years.
- Further, sending CDs and DVDs to a landfill is a bad idea, because in addition to being around for a long time, they can release Bisphenol A.
- Burning discs is another poor choice,because they release toxic fumes.

8.2.4 Good News about CD and DVDs disposal

- There is good news. Many recyclers accept CDs and DVDs.
- The components can be recycled into everything from automobile parts to office equipment.
- Recycling is available, but it's not as easy as putting your organization's CDs and DVDs out with the glass bottles.

- Specialized recyclers will take the discs to reclaim the high quality plastic.
- Some CDs and DVDs contain 20 milligrams of gold, which is another commodity that can be rescued.
- The use of these recyclers is usually free, but you have to pay to ship your CDs and DVDs to them.
- The security of your data cannot be guaranteed, so your best bet is to cut the CDs and DVDs in half with a pair of shears before releasing them from your custody.
- Recyclers can recycle any CD irrespective of its condition.
- Also, be sure to send in physically damaged discs as well.

The following are some places to start in your CD and DVD recycling efforts:

• North America Link 7-9 and Link 7-10
• United Kingdom Link 7-11 and Link 7-12
• Australia Link 7-13 and Link 7-14

More good news: Companies and individuals are recycling. One recycler in San Jose, California processes a million CDs each month. In its second year in business, the company recycled 20 million CDs. A lot of those CDs came from software companies looking to get rid of surplus inventory.

8.2.5 Change the mind-set

To use less number of disk in your organization, you can follow following guidelines:

- Use rewritable DVD/CD media.
- Find out if the information you're looking for on disc is available over the Internet.
- If it is, you may not need to buy the disc then, keep your discs out of direct sunlight and away from heat and water. This will prolong their life.
- Minor scratches can be fixed by rubbing a mild abrasive (such as toothpaste) on the disc surface in a circular motion from the center to the outside.

We can reuse discs by doing things such as turning them into dresses, disco balls, drink coasters, and reflectors for bicycle seats.
But we can not do the same task in your organization with all your old CDs.
And this will definitely result in going to the trash and adding to that 45 million ton count.

8.2.6 David vs. America Online

- AOL is an American web portal and online service provider based in New York City.
- A Company formerly known as AOL Inc. and originally known as America Online.
- AOL grew to become the largest online service, displacing established players like CompuServe and The Source.
- AOL had about 3 million active users by 1985.
  Ï% AOL was one of the early pioneers of the Internet in the mid-1990s.
- It was the most recognized brand on the web in the United States.
- It started by provided a dial-up service to millions of Americans, along with web portal, e-mail, instant messaging
- When broadband service came AOL rapidly declined thereafter.
- Back to the very beginning of the investing days of **David Gardner**, when he was just an 18-year-old college student, he was one of the big purchasers of early internet powerhouse America Online (AOL).
- He bought it when he and his brother were just starting The Motley Fool on AOL's platform.
- In 2001, they set a goal of collecting one million of those installation discs and then shipping them to AOL.
- For a time, they even had a website (www.nomoreaolcds.com) where they actively sought people to send them their AOL discs.
- When one million discs had been collected, the duo intended to ship them to AOL (they estimated it would take 45 moving trucks).
- As of 2007, they had collected 400,000 discs before the project was shut down.

This was sort of a radical initiative, but it underscores the need for companies to be more responsible with their CD and DVD creation and distribution. The discs take between five and ten seconds to create, but they remain with us for hundreds of years.

8.3 Summary:

- Recycling computers is not a small and simple task to perform.
- It is definitely more than just calling a company to take the boxes away.
- It will take time for the selection of the appropriate company to do it, which is best suited for your needs.

- At the same time proper analysis is required to prepare for your computers' ultimate disposal.
- The same understanding and thinking is also required when you decide to upgrade or buy new equipment.
- This can help you save money, electricity, and the environment by opting correct components of your users' computers so they can be made greener.

8.4 Exercise

1. List various ways to clean a Hard Drive. Explain any two.
2. Write a short note on recycling CDs and DVDs.
3. Explain the advantages of using CDs and DVDs.
4. Explain the disadvantages of using CDs and DVDs.
5. What is "David vs. America Online" case? Explain what we learn from it?
6. What is the need to study recycling of drives we used in computers? Explain briefly how we can achieve it.

* * * * *

9

HARDWARE CONSIDERATIONS

Chapter Structure

9.0 Objectives

- As you are aware most of the capital amount required by any organization or firm is to make setup by using different hardware and software.

- In addition to that it also requires electricity to run all equipment which adds on to the expenditure.
- If we want to save on such expenditure, we can select our computers in such a way which can utilize less power.
- In this chapter we will discuss various ways for making such selection of hardware which cause less power consumption.

9.1 Introduction

In this chapter we will look at different ways we can select hardware for our organization that use less power. Which also means we will spend less money in the long run. This will cause less damage to the environment.
You will acknowledge real savings when this cost cutting is done for a large number of computers in any organization.

9.2 Certification Programs

Today we can find a list of hardware which are energy efficient very easily.
It's not the same case as in the past, where we needed to go through a number of hardware manually checking their power consumption to decide which one to take or not.

Nowadays it's a really very easy way to compare the hardware parts on the basis of different attributes.

Let's take a look at different certification programs available which can just look at a product and depending on what level of certification it has it will tell you that how much you'll save money

Some of the common certification programs which will explain how you can use them to your benefit is discussed in this section.

9.2.1 EPEAT

- EPEAT means "The Electronic Product Environmental Assessment Tool".
- It is a global ecolabel for the IT sector.
- It was developed using a grant from the Environmental Protection Agency(EPA) and is owned and managed by the Green Electronics Council (GEC) which is a non-profit organization founded in 2005.
- It helps to buy and sell environmentally preferable electronic products to the purchasers, manufacturers, resellers, and others.
- EPEAT-registered products must meet environmental performance criteria.
- The complete set of performance criteria includes 23 required criteria and 28 optional criteria in eight categories.

- To be registered as EPEAT certified, products must meet all the required criteria. Products may then achieve a higher-level EPEAT rating by meeting additional, optional criteria.
- It includes,
    * materials selection,
    * supply chain greenhouse gas emissions reduction,
    * design for circularity and product longevity,
    * energy conservation,
    * end-of-life management and corporate performance.
- In the market not a lot of machines are available which are EPEAT certified.
- It is a ranking system that helps purchasers in the public and private sectors evaluate, compare and select hardware based on their environmental attributes.
- It evaluates electronic products according to three tiers of environmental performance as shown in below table:

Three Tiers Certification Level	**Requirements**
Bronze	Product meets all required criteria.
Silver	Product meets all required criteria plus at least 50 percent of the optional criteria that apply to the product type being registered.
Gold	Product meets all required criteria plus at least 75 percent of the optional criteria that apply to the product type being registered.

The Three Levels of EPEAT Certification

- EPEAT covers products like , Computers & Displays,Imaging Equipment,Mobile Phones,Photovoltaic Modules and Inverters (PVMI),Televisions,Servers.
- Check this site for more details: www.epeat.net

9.2.2 RoHS

- RoHS is an “Restriction of (the use of certain) Hazardous Substances” in electrical and electronic Equipment.

- The primary objective of this directive is to put a constraint on the use of hazardous substances in electric and/or electronic equipment.
- To promote better, environment friendly methods for recovery and dumping of wastes from electrical and electronic equipment.
- RoHS restricted materials are hazardous to the environment and pollute landfills.
- Such materials are dangerous in terms of occupational exposure during manufacturing and recycling.
- Hence RoHS laws play a vital role to counter the ill-effects of the e-wastes.
- Several countries emphasize the need to address the hazardous problems and challenges caused by electronic wastes.
- Plenty of RoHS-certified devices are offered all over the world.
- Businesses in California are forbidden to buy any hardware that is banned under European RoHS law since January 2007.

9.3 Energy Star

- EPA is an "Environmental Protection Agency.
- It was established in December 1970 by the executive order of President Richard Nixon.
- It is an US agency who works to protect human and environmental health.
- It is responsible for creating standards and laws promoting the health of individuals and the environment.
- However, **the Environmental Protection Agency's Energy Star program** is the biggest and most well-known program for certifying energy-efficient electronics in the United States.
- ENERGY STAR currently certified products in more than 75 categories, including televisions,air conditioners,washing machines and computers.
- ENERGY STAR certified products have the same features consumers look for in conventional models, but use less energy.
- ENERGY STAR certified equipment can help to reduce energy bills, improve comfort, and help to protect the environment.
- Let's take a closer look at what it takes to be Energy Star certified and what that means for computers, monitors, and other devices in this section.
- Office equipment like computers and monitors to imaging equipment, such as printers and copiers has earned the ENERGY STAR helps eliminate wasted energy through special energy-efficient designs.
- They use less energy to perform regular tasks, and when not in use, automatically enter a low-power mode.

9.3.1 Computers

- ENERGY STAR certified computer specification will save consumers and businesses more than US$1.8 billion in energy costs over the next 5 years and prevent greenhouse gas emissions equal to the annual emissions of 2.7 million vehicles.
- Computers have been certified under the Energy Star program for years, though the EPA estimates that by toughening certification standards.
- In order for a computer to be Energy Star certified, it must meet the requirements outlined in the following Table.

Product Type	**Tier 1 Requirements**
Desktops, integrated computers, desktop-derived servers and gaming consoles	Standby (Off Mode): <= 2.0 W Sleep Mode: <= 4.0 W Idle State: Category A: <= 50.0 W Category B: <= 65.0 W Category C: <= 95.0 W
Notebooks and tablets	Standby (Off Mode): <= 1.0 W Sleep Mode: <= 1.7 W Idle State: Category A: <= 14.0 W Category B: <= 22.0 W
Workstations	TEC Power (P_{TEC}): <= 0.35 × [P_{Max} + (# HDDs × 5)] W **Note:** Where P_{max} is the maximum power drawn by the system, # HDDs is the number of installed hard drives in the system.
Efficient power supply requirements	Internal power supplies: 80 percent minimum efficiency at 20 percent, 50 percent, and 100 percent of rated output and minimum Power Factor 0.9. External power supplies: Either Energy Star qualified or meet the no-load and active mode efficiency levels provided in the Energy Star External Power Supply (EPS) specification.

Tier 1 Energy Efficiency Requirements Effective July 20, 2007

- Energy Star website provides the savings calculator to find cost savings from using Energy Star–rated computers.
- Using the ENERGY STAR product finder, you can select from hundreds of certified efficient computers from the best, most trusted, and most popular brands.
- We can filter the list of models by specific attributes such as:
    * Form factor (e.g., desktop, notebook, two-in-one notebook, tablet, etc.)
    * Processor speed
    * Memory
    * Networking features

9.3.2 Monitors

- ENERGY STAR certified monitors consume 20 to 60 percent less power compared to others that aren't Energy Star certified.
- The Energy Star website contains a more thorough tool than our rough estimate. It is a Microsoft Excel tool that can help you calculate your cost savings.
- In order to achieve an Energy Star certification, monitors must meet the following criteria:
    * In On mode, the maximum allowed power varies based on the computer monitor's resolution.
    * In Sleep mode, computer monitor models must consume 2 watts or less.
    * In Off mode, computer monitor models must consume 1 watt or less.

