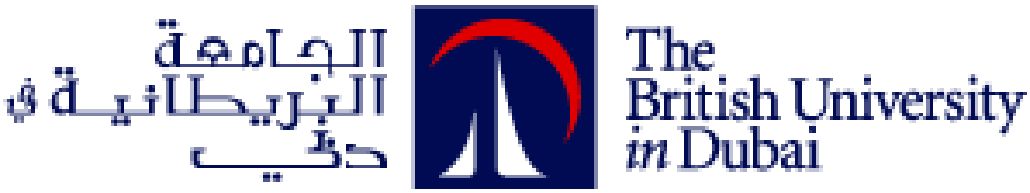

Sustainable IT Implementation in UAE

تطبيق تقنية المعلومات المستدامة
في الإمارات العربية المتحدة

By
Jamil Tahhan

Dissertation submitted in partial fulfillment of
MSc in IT Management

Faculty of Engineering & IT

Dissertation Supervisor
Dr. Mohammed Dulaimi

March-2011

DISSERTATION RELEASE FORM

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Jamil Tahhan

Date: 07 March 2011

Abstract:

Global warming and other environmental issues have raised humankind's awareness towards the planet and viability of the coming generations. Many movements have been taken to force the companies to monitor their environmental impacts. They aim to save the planet and the natural resources to ensure that the coming generations can continue living and developing in our planet. This has created the concept of sustainability. Researchers have seen that organizations that adopt sustainability will have a competitive advantage over their competitors which will ensure their long-term run.

This research will investigate the sustainable IT concept in UAE organizations in terms of level of awareness, main drivers and current practices. In addition, it aims to determine the main factors for successful and smooth implementation which in turn will assist other organizations toward their sustainability.

The literature review will present a detailed overview of the concept of sustainability and sustainable IT. It will also build business case for sustainability, investigate the main drivers for sustainable IT and explore the Global reporting initiative's (GRI) indicators for sustainability reporting. In addition, a review of most used sustainable IT practices will be conducted providing a solid base for analyzing the current sustainable IT practices in UAE.

Three case studies based on semi-structured interviews were conducted on a group of Dubai and Abu Dhabi governmental organizations. In general, the level of sustainable IT awareness in these organizations is between low to medium with social responsibility of IT remaining weak. With regarding to practices, they are almost equal to levels of awareness.

Research has showed that organizations are focusing more on the economical sustainability rather than environmental sustainability. Moreover low public

awareness about sustainability made companies less concern about their social responsibility.

Based on the discussions, analysis and comparisons; recommendations have been provided to the interviewed organizations and to the UAE government in general to improve sustainable IT practices. The main recommendation is to raise the awareness about sustainable IT and its benefits for the organization and the whole society. The government should create this awareness within the public and the organizations. Moreover, IT departments should make the management aware of the benefits of sustainable IT to have their support during the implementation.

الخلاصة:

الإحتباس الحراري و المشاكل البيئة الأخرى أدت إلى زيادة وعي البشرية اتجاه كوكب الأرض و قدرة الأجيال القادمة على العيش. و قد تم اتخاد العديد من الإجراءات لإجبار الشركات على مراقبة أدائها البيئي. هذه الإجراءات تهدف لحماية الأرض و المصادر الطبيعية لتضمن قدرة الأجيال القادمة على العيش و إعمار كوكب الأرض. و هذا تسبب في ظهور مفهموم الإستدامة. يرى الباحثون أن الشركات التي تتبنى الإستدامة سوف تحقق ميزة تنافسية على منافسيهم و بالتالي ستضمن أداء أفضل على المدى البعيد.

هذا البحث سوف يستكشف مدى وعي الشركات في الإمارات العربية المتحدة لمفهوم الإستدامة و أسباب تبني مفهموم الإستدامة و أهم التطبيقات الممارسة في هذه الشركات. إضافة لذلك يهدف هذا البحث لتحديد أهم العوامل اللازمة التي تساعد الشركات على تطبيق الإستدامة بشكل ناجح و بدون عقبات.

في البداية سوف يتم عرض نظرة تفصيلية عن مفهوم الإستدامة و تقنية المعلومات المستدامة. ثم سوف يتم مناقشة الجدوى الإقتصادية للإستدامة و استكشاف الدوافع الأساسية لتبني تقنية المعلومات المستدامة واستعراض لمؤشرات المبادرة العالمية لتقديم التقارير الخاصة بالإستدامة. إضافة إلى ذلك سوف يتم مراجعة أكثر الممارسات شيوعاً لتقنية المعلومات المستدامة والتي سوف تشكل أساسا في تحليل ممارسات تقية المعلومات المستدامة في الإمارات العربية المتحدة.

تم دراسة ثلاث حالات عن طريق إجراء مقابلات مفتوحة مع شركات حكومية من دبي و أبوظبي . بشكل عام إن إدراك هذه الشركات لتقنية المعلومات المستدامة يتراوح من المنخفض إلى الوسط مع وجود ضعف في المسؤولية الإجتماعية لتقنية المعلومات. أما بالنسبة للممارسات فجميع الشركات تقريباً عندها نفس مستوى الوعي.

هذا البحث يبين أن الشركات تركز على الجانب الإقتصادي للإستدامة أكثر من الجانب البيئي. علاوة على ذلك ضعف وعي المجتمع للإستدامة جعل الشركات لا تهتهم بمسوؤليتها الإجتماعية.

بالإعتماد على المناقشات والتحليلات و المقارنة تم وضع توصيات للشركات التي تم مقابلتها وتوصيات لحكومة الإمارات العربية المتحدة لكي تحسن الممارسات في مجال تقنية المعلومات المستدامة. و التوصية الأهم كانت زيادة الوعي بتقنية المعلومات المستدامة و فوائدها للشركات و لعامة المجتمع. فالحكومة يجب أن توجد هذا الوعي بين الأفراد و بين الشركات. إضافة لذلك فإن قسم تقنية المعلومات في كل شركة يجب أن يجعل إدارة الشركة تدرك فوائد تقنية المعلومات المستدامة لكي يحصل على الدعم اللازم لتطبيقها.

Dedication

To those who wished me success.

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Chapter 1 Introduction

1.1 Overview:

Sustainability is a new concept that has started to be adopted by businesses. Many companies have realized that achieving competitive advantage required focusing on its triple-bottom line, economical, social and environmental aspects. This means adopting Corporate Sustainability. This requires integrating the corporate sustainability strategy into its operations starting from the supply chain to after sale, or in delivering its services.

Each business unit has its own responsibility towards environment, society and the economy in a way that achieves the required competitive advantage. Businesses which are late in adopting this new concept will see themselves out of the market (Porter and Reinhardt, 2007). IT has its own responsibility in achieving sustainability, since it is one vital element of organizations success.

1.2 Background:

Rapid development and industrial revolution in the last 50 years have had bad impact on the environment which creates a public concern about the future of the planet. The UN and many governments have issued regulations to save the Earth from two main problems climate change and e-waste generation. Climate change, which is caused by global warming, is becoming noticeable worldwide in terms of its consequences such as droughts, floods, deforestation and hurricanes. Global warming is caused by greenhouses gases generated from the industry activities which causes increment in the world's temperature which in turn result in the previous effects. Untreated e-waste is the second problem. It has a direct impact on human health and it is very obvious in China and India. These countries are the destination of global e-waste, where an increased number of people have cancer. Moreover, it has bad impact on other

aspects of life. From these two problems, the concept of begin green emerged, which means being nice to the environment and saving the planet.

Another problem which has appeared is raw material resources and natural resources, being used in an unsustainable way which may lead to distinction of these resources and affects the development of the coming generation. This problem has created new awareness of the use of resources in a sustainable way and the concept called environmental sustainability. Current industrial activities and lifestyle narrow the chances of the coming generations by damaging the ecosystem on which human society and economy are based on. This requires a global movement towards sustainable development (Labuschagne and Brent, 2005). Public groups, governments, cost saving and other drivers pushed organizations to give more attention to the society and local economic to build sustainable society and sustainable economic. These three dimensions: economic, social and environmental aspects have created new concept of triple bottom line, and organizations should focus on and balance between these three dimensions to achieve sustainability. In all of the above, IT is part of the problem, but it could be a major solution.

IT causes 2 percentage of the global greenhouse gases, most of the e-waste generated from IT products is not treated in a proper way. IT can contribute to reduce the effects of other business activities such as transportation by adopting the telecommunication technologies. Many IT practices also have positive impact on the economy and the society such as non-discrimination hiring and enable work-life balance. IT sustainable strategy should be part of the corporate sustainability which is in turn a main part of the corporate strategy. Implementing sustainability strategy successfully needs management commitments, building sustainability culture in the organization to ensure employees' participation in the strategy .Management should put the policies and goals, set the indicators and metrics to measure the performance as without measuring they cannot manage it. Then they implement the required activities to achieve the goals and review them periodically to identify the required adjustment, results should be communicated to both internal and external stakeholders. Reporting

using Global Reporting Initiative (GRI) indicators will enable stakeholders to do performance comparison between different organizations. GRI is becoming a standard way for reporting.

Sustainability has a strong business case and even in the current downturn it is considered as part of the solutions but its philanthropic part is becoming difficult to justify. Organizations should not only focus on its economic sustainability, which will serve only for a short-term; instead it should satisfy its triple-bottom line in order to success for the long run. It is the ultimate goal (Dyllick, and Hockerts, 2002, cited in Chen et al, 2008). Moreover, natural resources are important for economic activities such as manufacturing and agriculture, thus environment sustainability is more important than economic sustainability. Reduction in natural resources is the main risk for the manufacturer and saving them is a key factor for long-term viability (Chen et al, 2008).

Due to the importance of sustainability, the UN department of economic and social affairs has established a division specializing in sustainable development. It is the source of expertise in sustainable development within the UN system. It is mainly for reviewing the progress of Johannesburg Plan of Implementation and the Barbados Programme of Action. It is working for integration of three dimensions of sustainability in policy-making in all levels; international, regional and national. It promotes sustainable development through cooperation at the three levels and it provides technical assistance, advices to developing countries to adopt sustainable development.

1.3 Aim of dissertation:

This dissertation aims to raise the awareness about sustainable IT and contribute to the knowledge of IT activities' impact on the environment, economy and society and how it can be sustainable in UAE organizations.

Research objectives: objectives are acceptable evidence of the researcher purpose and direction, and they should be SMART (Specific, Measurable, Achievable, Realistic and Timely). The research objectives are:

- Investigate the drivers for sustainable IT in UAE.
- Identify best practices and new technologies for sustainable IT.
- Build the business case for sustainable IT, especially in the current economic downturn.
- Investigate how a sustainable IT strategy can be incorporated into a corporate strategy.

1.4 Research questions:

The following are the dissertation's research questions, and they are derived from the research objectives:

- What are the main drivers for sustainable IT in UAE organizations?
- What are the practices and metrics used by UAE organizations attempting to implement sustainable IT?
- What are the main issues and factors that need to be addressed in order to successfully incorporate sustainable IT strategy into corporate strategy?

1.5 The value of the dissertation:

The dissertation will give a better understanding of sustainable IT. It will represent the drivers for sustainable IT and its benefits to organizations' triple bottom line which will encourage organizations implement it especially in the current downturn. In addition, the study will identify the main factors for smooth sustainable IT implementation with the best practices and metrics to be used.

1.6 Dissertation structure:

The dissertation consists of seven chapters as described below:

Chapter 1: Introduction

This is the introductory chapter. This chapter will provide an overview about sustainability. Then it will present the background introduction about the area of the study; the climate change, the e-waste, the role of IT in sustainability, its importance and how to adopt it. It will also present aims and objectives of the dissertation, the research questions and the value of this dissertation. Finally it will explore the contents of the dissertation.

Chapter 2: Sustainability

This chapter will explore the different definition of sustainability and its three dimensions. Then it will discuss the main sustainability issues environmentally, economically and socially and the impact of IT. After that, it will demonstrate the situation of sustainability in UAE and the relevance regulations. Then it will use the literature to show that sustainability has a strong business case even in the current downturn. Then it will review the literature to identify the required factors for successful implementation.

Chapter 3: Drivers and Practices for sustainable IT

This chapter will investigate the drivers that make organizations adopt sustainable IT. It will explore the economical, environmental and social drivers. It will find out the most used practices in sustainable IT regarding its three dimensions. Then it will discuss the metrics used to measure the performance.