Q. How much will your business save money by using Energy Star–certified monitors?

ANSWER:

Following results addresses various issues where we can save by using Energy Star–certified monitors:

Electricity usage cut in half You'll save US$25 to US$75 per PC each year.

Cooling loads reduced You'll also save US$5 to US$10 per PC per year in office cooling costs. That number increases to US$10 to US$25 in warm climates.

Reduction in peak load demand charges If your utility charges extra during peak demand times, this amount is lessened.

Faster boot times Waiting for computers to boot is eliminated. Because the computers are already technically "on," you don't have to wait for them to boot up.

They simply need to awaken from low-power mode, which is much faster than a boot up.

- To maximize power savings, the EPA recommends setting computers to enter system standby or hibernate after 30 to 60 minutes of inactivity.
- To save more, we must set monitors to enter sleep mode after 5 to 20 minutes of inactivity. The lower the setting, the more energy you save.
- Take a note that,on laptops we must activate these settings in the AC power profile, not just the DC (battery power) profile.

9.3.3 Printers, Scanners, All-in-Ones

- It is always advantageous to your organization to seek out Energy Star–rated peripherals such as printers, scanners, and all-in-one devices.
- Like computers and monitors, these devices don't cost any more than non certified models,but they do use less energy.
- For a laser printer to earn the Energy Star certification, it must:
    * Use at least 25 percent less energy than regular printers.
    * Be able to print on both sides of a page, thus saving paper.
    * Run cooler and last longer, thus reducing the cost of air conditioning and maintenance.

9.3.4 Thin Clients

- Thin computers rely on the server for processing activities and are used mainly for input and output between the server.
- Thin clients play a vital role when computers are being shifted largely using more as communication devices as opposed to processing devices.
- Fat clients are the PCs which normally do most of the processing and then transfer the results of the data to the server.
- Thin clients usually run web browsers or remote desktop software.
- Following are the advantages to using thin clients :
    * **Lower administrative costs -**
      Thin clients are largely managed at the server, and there's less opportunity for hardware failure. The entire system is managed centrally which results in less chance of virus or other malware infection.

    * **Security -**
      Data is not actually stored on the thin client, the chance for physical data theft is drastically reduced.

* **Lower hardware costs -**
  Thin clients tend to be less expensive than fat clients because they do not contain disk drives, application memory, and high-power processors.

* **Efficiency -**
  In a fat client, the CPU is idle most of the time. With a thin client, memory can be shared. If multiple users are using the same application, it only needs to be loaded into the server's RAM once. In a fat-client scenario, each workstation must have its own copy of the application in memory.

- **Lower energy consumption -**
  Thin clients use a lot less energy than fat clients. This reduces the amount of energy consumed, which equates to less heat generation, thus reducing the price of air conditioning.

- **Easy hardware failure management -**
  If a thin client fails, it is easier to replace than a fat client. If a thin client fails, the unit is simply swapped out. There is no need to try and recover files and transfer them from the old, broken machine to a replacement.

- **Hostile environments -**
  Thin clients don't have moving parts, they can be used in dusty environments and other harsh locales, such as manufacturing floors, also there's no worry over fans clogging and overheating the computer.

- **Ease of upgrade -**
  If your system needs more computing power, it's easier to add another blade server to increase system resources to the level you need rather than having to upgrade individual clients. This results in less downtime, and you don't have to worry about disposal of replaced equipment.

- **Less noise -**
  Because there are no fans in the thin clients, no noise is generated.

- **Less disposed equipment -**
  Thin clients can remain in service longer than fat clients, so they aren't disposed of as often. Also, because there are no hard drives or DVD-ROM drives, there are fewer components to discard when they reach the end of life.

9.4 Servers

- We can use servers in our green workplace in various ways.
- We can reduce the number of machines by doing thoughtful use of **consolidation** and **virtualization** technologies.
- We are also able to use servers for new functions.
- In this section, we'll talk about the different types and functions of servers.

9.4.1 Blade Servers

- A **server** architecture uses multiple **server** modules also called "**blades**" in a single place.
- A **blade** server is a stripped-down server computer with a modular design.
- It is optimized to minimize the use of physical space and energy.
- **Blade** servers have many components removed to save space, minimize power consumption and other considerations, while still having all the functional components to be considered a computer.
- It is widely **used in** datacenters to save space and improve system management. Each **blade** has its own CPU, RAM and storage.
- The main advantage of blade servers is that they increase your organization's datacenter capabilities, without adding to its size.
- If you are going to be performing complex calculations with a lot of data, you'll need a server that's pretty powerful.
- The benefit of a blade system is that you can easily update the system if you discover you need more power.
- It's better to plan for future growth than to pay up front for power you don't need.

Advantages of using blade servers are:

- **Less space needed**
  Blades take up 35 to 45 percent less space than tower or rack-mounted servers.

- **Reduced power consumption**
  By consolidating power supplies into the blade chassis, you reduce the power supplies needed and you benefit from an overall reduction of power use.

- **Lower management cost**
  When you consolidate your servers, deployment, management, and administration are simplified and improved. This itself contributes to cost savings and less headache for the IT staff.

- **Simplified cabling**
  Rack-mounted servers were a good way to consolidate hardware in fewer locations than tower servers. However, they also had a lot of cabling involved. Blade servers reduce cabling requirements by 70 percent. Fewer cables means better airflow, which means lower cooling costs.

Different Types of Blade Servers are as follows:

Server Type	Functionality	Usage
Single-function blade server	Bare-bones CPUs, sometimes with onboard storage or porting, and they run single tasks, applications.	Ideal for academic or office environments where blades can be assigned individual including web hosting, e-mail, and scheduling software.
Blade PCs	The central core of a thin-client setup. This server provides the processing and storage capacity for clients, which is then accessed by thin clients.	General office applications.
Enterprise-level blade server	Maximum power set in a small space. These systems generally use multiple racks and require compatibility with legacy systems, networks, and software.	These are most often used by digital production studios, high-level stockbrokers, and financial corporations.

9.4.2 Consolidation

- Organizations have several small servers that each perform the function of a single legacy application that cannot be removed because it is still used by some processes. These servers are excellent candidates for consolidation.

- By consolidation you save the entire energy consumption of the original server and its cooling costs, and you also have better manageability.
- Consolidation is possible because of virtualization.
- Virtualization is the practice of software creating the instance of a PC on a server.
- In virtualization multiple virtual servers can exist on one machine.
- Then you can load the virtual server, install whatever operating system and applications you want, and run it side-by-side with other virtualized servers.

9.4.2 Products

- Many companies offer blades.
- IBM, Hewlett-Packard, and Dell all have their own offerings with their own features and capabilities.
- Please take a note of that, Dell offers lead-free servers for customers who want to green up their IT departments.

9.5 Hardware Considerations

The devices that are best for your organization must be taken into consideration simply because one kind of hardware is not applicable to all. Though we need to follow some guiding principles to find the hardware that will have the least impact on the environment.

9.5.1 Planned Obsolescence

- End-of life hardware as a part of your systems development life cycle was planning for the end which is also known as **planned obsolescence.**
- It gives us realizing straight forward that some day in the future, your brand new equipment won't serve you anymore as you are expecting.
- At this very time while purchasing new hardware, we also need to think about how you will dispose of the old device and new one can be kept around longer than normal.

The following are some considerations:

1. **Lease and buy-back programs:**
    - It provides a good way to discard your computers if you plan on installing new ones.
    - In addition to formal leasing companies, you can also find leasing programs through Dell and Gateway.
    - Some of the manufacturers also take back your old machines.

2. Use hardware and operating systems that are readily upgradeable.
3. **Years available after production:**
    - This means that some of the spare parts, service, and support will be available in a few years.
4. Make sure the memory is easily expandable.

9.5.2 Packaging

Packaging and shipping aren't a concern directly for the overall operation and functionality of your system.
But they indirectly give impact on the environment by the choice material for packaging and the way of delivery of the product or service.
Most of the cases, computer equipment comes in packaging that cannot be reused or recycled.
Using non- recycled material makes it difficult to get rid of it for a number of years.
Most of the time paper manual which comes with the device not even used for once by the customer which definitely gives negative impact on the environment.

The following are some tips you can employ when having new computers shipped to you:

- Ask for multiple computers to be packaged together for shipping, rather than being
  boxed individually.
- Require recycled-content materials and recyclable packaging.
- Require material types to be identified. Recyclers need to know material types, so require labeling to show what type of plastic is used.
- Require manufacturers or shippers to take back packaging for reuse or recycling.
- Ask for online manuals and preinstalled programs.

9.5.3 Toxins

We can manage toxic material used by checking equipment and following given guidelines:

- Look for manufacturers who use low levels of toxic chemicals.
- Look for manufacturers who use lead-free solder.
- Look for manufacturers who use low-mercury and long-life lamps in flat-panel displays.
- Batteries should be removable, rechargeable, and recyclable.

The State of Massachusetts recently awarded points to bidders who avoided toxic chemicals in the manufacturing and assembly of computers.

9.5.4 Other Factors

Other factors also need to be taken into consideration while selecting any hardware. Initially these factors seem to be negligible but it can become big headaches that can ultimately lead to your getting rid of a computer before it needs to be disposed of.
Some of the issues needs to be taken care are as follow:

- Are machines and parts designed so that they can be assembled and disassembled with universally available tools?
- Require that metal casings be readily recyclable. Metal casings are recyclable. Plastic
  casings require flame retardants and are not recyclable.
- Require recycled-content computers.
- When possible, use remanufactured or refurbished equipment—it's less expensive and saves another box from a landfill.
- Look for manufacturers who do what they can to lessen their products' toxicity in adhesives, labels, coatings, finishes, fasteners, and metallic paint.
- Machines should be Energy Star compliant for overall energy use as well as sleep modes. Require that Energy Star is active upon delivery.
- Require online or electronic documentation.
- Choose printers and copiers that use remanufactured toner cartridges.
- Think about air quality when selecting printers. Environment Canada requires a desktop printer's ozone concentration not to exceed .04mg/m3. Dust concentration cannot exceed .24mg/m3.

9.6 Remote Desktop

- Remote desktop facilitates users to do work from home or a remote site.Current pandemic makes every one/most of us witness the ability and usability of the same feature.
- Remote desktop can also be used for the following purposes:
  * To power thin clients If you buy thin clients, Remote Desktop can be used to connect your thin clients to the server.
  * To extend the life of existing machines Rather than getting rid of old machines, you can turn them into thin clients and run applications from the server.

- Remote Desktop is a feature that was initially rolled out with Windows XP.
- It allows the user to access a computer from home or from another computer on the company network.
- Remote Desktop allows the user to access everything on the remote computer such as files, applications, and network connections.

There are two components to a Remote Desktop connection:

- **Server**
  The remote computer to which you will be connecting. It could be your office desktop computer or a special computer setup for road warriors to access when they're out and about.

- **Client**
  The computer you will use to form your connection with the server. It could be a PC at home, a road warrior's laptop, or even a coworker's PC in a neighboring cubicle.