Chapter 4: Sustainability Indicators and their Relevance to IT

This chapter will show how Global reporting initiatives (GRI) indicators will help organizations identify their sustainability issues. It will discuss the indicators that can be applied to IT only. Then it will map these indicators with their relevant practices and metrics which were discussed in the previous chapter.

Chapter 5: Research Framework and methodology

This chapter will present the research methodology. First of all, it will discuss why the qualitative technique and inductive method are suitable for this research. Then it will discuss the selection of case studies as primary research method. After that it will mention the benefits of using semi-structured interviews of building the case studies. Finally it will discuss the selection of the sample and it will give a brief description for each organization.

Chapter 6: Data Analysis

This chapter will present the collected data and the findings from the interviews. Data will be categorized in different categories according to the research questions and objectives. Each category will be discussed and a comparison between the organizations will also be presented. Each category will be supported by a table which summarizes the findings in clearly.

Chapter 7: Conclusion and recommendations

In this chapter the results from the analysis will be presented. In addition the main conclusion of this research along with recommendations will be presented. The results will be categorized according to the research objectives and recommendations will be made for respective each case study organization and for improving sustainable IT in UAE in general. Finally, the research limitations and possible future work will be discussed.

Chapter 2 Sustainability:

2.1 Definition:

The word "Sustain" is derived from the Latin word "sustenere", and it means preserving the economical, environmental and social systems for the coming generations, so resources should be used to a degree where it is possible to restore them in a regeneration process (Schmidt et al, 2009). The Brundtland Commission defines sustainability as a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987, P. 1). Sze´kely and Knirsch (2005) defined sustainability as building the society with achieving balance between economic, social and environment aims. Sustainability approach by which company integrates its economic, social and ecological objectives into its corporate strategy with achieving balance between these three bottom line (Sze´kely and Knirsch, 2005). Literature agrees on three dimensions of sustainability: economic, social, and environmental (M´alovics et al, 2008). All definitions in the literature agree on the three main dimensions economical, ecological and social systems for the future generations which are refereed as "triple-bottom-line" (Elkington, 1997).

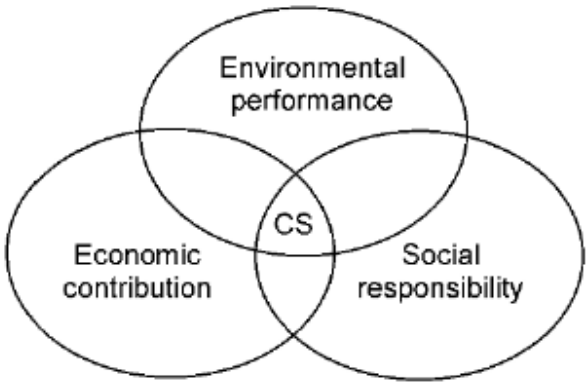

Figure 2.1 Corporate sustainability (CS) and the triple bottom line (Azapagic, 2003)

Sustainability is achieved by balance between these three dimensions overtime which means sustainability management (Marcus 2005, cited in Schmidt et al, 2009). Sustainable management is long-term optimization of economical, ecological and social systems to generate most financial performance for the business (Schmidt et al, 2009). Sustainable development defined by The International Institute for Sustainable Development, Deloitte & Touche and the World Business Council for Sustainable Development (WBCSD) as "adopting business strategies and activities that meet the needs of the enterprise and its stakeholders today, while protecting, sustaining and enhancing the human and natural resources that will be needed in the future" (Labuschagne and Brent 2005, p. 160).

There are two types of sustainability as per capital theory approach which considers that total capital consists of natural and man-made (economic and social) capital. Firstly, weak sustainability considers that the natural resources, which decreasing, are equal to the man-made capital which is increasing so the total capital is maintained which will achieve the sustainability. Secondly, strong sustainability means that the natural resources should be maintained and not the total capital since it cannot be replaced by manufactured capital. Strong sustainability assumption is more powerful, since opportunity for man-made capital to substitute natural resources is too low (Gustafsson, 1998; Cleveland and Ruth, 1997). Whenever sustainability is mentioned in this study it implies the strong sustainability.

There is a similar concept called Corporate Sustainability Responsibility (CSR). It means that business should consider the environment and the social in his activities, not only the financial issues, which also means business should go beyond profit-oriented activities and increase the well-being of community to have a better world (Robins, 2005). As per Azapagic (2003) CSR in general means that business shows a continuous improvement and concern about its triple bottom line economical, environmental and social. Even many corporate sustainability concepts is follower to the CSR, CSR still has confusion in its definition (Marrewijk, 2003). According to Marrewijk (2003), who presents different definitions for CSR, ambiguity of CSR is

due language problem and it meets with corporate sustainability in its meaning and many people consider them as synonyms. Weber (2008), who develops a business case for CSR, says that CSR management is very similar to Corporate Sustainability (CS) management. He says that CS integrates between the three dimensions economical, social and environmental into business management, while CSR see the economical success as a result of focusing on social and environmental aspects. Marrewijk (2003) has the opinion that CS is the ultimate goal of CSR and Weber (2008) sees CSR as a short-term goal to achieve corporate sustainability. However Weber (2008) has also used CSR and CS as synonyms in his paper discussing the business case for corporate sustainability. So the important part is that CS and CSR are trying to improve the economical, social and environmental performance of the organization.

There is also a sustainable business which involves "sustaining and expanding economic growth, shareholder value, prestige, corporate reputation, customer relationships, and the quality of products and services. It also means adopting and pursuing ethical business practices, creating sustainable jobs, building value for all the company's stakeholders and attending to the needs of the underserved" (Sze´kely and Knirsch 2005, P. 628). As per Kleef and Roome (2007, p. 44), sustainable business should take into account "the interests of future generations, biodiversity, animal protection, human rights, life cycle impacts, and principles like equity, accountability, transparency, openness, education and learning, and local action and scale".

Sustainable IT is about aligning IT with business strategy to achieve market-leading business value, customer value and societal value (Harmon and Auseklis, 2009). They said that sustainable IT is shifting the process, behavior and organizational culture to integrate the business model within the social and environmental responsibility. Schmidt et al (2009) said that sustainability in IT is a wider concept that Green IT, since it also concerns about electronics waste. Green IT is the practice of maximizing the efficient use of IT resources to minimize environmental impact for

the whole life cycle (Harmon and Auseklis, 2009), but by applying the definition of sustainability (WCED, 1987) on IT; sustainable IT concerns that the materials used at the time of manufacturing are not badly harvested and they will be reserved for the future. As per Murugesan (2008), Green IT is trying to improve the economic and ecological performance by reducing energy consumption, recycling and reduce the total ownership cost of the assets. He argued that Green IT is currently not practicing its social responsibility, whereas, based on sustainability definition, sustainable IT does consider the social responsibilities. Green IT is more about power consumption efficiency and effects on environment when using IT (Harmon and Auseklis, 2009). Thus according to the above, all literature agreed that Green IT is defined as environmentally sustainable information technology but some of them added the economical aspect to it. However, all agreed that sustainable IT concerns environmental, social and economic aspects.

2.2 Main Sustainability Issues

2.2.1 Environmental:

Two of the main problems facing the Earth are climate change and the huge amount of produced E-waste:

Climate change, a result of global warming, is one of the most serious environmental issues, which is threatening humankind (Chalcraft, 2009). Page (1998) also says that global warming is the main reason for this change in climate. Sathiendrakumar (2003) also agreed that climate change is dangerous phenomena and it will threaten the neural environment and the survival of the human race and its surrounding ecosystem. Ramazan and Soytas (2009) said that energy consumption is causing greenhouse gases emissions which are in turn the main source of global warming. Sathiendrakumar (2003) also agreed that increased amount of greenhouse gas emissions (carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O) and carbon monoxide (CO)) is badly affecting our climate. Angulo-Brown et al (2009) declared that anthropogenic activities which increase the greenhouse gases, carbon dioxide, in the Earth's atmosphere. Greenhouse effect is a major concern in the last few decades (Chi, 2000).

"Greenhouse gases" according to United Nations Framework Convention on Climate Change (1982), means those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation. Sathiendrakumar (2003) explains the greenhouse effect as the process by which the infrared radiation from the sun, which supposed to radiate, is absorbed by the greenhouse gases (mainly water vapor, carbon dioxide, chlorofluorocarbons, methane and nitrous oxide), and the trapping of the radiation in the atmosphere is heating the earth surface and increasing the global temperature.

Murugesan (2008) claims that the increased concentrations of greenhouse gases in the atmosphere is pushing the Earth's temperature higher and this is changing the world

climate and weather patterns in different countries causing serious problems in the world like floods and droughts and other effects such as disease, smog, acid rain. Dickson (1999, cited in Sathiendrakumar 2003) also agrees that warmer temperatures will cause extreme weather events, such as heat waves, floods and storms. These results will increase likelihood of death, injuries, resource shortages and enforced migration (McMichael et al, 1996; WHO, 1997, cited in Sathiendrakumar). Generating electricity is the major cause of global warming, since it needs burning coal and oil which release carbon dioxide and pollutants the atmosphere (Murugesan, 2008). According to United Nations, climate change is a result of harmful human activities over time which affects the global atmosphere (Chalcraft, 2009). Scientists have agreed that climate change is the result of huge amount of greenhouse gases produced by industry activities (Milne and Grubnic, 2009). Hennessey (2000) also mentions the concentration of carbon dioxide has increased in the atmosphere by 30% from 1870 to 2000.

Information technology contribution to climate change:

Gartner (2008) claimed that ICT industry is responsible for about two percent of global carbon dioxide which is equivalent to the aviation industry. Another study on 2005 showed that global power consumption of servers worldwide including cooling and other associated infrastructure used 123 000 Giga watt hours (GWh) of electricity. This is equivalent to Poland power consumption and Google by itself operates about 450,000 servers consuming nearly 800 GWh a year (Chou, 2008). Cameron (2009) claims that server farms in US and their cooling infrastructure are responsible for 1.2 percent of US power consumption. Assuming these servers are using coal power generation, they will produce 72 metric tons of CO2 per year which is about double Ireland production of CO2. He also mentions that servers worldwide release about 200 million metric tons of CO2.

Idle desktop PC uses about 115W; 80 W for the system unit and 35 for 17-inch LCD display. The cost to operate a PC 24 hours day, seven days a week, for one year is

8,760 hours/ year x 115 W x AED 0.24/kWh = 241.776 AED, but if PC is on only during the working hours the annual bill for PC will be 1,125 hours/ year x 115 W x AED 0.24/kWh = 31.05 AED which less 8 times. Active energy level adds few percent to the annual total (Nordman and Christensen, 2009). Electricity is generated by burning the fossil fuels which release CO2 into the atmosphere which contribute to global warming (Nordman and Christensen, 2009). The average amount of CO2 released per kWh is 0.7 kg; that means each idle PC yearly generates about 7 tons of CO2 (Nordman and Christensen, 2009). PC energy use can be cut more than 50 percent, if sleep used instead of idle mode (Nordman and Christensen, 2009). Most greenhouse emissions of ICT are related to power consumption (Casal et al, 2005).

E-waste: Gungor and Gupta (1998) defined waste as redundant goods, by-products or residues that have no value and must be disposed of at a cost. They said that waste, hazardous and non-hazardous, is generated by consumers and manufacturers. Waste Electrical and Electronic Equipment (WEEE) describes e-waste as discarded appliances that use electricity such as computers, televisions and cell phones and even the non-electronic goods such as refrigerators and ovens (Robinson, 2009). In 2006, the total production of E-waste per year was about 20–50 million tons (UNEP), which represents 1-3% of total waste production of 1636 tons per year (OECD, 2008). Krikke (2008) also claims that 40 million tons is the total production of e-waste worldwide every year. Cobbing (2008) calculated that total e-waste production will be 5.5 million tons in 2010, rising to 9.8 tons in 2015. Analysts predict that two-thirds of the estimated 870 million PCs made worldwide in the next five years will end up in landfills (Murugesan, 2008).

Most E-waste is currently landfilled (Barba-Gutierrez et al, 2008). As per Ladou and Lovegrove (2008), most e-waste is not recycled since it is thrown with household waste and receives no special treatment. Krikke (2008) also agreed that 80 percent of the e-waste is dumped in landfills and the other 20 percent is properly disposed of and recycled. According to Krikke (2008) China is the world's first destination of e-

waste; it is receiving about 70 percent of world's e-waste, followed by India and Africa, since recycling a PC cost about $2, and US$30 in US and EU.