9.6.1 Using Remote Desktop

For using a Remote Desktop server, you will need to identify which user accounts will be authorized access. These user accounts must have passwords. When you configure your server for Remote Desktop, you enter the user account name when Windows Vista asks for the object name in the Select Users dialog box.

To configure a Remote Desktop server, follow these steps:

1. ***Select Start*** | *Control Panel* | *System And Maintenance*.
2. **Click the Allow remote access** icon from the System portion of the dialog box.
3. In the Remote Desktop portion of the dialog box are two selections you can make, based on your connection and security needs :

• Allow connections from computers running any version of Remote Desktop (less secure)

• Allow connections only from computers running Remote Desktop with Network Level Authentication (more secure).

Network Level Authentication (NLA) :

* It is a new form of authentication that completes user authentication before a remote connection is made.
* This is a more secure method of authentication and can protect the remote computer from attacks and malware.
* The best choice is to select the second radio button, allowing connections only with NLA-enabled computers.
* However, if your connecting computers don't have NLA, or you just don't know whether they do, you should select the first radio button.

4. **Click the Select Users button.** This calls up the Remote Desktop Users dialog box in which you will add users who will be allowed to remotely access this computer. Administrative accounts are automatically given access.
5. **Click Add.** This calls up the Select Users dialog box. User accounts have three identifying components: object type, location, and name.
6. If you want to locate a user account from the Remote Desktop server, make sure the "Select this object type" option is set to Users. Then type an account name in the "Enter the object names to select" box. If you wish to enter a user from another computer on an Active Directory–based LAN, click the Locations button and select the domain. Then enter the user account name.
7. **Click Check Names.** This gives Windows Vista a chance to enter the name in the computername\username format.
8. **Click OK.** The user you just indicated will be added to the list of users permitted to remotely access your Remote Desktop server. To add more users, repeat steps 6 through 8.
9. **Click OK** twice to exit all the dialog boxes.
10. Finally, if your Remote Desktop server is protected by a firewall, make sure the firewall allows remote connection traffic.

Remote Desktop Client:

The Remote Desktop Connection tool is installed by default and is located by accessing ,

Start | *All Programs* | *Accessories* | *Remote Desktop Connection.*

The Remote Desktop client is a 3.4MB file that you can download via Link. When installed, this client allows older versions of Windows to connect to a Windows Vista Remote Desktop server.

9.6.2 Establishing a Connection:

You should test the connection immediately after your Remote Desktop server and client has been configured to make sure it works the way you want.
The first step is to ensure that the Remote Desktop server is turned on and you're connected to the network.
If someone is logged on locally, the client trying to access the server will see a message telling them that the local user must first disconnect.
Simultaneously, at the remote computer the user will see a message allowing them to prevent the Remote Desktop session from taking place. If the user fails to respond to the request after a certain amount of time, Windows assumes the user is away, and they are automatically logged out.
Next, start the Remote Desktop client using these steps:

1. *Select Start | All Programs | Accessories | Remote Desktop Connection.*
2. From the Computer drop-down list, pick the name of the server computer or enter its IP address.
   If the drop-down list does not contain any computer names, click Browse For More to see the available computers in your domain or workgroup. This list will only show computers that have been enabled for Remote Desktop.
3. Click Connect.
4. When Remote Desktop is done forming its connection with the remote computer, you'll see a Windows Vista–style splash screen. The screen contains icons for the users who have been authorized to remotely access the computer. Click your icon and then enter your password.
5. Click OK.

After connecting, the client will see what the server's desktop looks like, and they can use it as if they were sitting at that computer.

The main difference, however, is at the top of the screen, where a special toolbar can be used to minimize, maximize, or close the Remote Desktop view.
For example, if you wish to work on your client computer, you click the minimize button. To return to the Remote Desktop connection, click the maximize button.
The pushpin icon locks the menu in place.

9.7 In Practice

Let's discuss how we can do this in the real world in this section.

- Green technology is not only about green computing only but it also focuses on the hardware used in any organization.

- Using Energy Star certified equipment makes sure to not affect or lesser adverse impact on the environment.
- Nowadays,every organization is focusing and trying to adapt green IT technologies to reduce energy consumption and paper cost as well.
- The cost required to make a green IT suitable environment in any organization is less when compared to long term benefits of it.

Following Table enumerates the cost savings as well as shows some savings that will differ across organizations depending on their needs and utilization.

Description	Savings Estimate	Comments
Moving from rack-mounted servers to blades	25 percent	Generally speaking, a company can reduce about 25 percent of its server farm by switching to blades.
Floor space for blade servers vs. rack-mounted servers	45 percent	Blade servers will take up a little more than half the space of existing rack servers.
Powering blade servers vs. rack-mounted servers	25 percent	Rack-mounted servers consume about 280 W, whereas blades consume 218 W.
Thin-client power consumption vs. fat-client consumption	85 percent	Thin clients (with a monitor) consume as little as 24 W, whereas fat clients (with a monitor) consume 170 W.
Energy Star–rated monitors vs. conventional monitors	92 percent	Energy Star monitors save power because of hardware considerations and also software settings.
Energy Star–rated computers vs. conventional computers	55 percent	Energy Star computers save power because of hardware considerations and also software settings.
Organizational savings	Varies	Organizations will save money in such areas as software license fees, management, repair, cooling, and so forth.

Electricity and Money Can Be Saved in Several Ways

Hardware is a major investment for your organization.
We must consider your mission-critical applications and lessen your environmental impact simultaneously.
This will make **going green** possible and achievable.

9.8 Exercise

1. Write down steps to configure remote desktop server.
2. What is a thin client? Explain in brief.

3. What is a certification program? List down different certification programs. Explain any one of them in detail.
4. Define and explain the terms packaging and Toxins with respect to hardware considerations.
5. Explain Restriction of Hazardous Substances certification.
6. Write a note on the energy star program for computers.
7. What is the use of a remote desktop? Explain its components.
8. Write a short note on the Electronic Product Environment Assessment Tool(EPEAT).

* * * * *

UNIT - V

10

GREENING YOUR INFORMATION SYSTEMS

10.0. Objectives

This chapter would make you understand the following concepts:

- Different metrics to track and analyze greening of information systems.
- Different technologies and methods that help to achieve eco-friendly processes.
- How to improve technology infrastructure in an ecofriendly way.
- How can cost of achieving and maintaining a green IT infrastructure be balanced.

10.1. Introduction

Power is the preliminary requirement to run a datacenter. Traditionally huge amount of power is consumed by the datacenter. The Servers, Switches and other devices in our data center requires power to run efficiently. We are very much aware of how emissions are endangering the environment. Power, i.e., electricity if generated from conventional sources contribute to pollution threatening future generations and contributing to greenhouse gases which is resulting to global warming. The more demand for power, the more it is being generated from traditional sources and emissions are increased. Simply cutting down power consumption may not solve the problem as it may have an affect the quality of services that the organization provides. Utilization of power by the systems may not be directly reduced altogether, however it can be regulated and utilized more efficiently thereby preventing excess power utilization and leading to saving. We can also improve our business processes by switching over to greener and more productive ways of working. The best example is of "Green Office" [1] ,a concept wherein a suitable environment management system is built which helps in reduction of carbon footprint in our organization. Awareness, therefore, becomes the crucial part of argument as if one is aware of something, one is in a better position to act. The organization needs to be aware of how much power is being consumed, what processes are in place, what practices have become redundant etc., failing which, no comparisons or improvements can be made. We would be learning various metrics that can be used to track our progress in greening our information systems and business processes and analyzing these metrics, how can we improve the existing processes further without incurring huge costs in this chapter.

10.2. Initial Improvement Calculations

Awareness leads to action. If we are unaware of the existing business processes in the organization, the costs involved in them, the practices that are no more necessary or that are affecting the productivity of the organization, we cannot draw much needed statistical comparisons and analytics to propose improvements. We need to consider various factors that help us to track our progress efficiently and effectively without compromising the distinct services of our organization and without affecting the efficacy of our systems. Our

progress must always be backed up with numeric data that can help us to track progress statistically, review our existing metrics and propose improvements. This is a continuous process which must be always supported by the management in the right spirit.

10.3. Selecting Metrics

Metrics tells us whether a process in use at present is good enough for the organization and whether our intended purpose is being successfully achieved or not. By using metrics, we can determine whether a process is positively or negatively affecting the organization. By analysing the metrics, we can propose improvements to existing processes. Some metrics that we use for greening the information systems are:

10.3.1. Power Usage Effectiveness (PUE)

PUE is defined as:
PUE= Total Facility Power / IT Equipment Power
Where,
Total Facility power means just the power to the datacentre. This means everything that is used to support the equipment's.
IT Equipment Power is the power needed to manage, process, store or route data within the datacentre. These include load associated with all IT equipment.

10.3.2. Datacentre Efficiency (DCE)

It is defined as IT Equipment Power / Total Facility Power
What does PUE and DCE tell you?

- When you can improve datacentre's operation efficiency.
- Comparison with other competitors
- Are processes improving with changes?
- Do any opportunities exist to repurpose energy for additional equipment's?

PUE and DCE are used to show how energy is being utilized in a datacenter. If PUE is 4, it means that the datacenter requires 3 times more energy than what is necessary to power IT equipment is another very useful indicator. If PUE is 4.0, DCE would be 0.25 meaning that 25% of power is being used by IT equipment.
PUE can range from 1.0 to infinity with the PUE of 1.0 indicating 100% efficiency. Majority of the datacenter's these days have a PUE of 3.0 or higher but if properly planned a PUE of 1.6 is achievable.

10.3.3. Datacenter Density

A data centre rack is a steel and electronic system that is tailored to house servers, networking devices, cables and other data centre equipment's. Datacenter Density is the measurement of your CPU cycles over square footage. More the CPU cycles, the better. CPU cycle refers to a single electronic pulse of the CPU. Datacenter's with more rack density and higher space utilization score higher in this metric.

10.3.4. Storage Utilization

Storage is a critical resource in any datacentre. Storage comes at a cost and therefore every datacentre utilizes storage space very carefully. Storage utilization compares how much storage you are using with how much is available for use. This is a tough one to measure as storage space is continuously changing due to various applications storing, compressing or deleting their files from storage. Some questions that are to be noted here are:

- Are we counting virtual memory being utilized by live applications?
- Are we counting backup data?
- Is duplicate data being considered? Etc.

It is therefore crucial to consider those measurements that would remain consistent as other indicators which tend to change soon may cause issues in deriving the metric.

10.3.5. Storage Density

Similar to datacenter density, we compare our storage space to datacenter's area. This simply helps you to determine whether you are making the best use of your facilities. It can be formulated as follows:
Storage Density = Total Storage Area / Total Datacenter Area

10.3.6. CPU Utilization

This is among the most crucial metrics that a system administrator may use to decide the effectiveness of the server. This measurement examines the utilization percentage of the server's CPU. There are various commercially available tools used to measure this. Ex. System Monitor is used to track CPU utilization on Windows Server. Utilization increases as we keep on adding tasks. A server utilization between 50 to 80 percent is generally considered optimal.

10.3.7. SWaP

This metric stands for Space, Watts and Performance and is expressed as:
SWaP=Performance / Space * Power Consumption

This metric was developed by Sun Microsystems which developed a metric that calculates issues such as floor space and power used along with performance. SWaP does not mean anything on its own. However, this gives a crucial understanding when comparing two servers. E.g., the servers might be equivalent in performance, but they could differ in other parameters.