E-waste contains many hazardous materials, such as lead, mercury, arsenic, cadmium, selenium, hexavalent chromium, and flame retardants that create dioxins emissions when burned. These toxins can cause brain damage, allergic reactions and cancer (Puckett and Smith, 2002). Krikke (2008) said that dumping e-waste in the landfills is poisoning the soil and precious water resources and affecting a growing section of the population. Puckett and Smith (2002, cited in Widmer et al, 2006) said disposing of and recycling of e-waste without controls will result in bad impacts on environment and human health. United Nations Environment Programme (UNEP) (Chaaban 2001, p. 336) defines these hazardous wastes as: "wastes other than radioactive wastes which, by reason of their chemical reactivity or toxic, explosive, corrosive or other characteristics causing danger or likely to cause danger to health or the environment, whether alone or coming into contact with other wastes, are legally defined hazardous in the state in which they are generated or in which they are disposed of or through which they are transported". Chaaban (2001, p. 337) defines hazardous wastes as: "One that may cause or significantly contribute to serious illness or death or that poses a substantial threat to human health or the environment when improperly managed". Electronic waste or e-waste—discarded computers and electronic goods—is one of the fastest-growing waste types. The problem of e-waste is becoming global (Murugesan, 2008).

Guiyu City, in China, known as the world's e-waste capital, is a disaster zone. It has been observed that a high percentage of lead, mercury, cadmium, and other toxins released into the environment which causes lead poisoning in 80% of children (Krikke, 2008). E-waste has bad impact on different aspects of the ecosystem such as contaminated materials can enter aquatic systems via leaching from landfills where E-waste may have been deposited (Robinson, 2009). Wang and Guo (2006) found that the load concentration in Nanyang River, near Guiyu, is 8 times higher than the local drinking water standard. E-waste contaminants can also spread into the air via dust

which causes health problems to people through ingestion, inhalation and skin absorption (Mielke and Reagan 1998, cited in Robinson 2009). Air samples taken near Guiyu showed high concentrations of chromium (Cr), copper (Cu), Zinc (Zn), lead (Pb), Polycyclic aromatic hydrocarbons (PAHs) and Polybrominated diphenyl ethers (PBDEs) (Robinson, 2009). E-waste has also bad effects on the soils and terrestrial environments: it has been detected in chinese agricultural soils near e-waste reprocessing sites has high concentrations of hazardous materials PBDEs, PAHs, PCB , Pb and Cu.

Analysis of rice samples from e- waste processing showed concentrations of Pb and Cu 2-4 times more than the allowed concentrations of these elements in foodstuffs in China (Fu et al, 2008). The same case has been observed in chicken tissues which has a high level of PBDEs (Liang et al 2008, cited in Robinson 2009). All these have impact on human health. People in Guiyu have high level of dioxins in human milk, placentas and hair, which indicates that these materials are taken by humans through water, food and air to a level which causes serious health problems (Chan et al 2008, cited in Robinson 2009). Children in Guiyu have a high level of Pb (Huo et al,2007; Li et al, 2008b, cited in Robinson 2009) and Cd (Zheng et al, 2008) which affect their cognitive abilities (Li et al, 2008b, in Robinson 2009). Moreover, e-waste contributes to the global warming problem, since landfills emit huge amount of methane CH4, which is more powerful greenhouse gas than CO2. It has a warming potential of 25 times that of CO2. Even methane concentrations in the atmosphere are about 200 times lower than CO2 concentrations, it is responsible for 20% of the global worming (Mackie and Cooper, 2009).

Refer to Appendix (A) for more information about Potential environmental contaminants arising from E-waste disposal or recycling.

Information technology contribution to the e-waste generation:

As per Krikke (2008), a typical PC consists of 23 percent plastic, 32 percent ferrous metals, 18 percent nonferrous metals, and 12 percent electronic boards (gold, palladium, silver, and platinum). According to Murugesan (2008), computers contain toxic materials like lead, chromium, cadmium, and mercury. Murugesan (2008) said if computers are buried in landfills, toxic materials can leach harmful chemicals into waterways and the environment. If they are burned, they release toxic gases into the air we breathe. Thus, if e-waste is not discarded properly, it can harm the environment and people. Lee et al (2004) also agreed that hazardous materials contained in computers parts (CRT, batteries and plastics, etc.) can cause serious pollution if they are not disposed of properly. According to the UNEP (United Nations Environment Programme) (2007) e-waste is increasing three to five percent each year which is causing many social and ecological problems. ICT equipment make up 25 percent of the about 20 to 50 million tons of e-waste generated each year. This means that ICT waste production comprises 5 million tons per year, which is equivalent to 9000 fully loaded Airbus A380 passenger planes containing dangerous metals, such as lead, mercury and cadmium (Schmidt et al, 2009).

IT is damaging our environment in different ways through its lifecycle from production through its use ending by its disposal. Computers and other IT equipment consume huge amounts of electricity which contribute for greenhouse gas emissions (carbon dioxide). IT hardware causes environmental problems during production and disposal. It uses many environmental recourses such as water, chemicals and raw materials in unsustainable way, and after disposal it is contaminating the environment with hazardous materials (Murugesan, 2008). Chen et al (2008) has also agreed that IT causes two environmental problems, since it is using a huge amount of energy. In addition, disposal of old computers which have toxic materials is another environmental issue (Chen et al, 2008).

2.2.2 Economical:

Increase in operation costs because of increased energy consumption and energy costs affect the economic situation of the organization (Murugesan, 2008). In addition, non-compliance of the IT with the regulations regarding the carbon emissions and e-waste will cost the organization fines (GRI, 2006).

2.2.3 Social:

Bribery and corruption are a main risk to the reputation and sustainability of organizations (BSR, 2008). Poor social responsibility will damage the company image in the society (Salzmann et al, 2005). According to the right to Freedom of Expression which is contained in Article 19 of the Universal Declaration of Human Rights: "Everyone shall have the right to freedom of opinion and expression; this right includes freedom to hold opinions without interference and to seek, receive, impart information and ideas through any media and regardless of frontiers." This means that customers have their own privacy and data security. Customers should have control over their data and it requires consumer educational awareness rising. Other articles related to Human rights article 23 and article 24. Article 23 declares that "(1) Everyone has the right to work, to free choice of employment, to just and favourable conditions of work and to protection against unemployment. (2) Everyone, without any discrimination, has the right to equal pay for equal work. (3) Everyone who works has the right to just and favourable remuneration ensuring for himself and his family an existence worthy of human dignity, and supplemented, if necessary, by other means of social protection. (4) Everyone has the right to form and to join trade unions for the protection of his interests" while article 24 declares that 'Everyone has the right to rest and leisure, including reasonable limitation of working hours and periodic holidays with pay". These articles have addressed the relations between any organization and its customers and employees.