10.4. Tracking Progress

Tracking progress is crucial for several reasons. One of the important reasons is that it makes it more likely to reach and surpass your goal. It also allows you to be more efficient in your time and workouts. It also lends accountability to the organization and people in charge and your goals. It allows us to perform analysis, identify gaps and challenges, shows where modifications and improvements are needed. It helps to also promote the guidelines more widely to decision-makers and policy makers. Various tools can aid us in tracking progress most efficiently. These tools offer various features and can be chosen as per organizational requirement. These analytics can be simply done with the help of a spreadsheet tool like Microsoft Excel; however, many other tools are available as follows:

10.4.1. BI Tools

We can use BI tools for tracking and analysing the metrics. BI, i.e., Business intelligence tools are tools that collect and process large amount of unstructured data from internal and external systems [2]. They provide a way of amassing large amount of data to find information through querying. They help us in data analytics through statistical techniques and obtain intelligent dashboards and visualizations that would help us in decision making. Few are as follows:

Digital Dashboards

They give us a visual summary of data using graphs and help us to understand the business conditions at a glance. They are also called as enterprise dashboards or BI dashboards.

Online Analytical Processing (OLAP)

It performs multidimensional analysis of business data and provides us the capability for complex calculations and to extract and view business data from different perspectives.

Reporting Software

They generate aggregated view of data and compare it across different timelines to give us a good understanding of overall conditions. They also generate different visualizations in the form of charts which add interactivity to the report.

Data Mining

It is the process used by large organizations to process large amounts of raw data and to identify interesting patterns in them. It relies on effective data collection, warehousing and computer processing. By mining data, organizations can improve their profits, marketing strategies, and also decrease any potential losses.

10.4.2. MS SQL Server

It's an RDBM system whose essential job is storing and recovering information on the basis of client queries. Microsoft makes different editions of SQL targeted at audiences with different requirements. When used in conjunction with other product such as Microsoft Performance point, which can be utilized to store data for analytics. MS SQL Server offers some essential services such as:

Service Broker

Service Broker is a message delivery framework that allows us to make native in-database service-oriented applications [3].

Replication

It is a technology for replicating and conveying information and database items starting with one database then onto the next and synchronizing between databases to keep up consistency and integrity of the information. [4]

Analysis

It is an online analytical processing and data mining tool in Microsoft SQL Server.

Full Test Search

This lets user running full-text queries against Character data in SQL Tables [5].

Integration

Provided Extract-Transform and Load capabilities of the various data types from one source to another. It might be seen as converting raw information into useful information [5].

Notification

Notification Services provides an adaptable server engine on which to run notification applications, with multi-server capability providing adaptability and versatility for deploying applications [6].

Reporting

Provides reporting features and decision-making potential including integration with Hadoop [5].

Analysis

This service provided by SQL server adds OLAP and data-mining capabilities wherein different algorithms such as clustering, Naïve Bayes etc. can be utilized to obtain interesting statistics from the data.

10.4.3. Microsoft PerformancePoint

It's a BI software product by Microsoft built with the sole endeavour of planning, monitoring and analysing business specific data. Monitoring and analytics are delivered through a monitoring server. It consists of a dashboard designer which enables us to:

- Elucidate data that we wish to monitor.
- Create and customize the monitoring of the selected data.
- Create Dashboards.
- Deploy the dashboard to SharePoint or Windows SharePoint services.

The content that the Dashboard Designer collects is stored in SQL server which is again monitored through the monitoring server. Various other data connections are also monitored through the monitoring server. Dashboard data can be visualized through SharePoint or can be viewed through a web-based interface. API's are at the disposal of developers to develop extensions which could be utilized to produce custom reports, wizards and so forth.

10.5. Change Business Processes

How we run the business has a huge effect on the environment. This is determined by how much power we consume and the waste that is generated. Implementing green processes in workspace can contribute a lot in reducing an organizations carbon footprint. This would include recycling products in office, using green infrastructure, reduced dependence on conventional power sources (i.e.,using solar panels for power requirements of office space), less use of paper etc. Our discussion would be focussing on the following areas: -

- Worker Time
- Power
- Inefficiency
- Paper
- Materials

10.5.1. Customer Interaction

Customer interaction consumes majority of worker time. We can save much of this time by making this process smooth and effective and also make the customers content with the new methods by easing up their problems. Technology plays a critical role here.

Customer Relationship Management

When a customer buys something from a company, they simply see the company as the seller and themselves as the buyer. The process that goes behind the curtain is not visible to them. The only thing that the customer is aware is that when they purchase something, someone processes the payment, sends the order to the warehouse, a staff may fetch the required product and send it to the customer. The shipping is again performed by someone else.

CRM (Customer Relationship Management) is a combination of strategies, practices and technologies that organizations use in order to manage and analyse customer interactions and associated data based on a customer life cycle. The final motive is to give a seamless experience to the customer which would improve relationship and would give rise to sales and profit. CRM applications compile data across several channels i.e., the interface between the corporate enterprise and the customer. Before we discuss how CRM improves the process, let us observe how things worked traditionally.

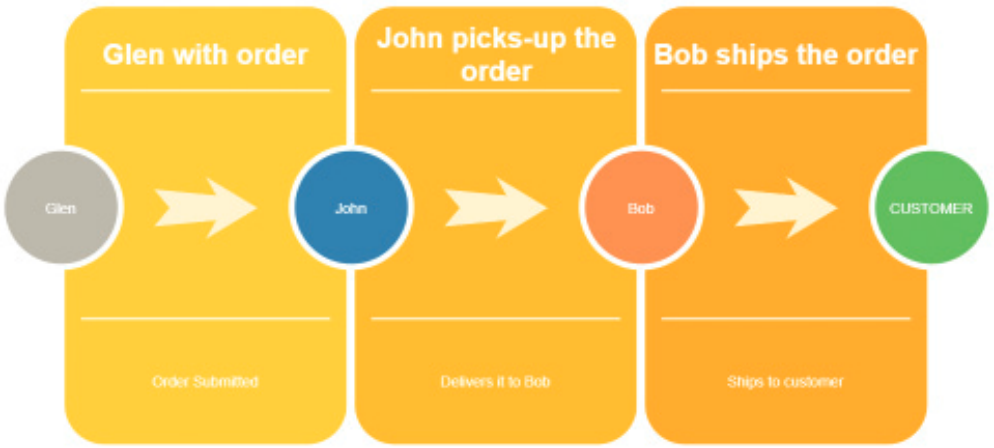


Figure 1: Traditional Way

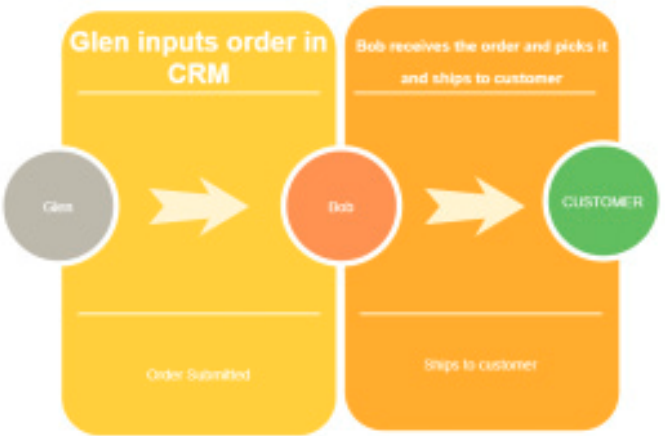


Figure 2:With CRM

Glen gets the purchase order and delivers it to the warehouse operator John. John looks for the order in the warehouse and then picks up the order to be shipped. Once the shipping company representative Bob arrives at the warehouse for taking the order, it is handed over to him, and then is sent to the customer. The shipping company delivers the order to the customer. If we observe the process completely, the process extremely becomes time consuming. Several people would be involved in processing one single order. With CRM applications we can improve this process to a huge extent.

Using CRM, an operator at the purchase department would simply input the order details into the application which would be visible to Bob at the warehouse. Bob simply needs to pick up the order and ship it. A tracking ID and shipping label is generated which would also help to track the order at every point. This greatly reduces the process eliminating much human workload as well as any errors of confusions that may incur.

The above examples simplify what a CRM does. CRM groups various operations in the organization as follows:

Customer Facing Operations

These include people and technologies that customers experience when they interact with the company. They can include face-to-face interactions, telephone calls, instant messaging, web chats, email, applications, etc. Self-service kiosks and Web Self Service are also a part of these operations. These are to be attention gainers which give customers a positive experience when contacting the company.

Internal Collaborative Functional Operations

There are technologies and people that directly influence the customer facing operations. They include policies and procedures, back office operations. These involve IT, billing, maintenance, planning, marketing, finance etc. The procedures have to be customer centric and smooth which would create a positive image for the company and would guarantee efficiency.

External Collaboration Functions

These are associated electronic systems and people which help the organization to develop good relationships with outside groups. These groups may consist of suppliers, vendors, distributors, lobbying groups etc. It is extremely important to have good relationships with these groups as they can make or break the reputation of a firm.

Customer Advocates and Experience Designers

These are people and associated electronic systems which help deliver worth to the customer and help the organization in making profits.

Performance Managers and Marketing Analysts

These are the people and associated electronic systems that design key organizational strategies and collect key metrics for analytics. This helps the CRM to stay on track and helps to improve pre-existing processes.

Customer and Employee Surveyors and Analysts

Employee surveys and customer surveys are key indicators of employee and customer satisfaction. Whenever these indicators are going downwards, its necessary that organizations perform thorough analysis and enhance the services. When employee and customer relationships are getting better, it means the organization is performing well and the services are being appreciated.

10.5.2. Technology

It is necessary to drive the CRM solution. Different pieces of CRM together indicate what the overall customer expectations from the enterprise. The technological components of CRM therefore include :

Database

It is necessary to store customer data which would include, their details, interactions with the company, order requests, return requests, feedbacks, support information, complaints etc. The database would also lend support to any application software that would be working on this data and would-be providing analytics.

Customer Intelligence

There is a requirement for a system for translating customer needs and profitability projections into plans which are segmented for varying types of customers. We must follow-up with the execution of our plans properly, and progress must be tracked and whether desired outcomes have been achieved.

Business Modelling

A business model helps managers to explore complex choices, using a set of assumptions to represent alternative future operative environments. It analyses the customer relationship strategy along with the goals. This helps to track whether we are achieving our goals.

Learning Competency and Management Systems

Complex systems need time to be implemented and tweaked. We need to continuously analyse the processes and keep tweaking the processes wherever we find that they are lagging in order to achieve the best possible results.

Analytics

Analytics help in analysing customer relationships and policies using various technologies such as voice recognition, statistical analysis etc.

Collaboration

This help customers interact with fellow customers using some common platform provided by the business. This is a very good way to understand various customer concerns.

10.6. Paper Reduction

We all know that paper is made from trees. A big way we can save money as well as help our planet is by cutting down on paper use. A paperless workplace may not be an absolute solution, but many would be able to embrace this philosophy while some would be able to handle only one change such as turning their fax services into paperless endeavour. Paper reduction can save a huge amount of money for offices. Furthermore, with the advent of email and internet at every household, every customer would generally prefer a digital document compared to traditional paper which may not be easily maintainable by them. Digital paperless documents can be stored for longer time without any hassle and can be used as and when one need it. Some of the tools that you can use in order to reduce paper use are as follows:

10.6.1. SharePoint Server

Once we go paperless, a mechanism to store the traditional paper-based data is necessary. We also should be able to find out this data without any hassle. It's important to make sure that this information is organized logically in the most efficient way. SharePoint is a web-based collaboration and web management platform. It can be also used to host websites that can then be shared across workspaces and documents. Sites hosted on SharePoint are ASP.NET web pages that are served using IIS and SQL server database for data storage. SharePoint is known to be very flexible with its configuration.

10.6.2. Workflow Management

Workflow management is the coordination of tasks that make up the work an organization does. Workflow means sequence of tasks that are part of some larger task and is sometimes synonymous with a business process. It's a management discipline which focusses on the format of work within some organization and how the organizational teams collaborate with one another to complete this work.

Once switched over to paperless environment, we must scan the cabinets full of paper-based documents and must be saved in SAN. Deadlines must be set, and scanners must be provided for all departments. It maybe initially not very easy for employees for accomplishing this task, but weekly meeting and follow up would help employees to cooperate and get the work done smoothly. It is also necessary for the employees to be aware which paper is being scanned and it must be named and saved according to pre-determined naming conventions that won't be ambiguous.

An easy way to start the changeover is to simply stop producing paper at the first place. When any document is produced by an online form, it must be stored as a PDF or Document file. If someone else needs the document, we can simply email a copy to then.

10.7. Green Supply Chain

Greening our supply chain is very important indicator of how serious we are about greening our business. This means that we need to interact with vendors who take our concerns of greening seriously. These are vendors that must be ecologically responsible. Many cumpanies like Dell take greening as a serious issue and deal with vendors who toe their line with being ecologically responsible to a huge extent.

10.7.1. Green Procurement

Whenever we need to acquire products, we can be ecologically sensitive by engaging in green procurement. For achieving this we need to perform assessments of in what manner product will affect the environment at various stages of its life cycle. This includes how the product was made at the first place, how was it transported, how it is used and ultimately how it would be discarded. From creation to the end-of-life stage every product has some impact on the environment which needs to be thoroughly assessed and understood. The following steps are recommended for a good green procurement program:

Get organizational support.

Organizational policies must be accommodative of changes and the organization needs to be completely on board. Involvement of management is to be very crucial as they must play an active role in decision making and must make necessary suggestions and provide support for eco-friendly purchase decisions.

Conduct a self-evaluation.

We must evaluate our current practices to discover issues which must be resolved and improved. Evaluating our current practices helps us to determine a benchmark and will help us to clarify what we purchase, how much we purchase, where it comes from etc. This will help us to determine a baseline that can help us to measure the greening of our processes.

Set Goals

Set long term goals that have specific measurements.

Develop a Strategy.

Once our goals are set, we need to figure out how are we going to achieve these goals. Identify the potential strategies that can be deployed to achieve these goals. We need to determine both short term and long-term goals and their associated strategies and also short-list the potential vendors with whom we may want to do business with.

Conduct a preliminary run.

It's preferred not to implement everything at once but rather conduct a preliminary run to study the efficacy of our strategies. By starting small, we will be able to determine where potential issues arise and how can we implement the program better.

Implement the plan.

Once our plan is in place, we will have to assign accountability and develop communications plan that would address employees, customers, suppliers, partners and the public.

Review the program.

Periodic review of our green procurement practices and procedures to ascertain that you are still getting what you want. We must continuously check if our goals and objectives are being met. This should be consistent with the organizations changing business objectives. Analytics help in review as studying the report helps us to decide where changes are required and how improvements can be made.

10.7.2. Just-in-time Buying.

When we align our raw material orders from suppliers directly with production schedules, this management strategy is called Just-in-time buying. Companies deploy this strategy to increase efficacy, furthermore, decline wastage by receiving products only as they need them for the production process, which reduces inventory costs. This strategy expects producers to forecast purchase requests precisely. The advantages of this inventory are as follows: Manufacturing runs are short, which implies that manufacturers can rapidly move

starting with one item then onto the next. Besides, this strategy lessens costs by limiting warehouse needs. Organizations likewise spend less cash on raw materials since they purchase barely enough assets to make the ordered products and no more.

10.8. Improve Technology Infrastructure

The entire goal behind learning this subject is to guide you to make improvements to your technology infrastructure that works efficiently and is also ecologically sensitive. We would learn how we can resolve the already discussed IT issues and improve the organizational processes to be more ecologically sound.

10.9. Reduce PCs and Servers

The best way to reduce carbon footprint and reduce power consumption by the organization is to reduce the number of physical servers. This change can be brought about by virtualizing the servers along with other opportunities to minimize the infrastructure. When we deploy separate physical servers, each consumes its own power for full capacity and would not be contributing to the project in anyway. Virtualization is assumed to enhance server utilization beginning at a normal of 10% to 20% for x86 systems by a minimum of 50% to 60%.

10.9.1. Virtualization

The answer to the question of how many physical servers can be eliminated by virtualizing them is a difficult one. However, a powerful server can virtualize quite several servers. This will also bank on the roles of the server and how far do we need our servers to be distributed. The formal definition of virtualization is it is the process of running a virtual instance of a computer system in a layer abstracted from the actual hardware. In a very simple language, it means running multiple operating systems on a computer system simultaneously. Several tools are available for implementing virtualization. The most popular and known tools are Oracle VirtualBox and VMware.

10.9.2. Thin Clients

Figure 3: Thin Clients connected to computer server.

Thin Clients are low performance computer that has been optimized for establishing a remote connection with a server-based computer environment. As a part of virtualization strategy, it is better to virtualize our everyday server. In this way we can replace costly hardware with thin clients thereby reducing our costs significantly and even recycling our existing systems. As processing and data storage is the responsibility of the server, we can use our existing clients and simply deploy the everyday applications onto the server

10.9.3. Rationalization

In IT, rationalization is the process of cataloguing and eliminating supplicate software applications used across the organization. We need to continuously look for servers that are being used less frequently. Such servers can be simply switched off or if their computational requirements are extremely low then we can move such servers to another server hosting many virtual servers. Legacy applications hosted on dedicated servers can be slowly shut down and phased off unless they are not of very critical importance. Services that are not useful can be shut down when not being used. Overall, it is necessary to calculate and catalogue which services are critical for the business and the services that the business does not depend on. The later part can be used only when necessary and can be switched off whenever not in use. Old and legacy servers if not used can be either recycled to host multiple virtual servers of can be sent for physical recycling thereby reducing maintenance costs and contributing to the greening of our infrastructure.

10.9.4. Terminal Services

Microsoft has provided Terminal Services as its driving technology which as a component of windows servers and clients, enables users to access applications and data ono a remove computer across any type of network.
Also called a communication server, is a hardware device or server that provides terminals, such as PC's, printers, and other devices with a common connection point to a local or WAN. Microsoft has implemented this in the form of a thin client terminal server computer. Any system running terminal services protocol would be able to gain access to the server. With terminal services only the user interface is visible at the client end. All the input is set back to the server for processing. Authentication and authorization are provided by the terminal clients. Terminal services web access makes a session possible through a web browser. Tunnelling can also be used to initiate a session.

10.9.5. Software as a Service (SaaS)

Another way of eliminating equipment from the company is that we do not host the applications on our servers in the first place. We use a specific model where the software is licenced through subscriptions and is centrally hosted at one location by the vendor. Rather than spending money on buying the necessary equipment, hosting and then maintaining

the entire software, we simply pay the fees charged to us by the provider. This is called Software-as-a-service and the software is called as on demand software.
Another benefit that we get is that we need not buy any upgrades or maintain the software infrastructure, all these are performed by the vendor and we simply reap the benefits of it. Troubleshooting is also the responsibility of the vendor. Some key characteristics of the SaaS software are as follows:

- Applications can be accessed over the network and can be managed easily.
- Management is from a central location which helps customers to access the application remotely via the web.
- Application delivery is closer to a one-to-many model.
- Updating is centralized which eliminates the need for customers to download updates, patches etc.
- Pricing of SaaS applications are usually based on per-user basis.

ASP vs SaaS

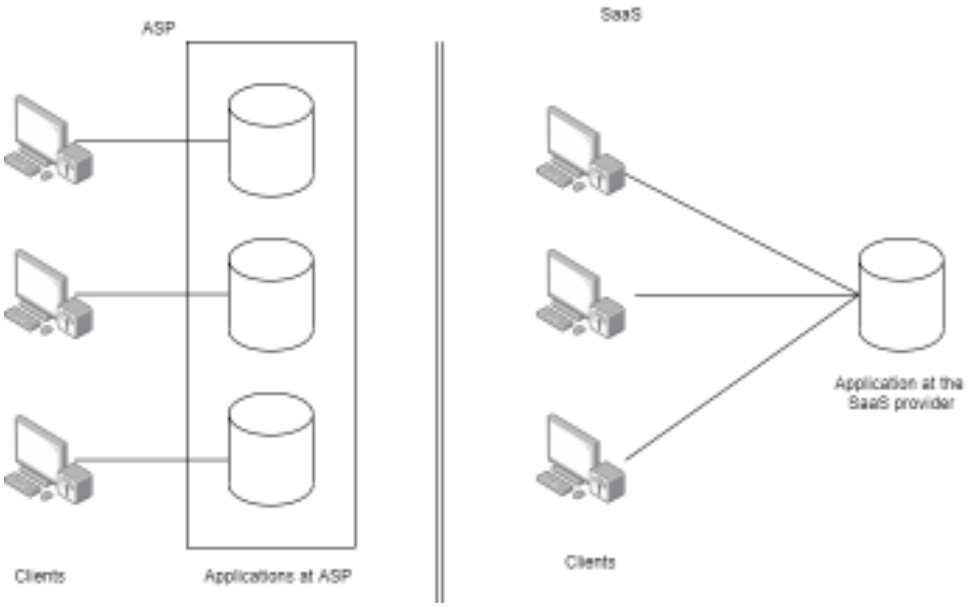


Figure 4: ASP vs SaaS

SaaS is different from Application Service Providers, i.e., ASP's. ASP's host applications on behalf of the client but font create their own applications. SaaS vendors, however, create their own applications and run them on their own. In SaaS, multiple customers are running the same software, but their data is separate at the logical level. ASP's, unlike SaaS, deploy one separate instance for each customer.

Telecommuting

Our purpose of greening IT systems is because we want to curtail the carbon footprint. Telecommuting is an arrangement wherein the employee works outside of the employer's office. Generally this implies working from home or at an area near and dear, like a coffeehouse, library, or co-working space. As organizations IT systems are unified via a shared services system, telecommuting would ease of the work of employees as the employee would have option to work from their place of choice and would access the resources via the internet without any hassle. This would mean:

- Less hardware purchases saving costs.
- Lower carbon emissions.
- Lower power consumption.
- Lower real estate costs.