2.3 Sustainability in UAE

UAE has long been aware of the importance of environmental resources for the coming generations. This has driven the sustainable development strategy by establishment of environmental agency, formulation of environmental strategy and legislations and moreover participation in multilateral environmental agreements (MOE, 2006).

Energy production and consumption are the main resources of GHG's. It accounts for 95% of total GHG emissions in UAE (MOE, 2006). "Emissions Summary for United Arab Emirates" report, which is available in United Nations Framework Convention on Climate Change (UNFCCC) website since Jul 2010, shows that energy sector is responsible for about 90% of the total GHG emission in UAE. The report shows that 2000 is the latest available year. Figure 4.1 shows the contribution of other sectors in GHG emissions.

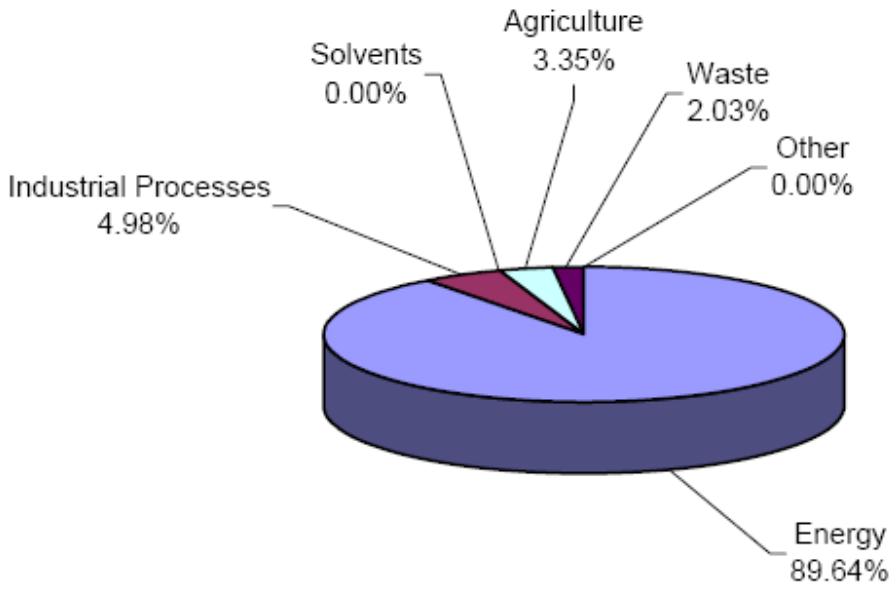

Figure 2.2 GHG emissions by sector in UAE

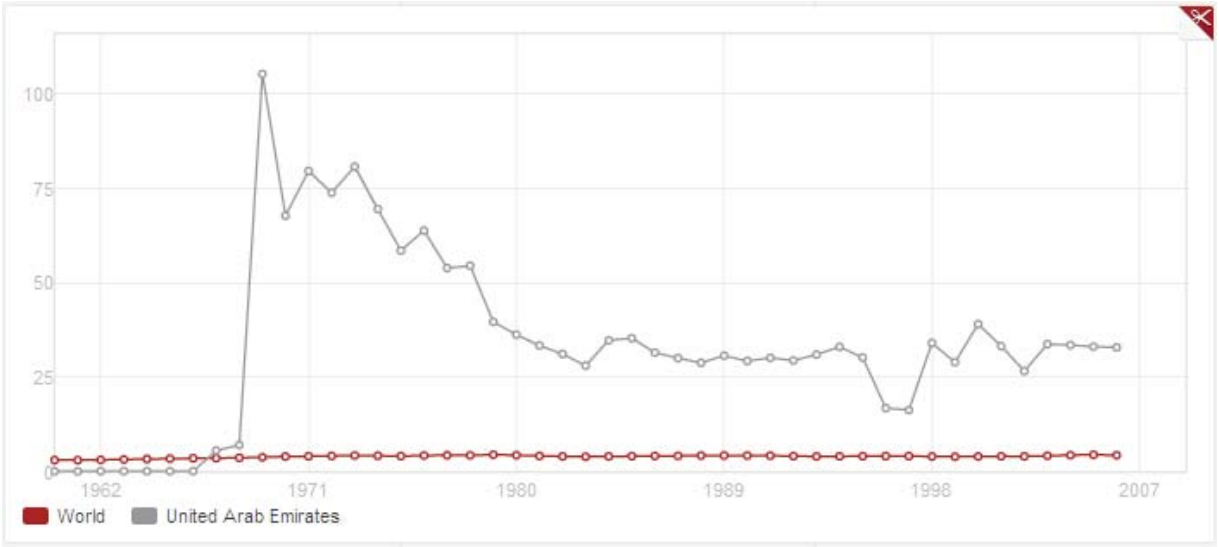

Figure 2.3 CO2 emissions (metric tons per capita) in UAE and the World

UAE has huge CO2 emissions per capita. Figure 4.1 shows the CO2 emissions per capita in UAE compared to the world emissions (http://data.worldbank.org, 2010).

Due to climate change, it is expected that UAE will face temperature increase between 1.6ºC and 2.9ºC in 2050 compared to the period 1961-90. In the same way, for average annual rainfall is expected to be between 45% less or 22% more by 2100 compared with the same period. Moreover sea level will increase by 9 to 88 cm between1990 and 2100. Climate change will also have a negative impact on costs, source of water, forming land, human habitats, general health and energy resources. Sea level is also increasing which also causes a risk for the UAE's investment-intensive coastal zones (MOE, 2006).

UAE has taken many movements to reduce the dependence on the oil industry and diverse its economy. It encourages the environmental friendly industrial growth. Many efforts have been taken regarding environments, such as establishment of environmental agency, formulation of National Environmental Strategy and National Environmental Action plan, and endorsement of major environmental and sustainable development related laws and regulations. In 1999 UAE has released the Federal Law No. (24) "Concerning Protection and Development of the Environment", which is the first comprehensive environmental law in UAE at the federal level. Natural gas has also been discovered in many emirates mostly in Abu Dhabi. As a result, UAE has encouraged the electricity production based on the natural gas. Decomposition of waste in landfills is main source of the methane emissions. UAE has increased its tree stock which absorbs about 7% of carbon dioxide emissions from the energy sector, or more than all the carbon dioxide emitted from industrial processes in the UAE (MOE, 2006). UAE is running one project to build a solar-powered plant that will sweat sea water and provide electricity. Another initiative is to reduce land filled waste emissions by implementing waste management system that include recycling, composting, land filling (EPA, 1998). UAE has formulated a national-level strategy for raising awareness regarding optional impact of the climate change on the UAE as well as the challenges and opportunities. UAE realized that reducing GHGs can be

done without affecting its economy. This can be achieved by implementing policies and measures within and across sectors, such as power generation, industry practices, transportation and real estate industry. These measures will increase energy efficiency, reduce air pollution, reduce waste and accelerating shifting to renewable energy. These initiatives will save costs and moreover will create new employment vacancies as well as new market opportunities.

As per the environment agency (a private communication through email with Director-Environmental Management Sector), there is no specific UAE legislation regarding GHG emissions other than those that pertain to ozone depleting substances that may have a GHG effect. They do not have the missions of IT industry alone. Central of Waste Management (CWM) (a private communication through email) also told that data about e-waste quantity is not available yet. They claimed that there is no e-waste treatment process, and they put tender for contractors to propose a solution. Regarding the waste management, there is law no. 21 of 2005 in Abu Dhabi (EAD, 2007). This law identifies the responsibilities of competent authority, waste generators, treatment and disposal facilities and other parties. It is also declared the control, inspection and penalties in case of violation of low. Moreover, UAE is party to several environmental conventions and protocols. Appendix (B) contains list of these conventions and protocols.

Abu Dhabi Sustainability Group (ADSG):

One of the best initiatives in UAE is Abu Dhabi Sustainability Group (ADSG). Environmental Agency – Abu Dhabi (EAD) has raised it at Abu Dhabi level, in June 2008 (Gulfnews, 2008). ADSG consists of 21 leading organizations in Abu Dhabi which adhere to sustainable development (EAD, 2010). This initiative is part of the government objective to be one of the best five governments in the world (Uaeinteract and Gulfnews, 2008). The group will meet quarterly to exchange experience, put targets and identify the training required for implementing sustainability (Gulfnews, 2008).

The group aims to enhance the economic development by maintain environmental and social cohesion. The group contains government, private and not-profit organizations form Abu Dhabi. They all adhere to develop sustainability management framework in their organizations. All members have signed the ADSG Declaration which insists that each organization will provide necessary financial, technological and human resource to adopt best sustainability practices (EAD, 2010).

2.4 Business Case for Corporate Sustainability:

Although adopting sustainability will not be a choice anymore, creating business case will help management take decision for adopting sustainability. Companies now have to adapt sustainability and the challenge has moved from "whether" to "how" to integrate corporate sustainability into day-to-day management decisions (Porter and Reinhardt, 2007).

First of all sustainability will have positive effects on company image and reputation. Image represents ''the mental picture of the company held by its audiences'' (p 696, Gray & Balmer, 1998). Company image can be changed quickly, but company reputation needs time, consist performance and good communication to the stakeholders to be built. Corporate Sustainability (CS) will positively influence company's reputation (Schwaiger, 2004; Fombrun & Wiedmann 2001) and it will increase its competitiveness (Gray & Balmer, 1998). Adopting sustainability will give a better image of the organization in the society and help attract best employees to join the company (IISD and WBCSD, 2002) and it will increase the brand value (Thorpe and Prakash-Mani, 2003). Sustainable IT helps in talent acquisitions and Retention which is important to have a competitive advantage over the competitors (BSR, 2008). Moreover it enhances employee's relations and increases their loyalty (BSR, 2008). Sustainable development will enhance the company's reputation in the society (Azapagic, 2003). Secondly it will increase customer loyalty (Weber, 2008) as many customers now consider the environmental records of their suppliers. Enterprises that have vision to provide products and services that address the environmental issues will have a competitive advantage over their competitors (Murugesan, 2008). Even corporate and institutional buyers, like Dell, ask their supplier to measure to what degree their products and manufacturing process are green, and force them to adapt the environment friendly practices (Murugesan, 2008). Thirdly, improving the social and environmental performance will attract ethical investors who are looking for such companies (IISD and WBCSD, 2002).

Cost saving is a direct and fast outcome form sustainability. It could be a result of increased efficiency of power consumption. Moreover it helps getting easier access to capital due to investors' concerns about sustainability (Weber, 2008). Cost savings is due to using cleaner production methods and technologies which improve material, energy and product efficiencies (IISD and WBCSD, 2002). Sustainability can also improve the business and production processes by reduce production costs and use resources efficiently and this will lead to cost saving (Weber, 2008). Efficient usage of the resources will save the organization a sufficient amount of money Murugesan (2008). Sustainability also increases sales and market share which means increasing the revenue. CS activities can help in increasing revenue indirectly by improving the brand image, or directly by achieving better risk management (Weber, 2008).

Sustainable development will have positive effects on employee motivation, retention, and recruitment. This will also improve the company's reputation, and it will make employees more motivated to work in a better environment or participate in volunteering environmental and social programs. This good environment will help attract potential expert to work in the company (Weber, 2008). Sustainability can achieve safe and healthy environment for workers and the community. This will improve the wellbeing and reduce the costs of social services and medication and therefore the cost of labors (IISD and WBCSD, 2002). Creating good work conditions will improve the motivation and productivity and decrease the turnover and absenteeism (IISD and WBCSD, 2002). Apart from the above, organizations with best sustainability practices will influence on regulation. First mover with best practices has much influence on the standards and regulations (IISD and WBCSD, 2002). It will also achieve better risk management and avoid the negative press, non-compliance to regulations and customer boycotts (Weber, 2008).