10.10. Shared Services

It is the consolidation of business activities that are utilized by various parts of the same enterprise. They are very cost efficient as they eliminate redundancy by centralizing back office operations. E.g., On hiring an employee, he or she is consequently added to all the databases of the company with one single interface eliminating any additional work by the HR. Using shared services results in lower costs, higher service levels, and greater responsiveness. This prototype can be scaled for both acquisition/geographic and service scope expansion with relatively low incremental costs.

10.11. Hardware Costs

Generally, whenever we are buying hardware like computers and servers we are prompted to look more at the memory, the processor and RAM which ensures efficiency of service. However, as an ecologically responsible organization we must be looking at how much power is consumed and what components we require. For example, majority of organizations push software updates or installations over the network which eliminates the need for CD or DVD drive in the system. In such situations we can avoid purchasing systems with DVD Drives. This would reduce our costs considerably. A Wi-Fi enabled campus would eliminate the requirement for network cabling again saving the costs to a huge extent. Coming to servers, we need look for servers that are tailored to correct size of power supply. Such servers may cost more but would decrease costs in the long run because less electricity is wasted, heat generated is less and less cooling would be needed. Wherever possible, it is advised to go for low power computer components with high energy star rating which would ensure that our IT architecture tops environmental standard.

10.12. Cooling

Cooling would be one of the prime contributors to the power costs as data centres generate ample of heat and require constant cooling. When we cool more efficiently, or we can

somehow reduce the overall need to cool. We can rollout physical improvements to the layout of our data centre such that it accommodates cooling, i.e., we ensure that airflow is not restricted. We use the hot-aisle/cold-aisle philosophy by adding supplemental coolers that use as much outside air as possible.
In addition to the above discussion, it is generally recommended to decrease the need to cool to a huge extent. This means load balancing electric supply lines as additional power turns into heat. Get better cooling systems with better environmental friendliness, which are ozone friendly and higher energy star rating. These would ensure green cooling contributing to our overall greening efforts!

10.13. Bibliography

[1] "What is Green Office?," [Online]. Available: https://wwf.fi/greenoffice/en/what-is-green-office/.
[2] M. Azure, "What are Business Intelligence Tools," [Online]. Available: https://azure.microsoft.com/en-in/overview/what-are-business-intelligence-tools/.
[3] SqlServerCentral. [Online]. Available: https://www.sqlservercentral.com/articles/service-broker-part-1-service-broker-basics.
[4] SqlShack. [Online]. Available: https://www.sqlshack.com/sql-server-replication-overview-of-components-and-topography/.
[5] Guru99. [Online]. Available: https://www.guru99.com/sql-server-introduction.html.
[6] Microsoft. [Online]. Available: https://docs.microsoft.com/en-us/archive/msdn-magazine/2002/november/sql-server-build-apps-using-sql-server-notification-services.
[7] Zabbix. [Online]. Available: https://assets.zabbix.com/img/screenshots/dashboard_dark.png.
[8] Microsoft. [Online]. Available: https://docs.microsoft.com/en-us/sql/database-engine/configure-windows/sql-server-service-broker.
[9] Wikipedia. [Online]. Available: https://en.wikipedia.org/wiki/Software_as_a_service.
[10] Peeriosity. [Online]. Available: https://www.peeriosity.com/shared-services/articles/2017/08/what-is-shared-services/.
[11] WikiPedia. [Online]. Available: https://en.wikipedia.org/wiki/Thin_client.
[12] Dzone. [Online]. Available: https://dzone.com/articles/saas-vs-asp-%E2%80%93-understanding.
[13] Apptio. [Online]. Available: https://www.apptio.com/blog/step-step-framework-mastering-application-rationalization/.
[14] TechTarget. [Online]. Available: https://searchvirtualdesktop.techtarget.com/definition/terminal-server.
[15] A. V. E. Toby Velte, "Greening Your Information Systems," in Green IT, McGraw Hill, 2008.

10.14. Questions :

1. List and explain tools used for measuring and tracking our data.
2. What is the difference between Application Service Providers and Software as a Service?
3. Explain characteristics of Software as a Service.
4. Explain the concept of Just-in-Time buying in detail.
5. Discuss some metrics which are referred while designing a greening strategy.
6. Discuss some tools that help in reducing paper usage.
7. Explain Customer Relationship Management in detail.

* * * * *

11

STAYING GREEN

11.0. Objectives

After going through this chapter, you can:

- Learn how to keep the greening process alive even after achieving our goals.
- How to select right metrics, analyse and present the data to various stakeholders.
- How to conduct audits and recommend improvements.
- Various organizations that would help us in greening efforts.

11.1. Introduction

Most of our efforts in previous chapters were concentrated on how we make our IT systems green. E.g., it requires huge energy to push the rocket outside the atmosphere of the earth. Once it's it takes very less energy to propel it to the destination. Similarly, most of our efforts and hard work is in initial phases wherein we invest a lot of time, money, and effort in greening our information systems. However, once we have finished our initial greening efforts our focus shifts from greening IT systems to maintaining them and staying green. We must ensure that the seeds of progress that we have sown is nurtured properly and our organization does not deviate from the green goals and strategy that we have already set. It is therefore important to put all guard rails in place to stay green. As in the rocket example we discussed earlier, once exiting the atmosphere we do not require a lot of energy to propel the rockets however we keep steering it in the direction of the destination by constantly making some inflight corrections. Similarly, we should constantly monitor the progress in our organization and keep making in flight corrections whenever we observe deviation from the path. In this chapter we would learn various techniques and procedures which we can incorporate in our organizational policies which would help us in our constant endeavour to stay green.

11.2. Organizational Check-ups

As an organization, greening must be included in core policies of our organization. We must always monitor the progress our organization is making to achieve our green objectives. This must generally be done by an independent team who would keep an eye on all the departments and would keep the organizational goals on track. For all this we would require creation of an independent team with new roles across the organization on the merits of the green plan.

11.2.1. Chief Green Officer

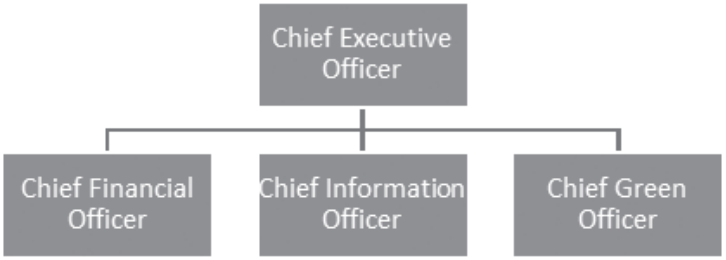


Figure 1: Chief Green Officer

Going green has two pronged benefits with primary one being the environmental benefits and the second one being the organizational benefits. However, achieving all this is not going to be an easy process. Organizations who are serious about their green targets would create a new position in their C-group by the name of CGO which stands for Chief Green Officer. This role would be responsible to make sure that the company is meeting its green goals and is monitoring the progress the organization would be making in this regard. He would be driving the green goals of the organization by adapting greener policies and suggesting improvements to existing ones. He and his team would be responsible to analyse and monitor all the metrics across the company and take necessary steps wherever the trends need improvement. The CGO, is therefore responsible for 3 things:

- Curbing the organizations environmental footprint
- Promoting goodwill among different stakeholders
- Discovering additional revenue opportunities.

Transitioning

Many companies chose to go green not on their own volition but rather because they we forced to do so by government regulations. Companies however had had a very long commitment to the environment and have undertaken many activities to preserve and protect it which must be indeed commended. But it was not built in within their organization. E.g., many companies have carried out replantation drives on barren lands. We also observe many organizations carrying out beach/road cleaning drives which projects them as an environment friendly and socially responsible organization. However, majority of the organizations still do not adhere to environment friendly practices like Recycling, reduced power consumption etc. Companies were rather pushed to incorporate these practices by laws made by the government. Although the organizations started in such a way, the momentum has remained ever since, and majority of the organizations have taken it seriously in a competitive mode to move in a much greener direction. A four-step process has been adapted in such cases as discussed below:

Compliance

In a very simple term compliance means following the law. Companies put steps into place to meet the minimum requirements as defined by the law. Generally, companies are not very much in favour of spending money in all this but once done, you get the ball rolling. As government regulations regarding environment started tightening the noose on organizations, companies were forces to get their compliance cells in action to at least get themselves complain to the minimum extent possible until they can focus on comping up with their own policies on the basis of set regulations which they can adhere to in the long run.

Personal Commitment

Companies dedication to eco-friendliness is reflected in the commitment shown by its management. Management has to nurture this idea and take it forward as the entire

company's commitment is reflected in their decisions. If one CEO has taken up the green commitment and is taking the organization in that path, the moment his term ends there is no certainty that the other CEO may follow in the same footsteps. Therefore, company policies must document this idea in their long-term vision document and must keep the trend going forwards across the organization. This also means that the entire organization must be committed to green initiatives as a part of their long-term strategy.

Public Trust

Public can always be sceptical about and organization's green initiatives. If an organization is marketing its green initiatives too much, then there is a huge possibility that the organization is just making unnecessary noise. E.g., the organization maybe talking about how less energy they consume but in reality, they may be consuming a good amount of power for their working. Public do not believe unless they see action at the most basic level. So, it is necessary that the company back up its advertisements with real action on ground. This would convince the stakeholders, shareholders, and general public about the company's commitment to green initiatives.

Sustainable Growth

Once an organization has met its green goals it is not the end of the story. One must sustain the initiatives take for long run. We must perform analysis, look at the gathered metrics and set new goals, correct any lagging areas and keep renewing our pledge to green initiatives. We must also spend extensive amount of time in developing green products and research on new methodologies for greening up the system further.

The points discussed above is good in theory but practically requires a lot of guidance and support. We can view all this from a compliance perspective, achieve our goals and simply stop there itself however, to get return on all the investments and efforts that have been put to achieve this compliance we need to have a leadership position created who will take these efforts forward. This is where CGO comes in. The aim of organizations to adapt these initiatives is to stay green and have a positive impact on the environment. For all this it is also necessary that we have a really good trust among the public. In addition to all this we can forge good relationship with NGO's and other environmental organizations and contribute to their efforts in saving the environment.

Structure

Figure 2:Position of CGO

In most cases, the CGO works directly under the CEO. This is because it would be more effective for us to put our concerns directly to the CEO rather than going through a chain of people. The CGO's job is to constantly stress the importance of going green at all the levels of the organization and keep up the pressure on the management. The CGO has to concoct innovate and cost saving green techniques for each department which will make them adapt the newer techniques. Some examples of this are:

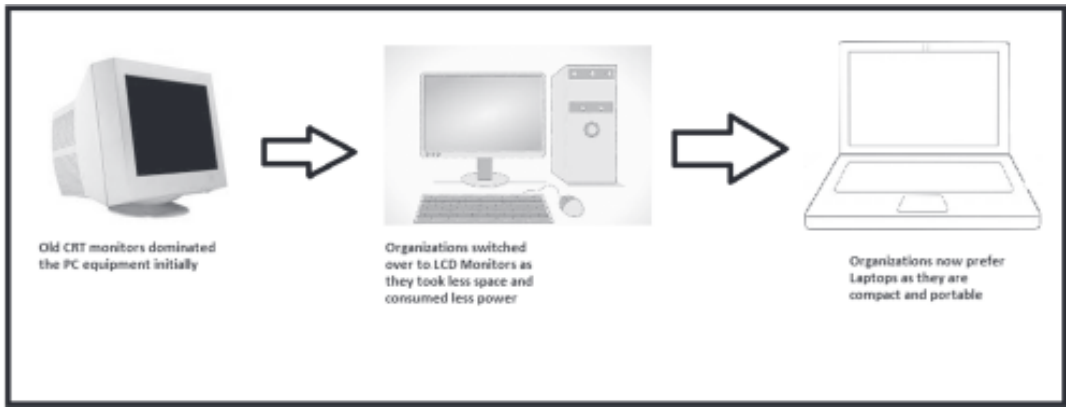
- Using eco-friendly biodegradable packaging by recycling would help us to reduce costs as well as be on the greener side.
- We must ensure that returns are kept at the minimum as fuel consumption during returns has a negative impact on the environment.
- Use eco-friendly receipts with paperless options which would eliminate paper use.
- Using scheduled pick-ups from pick up points than scheduled deliveries which would reduce fuel consumption by couriers.

Changes like these can be recommended above and then the CEO can take a final call on which ones can be actually implemented for the company. CGO simply doesn't stick to the enterprise's greening plan but would be observing all the departmental activities and would be assessing them for recommending any improvements. Environmental stewardship, corporate communications, strategic partnerships and product development are some areas where the CGO's oversight would be required. Departmental heads may have issues with this; therefore, it is recommended that the CGO maintain good relationship with all these departmental heads. It is also recommended that the CGO push his agenda in such a way that it's taken in good spirits by all the other departments. This relationship will help the CGO to guide the programs developed by other teams.

CGO therefore sets the strategy, guides them and configures the metrics to be measured. Once this is done, the primary duty of the CGO is to ensure that all the targets that have been set are being met. Whenever a department is unable to meet the environmental goals, the CGO and his team are ever ready to step in and help the team to reach these goals.

11.2.2. Evolution

Greening the organization is a continuous process. Once after initial greening efforts have been completed and goals accomplished, we do not stop our responsibilities there. The technology and organization have to continuously evolve with time. This prove that greening is a journey. We must continuously analyse the metrics and evaluate our present systems, equipment and organization to be as green as possible. The rewards remain the same, but we keep lessening the environmental impact and our contribution to the eco-friendly cause keeps growing.



If we talk about the equipment available in the market today, they are way better than what was available couple of years back. This is because many organizations have started to move towards greener equipment. Ideally, all departments in the organization depending on the green goals are working on their own way to contribute to the green targets of the organization. Therefore, wheels are already in motion from various quarters. E.g., An organization that used SAN storage for storing data, has slowly migrated to much more efficient SAN's and in few years again migrated to cloud storage whereby their own equipment's are reduced. Reduction in datacentre equipment will help in achieving efficient cooling as there is greater area for airflow, lesser power consumption as lesser equipment's are there. Using innovations, for example virtualization, will further get down the amount of equipment's. Even if additional area is available in the datacentre, it is recommended that such area be kept and not be given to other departments as one must always keep some scope for expansion. Additional area which is empty can be utilized rearrange the datacentre in such a way the efficient cooling would be achieved by increasing airflow or moving

additional equipment whenever required including other emergency use. It is necessary to take short, calculated leaps while taking decisions that a single giant leap which may turn out to be a bad decision.

11.2.3. Convince the CEO.

As a CGO and member of his team which is only going to look at things from environmental perspective, everything is going to seem obvious to us. However, our vehicle is not going to move unless me convince the CEO and his team to get the action plan rolling. However, a CEO may not be an environmental enthusiast but would rather be concerned only with the profits that the company is making at present. His long-term aim would only be focussed on increasing the profits and getting the company ahead in a competitive world. So, in order to get him on board, we need to explain thing in a language that he would be eager to listen. For Example, if we explain the CEO as follows, "Switching over to the blades server from rack server we would be able to achieve thorough computing capabilities", we would have already lost the ear of the CEO at the first word. This is because such kind of technical jargon is not going to be of a huge concern for the CEO. Rather if we explain in terms of monetary gains like, "Switching over from rack to blades will save us $700 per server per year", the CEO would be readily paying attention to what we are saying and would even be ready to convince his team on behalf of us to get you the stamp of approval. Few strategies can be incorporated to get the managements approval without any hassle:

Stay in touch with your contacts!

We need to maintain a personal relationship with each of our contact in the management circle to be able to communicate our concerns and problems efficiently and smoothly. It would also help use gain support from them whenever we are pushing our agenda as the management contacts would be sympathetic to our cause. Further, it also helps us to highlight how our programs are constructive to the corporate agenda.

Investor Relations Staff are our Friends!

We need to maintain a good relationship with the investor relationship staff who will be in regular communication with the investors. We need to highlight them the benefits of greening the environment and current practices that we have put in place. The benefits of energy management practices, paperless environment and socially responsible investors need to be highlighted to them. The internal HR and companies' communication department must be made aware of our environment friendly activities and achievements in this front. This is because employees would be proud to work in a company that's environment friendly and has showed willingness to be eco-friendly. Investors would also be favourable to the cause if we demonstrate considerable cost reduction which adds up to the profits of the company. In general, use an effective advertisement strategy both internally and externally.

Get recognized for your victories!

It is very much necessary to highlight our "wins" to the stakeholders and management to maintain their confidence. This is also to reinforce the confidence in their decisions and support they extended to us as they are able to see the results of our recommendations at the ground level. This would help us further to get support in future for any proposals that we would be submitting for their approval.

11.2.4. SMART Goals

Figure 3: SMART Goals

Goals are a part of every organization and each part of its business. It is going to give our organization a sense of direction, motivation, and focus. Similarly, SMART goals serve as a guidance for us to achieve or organizational objectives. We can use this same philosophy to achieve our green goals.

Specific

A goal must be precisely defined without any ambiguity. It must be put in terms that the people can relate to. To make a goal specific we can make use of the five "W" questions: Who, What, Why, Where and When. E.g., a general goal would be, "We are going to decrease greenhouse gas emissions", while a specific goal would be, "We are going to decrease our greenhouse gas emissions by 30 % by next year."

Measurable

A concrete criterion must be developed for measuring progress to a goal. These metrics must be continuously monitored by the greening team. By measuring this progress, we will actually want to remain on target, achieve milestones, and maintain motivation to keep

moving forward. Wherever we observe deviations from the goal we would be able to incorporate corrections and help the relevant team to stay on track.

Attainable

When the goals are identified, we generally think of different ways to achieve them. This can be done by looking at previous opportunities and identify new ones. Sometimes, previously overlooked opportunities are very useful as they can provide important clues to achieve the goals. It also means that we must set realistic and practically achievable goals and not hypotheticals ones, which would be discussed in detail in the net point.

Realistic

It is appreciable if an organization has a long-term goal that speaks in far-fetched terms, however we must ensure that it does not become unrealistic. E.g.," We are going to reduce emissions to zero in next 2 years ", the goal maybe attractive to set, but it is extremely unrealistic. Such goals will only lead us to failures. One must set high goals but ensure that the goals are achievable and are not a very distant leap bound to failure. Another thing to consider is that all resources to achieve the goal are available on time.

Timely

Any goal does not extend to infinity but is time bound. Every goal is set to be achieved withing a given time frame. So, goals must be defined with the help of a definite date which makes them achievable. Open ended goals should only be in case of low priority goals that are going to extend to a long time. If we do not define an end date for a goal, we would not consider the urgency or would not grant it enough attention and the goal would simply vanish from our records.

11.3. Equipment Check-ups

We have already discussed about the metric that we must be tracking to get all the analytics. It is necessary that we design and use appropriate metrics which would help us to simplify our reporting as far as possible and would also allow us to track metrics more efficiently. We are going to be discussing in depth, how to track this data further and keep moving forward in this section.

11.3.1. Gather Data

Good analytics can be performed only if we are gathering the right data. We must be aware of the data that we are gathering and whether it is necessary for the analytics. In

general, right data must be focussed on in the right form rather that taking unnecessary readings. E.g., for knowing how much energy we are conserving, we must have the data of how much energy are we using in a given time period. We must start by gathering baseline information that we can use to measure the readings in future. Some issues to be remembered while collecting data is as follows:

Determine how much information to be gathered.

How much data to gather varies among organizations. Discussing our previous example of energy consumption, some organizations would prefer taking monthly readings of their utility bills, whereas some will check their power consumption meters. Some may only equate it with the bill payments made every month along with their reading. With the existence of so many parameters, we must plan and determine what would be most useful to us and select it for reading.

Detail all energy sources.

We must keep record of all the energy we use from offsite vendors. This includes electricity, gas etc. The records must be kept as per amounts consumed in predetermined set of units E.g., kWh, MMBtu etc. This must be taking along with the amount of money we spend on each. It is also recommended to note the data of cost per unit E.g., "Electricity is prices at $10 per kW". This helps to get much more detailed analytics when we analyse the data and generate reports.

Document Energy Use

Whatever payments are made for energy use, keep record of all the bills, any discounts that we have got etc. We must also maintain the documentation that might contain the history of power use as this will help us to get a trend if we are saving power or consuming more. It is recommended to have minimum data of 2 years. In case we do not have the data, we can request it from the utility companies who generally have such data readily available.

Gather Other Data

To normalize our data, we may have to combine it with other data. This data would include non-energy related data like size of the building, working hours etc. Analytics of such combined data helps us to observe unique trends and can help the analysts to suggest unique solutions for alleviating our problems.

11.3.2. Tracking the Data

When we have decided the data to be monitored, we must shift our focus towards the system that we would be putting in place to achieve our objective. This system would help us track and compare our results and to generate unique trends. Many systems are available for this work starting from a simple Excel Spreadsheet to something like an SQL server which provides much more functionality. However, deciding on the tools require further discussion as they depend on what kind of analysis and to what extent we would like to perform our analysis. Some of the considerations to be given for tools are as follows:

Scope

The type of system we would be using would be largely decided on the fact of how much data we would be processing as well as what kind of data we would be processing. If measurements are taking more often, then the data set grows too large and a system like SQL must be in place for storing and processing the data. IF the dataset is qualitative then appropriate system must be put into place that can analyse and work with qualitative data.

Ease of Use

We are aware of the featured of modern DBMS systems, however they are not very user friendly. This is because we need to be trained in SQL in order to fire complex queries to get the required analysis from the database. Excel Spreadsheets on the other hand are easy to use however they do not have the processing power or capacity of a modern DBMS system. Therefore, a balance has to be struck between processing power as well as ease of use as a system that's complicated may not be very popular among employees, while a system that's not powerful enough may not give the required results for the management to review.

Reporting

The system that has been put into place must not only be able to track and analyse the data but also communicate the results across the organization. This would make the system extremely user friendly and would encourage its use across the organization. Various automation features are appreciable for the system such as automated data collection, periodic reports etc. Such a system can encourage change.

Some key points to remember during data collection for energy use are as follows:-

- Collect data from submeters whenever possible.
- Collect actual data.
- Estimated data must be discarded and not relied upon.
- Current data must be used.
- Develop periodic reports.

11.3.3. Baseline Data

We need to establish a baseline for our data before we step into actual analysis. A baseline is a fixed reference which we would be using for comparison process. This helps us to compare our current standing and establish realistic goals. In every business, a success or failure is measured against a baseline. We need to be aware of some issues when establishing a baseline as follows.

Establishing a base year

We can select a base year on the basis of some event wherein we decided to undertake a radical change in our organizational processes or an average of multiple years. It's completely the team's choice but we must use as complete and accurate data as possible in selecting this year as this would be used for all future comparisons.

Selecting the metrics carefully

We must select metrics in such a way that it gives the desired output on analysis which is useful for our organization. E.g., is our overall goal is reducing power consumption then we must measure and monitor kWh (kilo-watthours). Metrics should be chosen carefully as undesired metrics may yield undesired results. Presenting such information to the management will only make us lose their trust.

Sharing the results

All baseline results must be shared with the stakeholders of the organization. Primarily it must be shared with managers and all departments. We can additionally share it with any other stakeholders, internal or external who may lend their support during key decisions.

11.3.4. Benchmarking

It is the process wherein we compare our business process and performance metrics with that of industry best practices of other organization. Specific indicator is generally used I benchmark measurements. These procedures generally don't push us towards our predetermined goals, but they can be used to monitor our organization's progress with that or other organizations. Some ways for performing benchmarking are:

Past Performance

We compare our current performance across various indicators with that of historical performance figures.

Industry average

We compare our organization results with the average of other organizations in the same industry.

Top tier organizations

We compare our organization with the best or top one in our industry and not just the average ones.

Best Practices

We compare the best practices implemented in our organization with established best practices that have been used by majority of the industry.

Every organization aims to achieve the best industrial standards of working. The entire benchmarking process is simply about comparing our practices with that of other so that we are able to understand how well we are doing and where improvements would be required.

11.3.5. Analyze Data

Analysis of data is another intense activity that has to be carried out once the data has been collected. No one would be interested to look at long tables filled up with numbers that can't be understood to a lay user. People require the information that these numbers convey. We can show that information using visualization like graphs, pie charts, histograms etc. These interactive visualizations help the lay user to understand in detail about the information being conveyed by the numbers. We can analyse data from two viewpoints Quantitative and Qualitative.

Quantitative Reviews

These reviews involve studies that have numerical data. Analysing these numbers, we can come up with interesting patterns. We can therefore focus on the details as follows:

Usage Profiles

Look at peaks and valleys in the graph and how they are related with our operations. E.g., what operations are related with high power utilization and what operations are associated with low power consumption.

Performance Comparisons

We can use data to compare similar operations in our organization. E.g., branches performing same operations are consuming same amount of power across the branches. If yes, what are the reasons behind the same, what technologies are been used which are making this possible etc.

High Costs

We must associate the data with costs. This will help us to find out where are we spending more and where are we spending less amount of money. Generally, management will be very much interested in knowing cost related information.

Missing Information

Always look out for gaps, i.e., the areas where additional information would be required and try to fill those gaps when preparing reports.

Qualitative Reviews

Data here is derived from observation, interviews or verbal interactions. It focuses on the meanings and interpretations of the participants. Focus groups, interviews, observations and diaries are all a part of these reviews. Qualitative reviews are fuzzier compared to quantitative reviews. It mainly includes: -

Interviews

We need to talk to colleagues and employees seeking informed opinions, information, lessons learnt and in-house audits.

Review Policies

We must review our organizational strategies and methods to comprehend what impact they are having on our organizational performance including employees, equipment etc. and identify zones of improvement.

11.3.6. Conduct Audits

Baselining, auditing etc. are just a part of the story. We need to periodically assess all the equipment, policies, and procedures in the organization. This is called auditing. When we audit, we get an opportunity to identify improvements in various areas of our organization. Auditing must be performed periodically at regular intervals and necessary reports must be generated. As an example, energy audits are conducted by energy professionals. Similarly Cloud professionals would conduct cloud audit. Some steps to be followed while conducting audits are: -

Assemble the team.

We need to build a strong team who have the experience and knowledge of process, equipment's and procedures. We can take help of Subject matter experts as well as the technical team specialized in different technologies in the audit. However, an outside organization or team is more beneficial as they can give neutral and impartial opinions in the audit.

Planning and developing a strategy

Once the teams have been assembling, it's now their job to devise a strong plan to conduct the audit. This involves deciding the extent of the audit, allocating responsibilities and deciding the timeline of the audit. We can use benchmarking to identify non-performing systems, procedures etc. The audit teams experience matters a lot as they can give valuable suggestions to improve the existing processes and procedures.

Generate a report.

An audit report is the final phase of the audit which would highlight the areas requiring improvement. It would also contain valuable suggestions by the auditors on how to improve the existing processes. The report also recommends preventive and corrective actions wherever required.

Get Back on Track

Once the audit process is completed, we have reviewed and analysed our performance data, we should attempt to find out the factors influencing our results. This must be performed very carefully as this would influence our action plan and must detail which activities were completed successfully and which couldn't be. Based on all these we can review our plan once again and decide the further course of action. Some key strategies in reviewing our plans are as follows:

Get feedback!

We must have discussion with various stakeholders in the organization and get feedback from the respective stakeholders. We must ask the most important questions in feedback and also ask them for suggestions for any improvements.

Understand the level of awareness.

We need to find out whether our employees are aware of environmental issues. For example, if an audit for power consumption is being performed, we need to check the awareness of employees regarding energy issues.

Identify Critical Details

We need to study the reports and ascertain the troubling spots. We need to understand what contributed to anything failing or succeeding and whether it is a correctable defect or something that cannot be corrected.

Know side benefits!

Enlist any side benefits that you gained form the action plan. This could be anything ranging from employee comfort, impacts on other transactions, positive changes anywhere else and so on. All this helps in boosting our image.

It is a very hectic job to get our plans reviewed. This is because it is like going through the entire planning phase once again from scratch. However, this can grant a lot of benefits as follows:

- We can identify new sources of action.
- We can avoid common points of failure.
- We can evaluate the tracking system in place and calibrate it.
- Advertise our victories to both internal and external stakeholders.

11.4. Certifications

Certification are granted by external organizations if we comply with some standard policies. There are plenty of certifications that are available which can help organizations to prove their credibility on different categories. Just taking the example of energy certifications, we have, Energy Star, EPEAT, RoHS etc. These certifications help organizations to identify how energy efficient an equipment is. For an organization level, if we wish to remodel our facilities such that it is eco-friendly LEED can certify our efforts. At this point however, we do not have any certification to certify a green datacentre. Having formal certifications in place is a good idea and a good boost for the business.

11.4.1. Benefits of Certification.

A certification is generally set up by the industries who have come together and agreed on some standards and parameters that must exist for an organization to be certified. As an example, if we are going for energy certification, we will have to consider the following factors before we grant the final certification:

- Types of equipment that are in use.
- Efficiency in cooling and guidelines in place.
- What materials are being used in equipment's.
- End-of-life procedures and disposal procedures in place.
- Maximum power consumption.

These won't be diktats issued by organizations but would be rather guidelines handed over to industries that they will have to comply with in case they want to be certified green company in future. Various factors discussed in the previous chapters can be compiled to design our own green datacentre certification. We can start anywhere in the organization for greening it, it just requires the start and initial boost and once we have started showing results our organization will automatically get in track.

11.4.2. Realities

We have learnt various techniques to green our organization, however its not as simple as it seems to be. The real issues in front of us at present is not getting a certification, but to imbibe green practices and procedures in our organization. In future, with the clamour

growing around saving the environment, soon organizations will start acting responsibly to inculcate green practices in their organization to be more environmentally responsible. It is said that certification is a double-edged sword, but if competition in greening organization grows along with the benefits that come up with, organizations will green themselves just to earn a certification. This may seem insane, but its better than not pursuing greening at all. Majority of the organizations will do the minimum and stop which is also a good start. But that should not be the end, continuous improvement must be in place which would keep the show running. Ideally, we must put a metric in place to maintain the certification which will require the certified datacenter's to continue improvements to stay certified.

11.5. Helpful Organizations

Organization	Description
Business for Social Responsibility	Helps organizations endeavouring to engage in ethical business practices while being responsible to people, communities, and the environment.
Center for Clean Products and Clean Technologies Greenhouse Gas Protocol	Located at the University of Tennessee, promotes clean technologies. It is the most extensively used worldwide accounting tool for government and business pioneers to comprehend, measure, and oversee ozone depleting substance emissions.
International Association of Electronics Recyclers	It addresses and serves the interests of the electronics reusing industry for dealing with the life cycle of electronics products.
International Facility Management Association	A professional organization for facilities administrators.
Scientific Certification Systems	An independent provider of certification, auditing, and testing services and standards.
Sustainable Enterprise Program	It is an effort by the World Resources Institute to partner with corporations, investors, an business schools to "create productive solutions for climate and advancement challenges."
WasteCap Wisconsin	They help find cost-effective ways to reduce waste, including electronic waste, building waste, and manufacturing waste.
World Computer Exchange	WCE tries to make the process of donating old computers as easy as possible for companies and individuals.
Green Grid	The Green Grid is a global consortium dedicated to advancing energy efficiency in datacenter's and business computing ecosystems.

11.6. Bibliography

[1] A. V. E. Toby Velte, "The Greening Process," in *Green IT*, McGraw Hill, 2008.

[2] C. F. Institute, "SMART Goal," [Online]. Available: https://corporatefinanceinstitute.com/resources/knowledge/other/smart-goal/.

[3] WikiPedia, "Benchmarking," [Online]. Available: https://en.wikipedia.org/wiki/Benchmarking.

[4] L. C. University, "What is a systematic review?," [Online]. Available: https://libguides.library.curtin.edu.au/systematic-reviews.

[5] "Business for Social Responsibility," [Online]. Available: http://www.bsr.org/en/.

[6] "Center for Clean Products and Clean Technologies," [Online]. Available: https://www.fedcenter.gov/Bookmarks/index.cfm?id=1006.

[7] G. G. Protocol. [Online]. Available: https://ghgprotocol.org/about-us.

[8] "International Association of Electronics Recyclers," [Online]. Available: https://uia.org/s/or/en/1100013201.

[9] "International Facility Management Association," [Online]. Available: https://www.ifma.org/.

[10] "Scientific Certification Systems," [Online]. Available: https://www.scsglobalservices.com/.

[11] "Sustainable Enterprise Program," [Online]. Available: https://whitman.syr.edu/programs-and-academics/centers-and-institutes/sustainableenterprisepartnership/index.aspx.

[12] "World Computer Exchange," [Online]. Available: https://worldcomputerexchange.org/.

[13] "Green Grid," [Online]. Available: https://www.thegreengrid.org/.

11.7. Questions :

1. What is certification program? List different certification programs and Explain any one in detail.
2. Explain SMART goals in detail.
3. Why is it necessary to regularly perform equipment checks?
4. Explain the steps to conduct audits in detail.
5. Discuss the benefits of certification in detail.
6. Who is the CGO? Discuss his/her responsibilities.
7. Explain what data should be gathered while performing equipment checks.

* * * * *