In the current downturn, many commentators see that companies are concerned with their short-term survival. They see that organizations cannot support for long-term initiatives to protect the environment and invest in the community development which threaten the corporate sustainability. Vermeer and Clemen (2009) see that

social initiatives will suffer in the current downturn but the core elements of sustainability, the environment, will survive and even thrive in a re-order economy. Economic crisis has reduced the demand for many resources and thus the cost of energy. This makes the business case for environment sustainability difficult to make since resources are not harvested as before. Moreover, the upfront investment required to have better operational practices that save energy and other resources is another obstacle. They see that the main drivers now are the consumers who are looking for a product that is perceived to be greener, healthier and can generate an immediate savings. The other driver is the retailers who observed the standard for the environmental and social performance of its suppliers. According to Lubin (2010), environmental sustainability is the strategic option in the current downturn, but organizations have to know where and how to adopt it. Winston (2009) also claimed that adopted environmental sustainability strategy will motivate the employees and increase the workforce loyalty in the current downturn.

Based on the review above, it is understandable that philanthropic activities may decline in the current economic downturn however the environment aspect would continue to present a strong business case. The Economy will still be the first one to benefits from the environmental responsible activities as the research will present in the coming chapters. For example, acting good to the environment will have a direct impact on the economic dimension and indirect impact on the social aspects. For instance, reducing energy consumption will reduce greenhouse gases with a sufficient saving in operating costs. Communicating these results correctly to the public will give a good reputation and a better image for the company in the society, which will increase its sales and market share. Another example that improves the social responsibility of organization and enhances its image is that companies can send its old computers to charity organizations to be reused. This environmental responsible way will have a direct impact on the social dimension by creating good image for the company in the society which in its turn, again, increases its sales and market share.

Environment sustainability still has a strong business case to adopt, even if it requires upfront cash. It is still better to invest in environmental sustainability slowly with good communications of results. The best approach that exactly fits the current economic situation, suggested by Murugesan (2008), is the tactical incremental approach. In this approach, an enterprise will keep the current IT infrastructure and polices and apply new practices to achieve their modest green goals such as reduce power consumption. These practices could be related to power management such as switching off unused computers, using energy-efficient light bulbs, maintaining an optimal room temperature. These practices are easy to implement without much cost but it should be considered as short-term objectives.

2.5 Building Sustainable IT Strategy:

White (2009) said that management should ensure that sustainability is not added work and it is incorporated into the DNA of a company. Sustainability initiatives make business more profitable. The reason why it is not increasing profits for some businesses is that sustainable development initiatives are not integrated to the business strategy. Now many small-sized and large companies start incorporating sustainability into their business strategy (Sze´kely and Knirsch, 2005). They also added that successful sustainability strategy needs to incorporate sustainability strategy into the business strategy. Azapagic (2003) also agreed that sustainability strategy should be aligned with the business strategy.

Azapagic (2003) defined three different types in accountability structure to implement sustainability. The board could assign a line manager for sustainability strategy and the board will monitor the implementation. Alternatively, responsibility could be assigned to the whole board, reporting to CEO or MD, and therefore each director is responsible for managing his portfolio of activities in a sustainable way. Azapagic (2003) said that the best way is to form a sustainability management team which will coordinate and monitor the sustainability implementation. Intel (2009) is practicing this. It has started its sustainability program office on 2008; even its sustainability initiatives began over a decade ago. Murugesan (2008) advised that large enterprises should assign an environment sustainability officer to implement the strategy and monitor the overall progress to have a successful implementation.

Most of the literature has focused on the following points to have a successful implementation:

Sustainable strategy is a complement to the business and it helps the company takes positive decisions regarding the environment in its day-to-day activities (Olson, 2008). First of all, management should demonstrate leadership and commitment to sustainability. Senior management and directors are the main factors in implementing

sustainability successfully, and they should show commitment to sustainability. This commitment will not guarantee that sustainability will be implemented effectively, but it will ensure that implementation will not be difficult. Sze´kely and Knirsch (2005) considered this factor as critical success factor of sustainability implementation. They declared that management should have honest commitment to sustainability during its implementation. Lubin (2010) said that organizations should have a C-level leadership with allocated resources and responsibilities. Chief Sustainability Officer (SCO) should ensure that sustainability strategy is aligned with the business strategy. Lubin (2010) also considered leadership a critical factor for success.

Identification of sustainability issues relevant to IT and to other company's activities will help sustainability implementation. Issues can be identified by meeting the internal and external stakeholders. Interests of stakeholders, their concerns and time-scale are important for implementation (Azapagic, 2003). Sustainability issues are mostly common to different businesses and sectors, so doing case studies on same business activities will help identify the sustainability issues. An approach to identify the sustainability issues, suggested by Schmidt et al (2009) is to identify the IT resources which can be categorized as tangible - such as IT hardware, electrical equipment etc. and intangible resources such as electricity, water, and paper etc. Then we identify the sustainability issues for these resources in the entire value chain of the IT. Murugesan (2008) also suggested a holistic approach to address the IT environmental issues which has a similarity with Schmidt et al's approach (2009). Other tools that help identify the sustainability issues are the Global Reporting Initiatives' (GRI) indicators and the Global e-sustainability initiatives (GeSI). They will be discussed in detail in Chapter 4.

Companies should measure their current economic, environmental, and social baselines based on the identified sustainability issues to help business set objectives and targets (Azapagic, 2003). Intel (2009) has done the same by measuring its baseline before setting the sustainability goals. Then organizations can set objectives

and targets to clarify where the company wants to go and how it is getting there and how soon. The objectives and targets should be related to the sustainability issues identified previously and should be complementary to the business strategy and no conflicts should be there. IT then can set its own sustainability goals and objectives which should be aligned with the corporate sustainability strategy. This will ensure that all activities and tactics will serve a common purpose towards corporate sustainability (Olson, 2008). High performance needs setting clear sustainable performance targets that aligned with company's operating principles (Sze´kely and Knirsch, 2005). Companies should identify metrics and indicators tools for measuring and improving the level of sustainability. Then it can monitor the overall progress to ensure that the company is going towards sustainability and help set corrective actions in case of bad performance (Azapagic, 2003). Schmidt et al (2009) said that actions taken should be measured and evaluated by proper indicators, and this will help business managers monitor sustainable implementation progress and show the inefficiencies in operations.

Literature has also agreed that sustainable organizational culture is a main barrier against sustainability. Creating a supportive culture for environmental sustainability is an important step for implementing sustainability. This culture will make the employees more aware of the sustainability issues, opportunities and the required activities to achieve sustainability (Olson, 2008). Olson also said that creating a sustainable culture will reinforce people's behavior to adopt sustainability. Azapagic (2003) suggested achieving a cultural change through corporate strategy, change management programmers and formal risk management procedures. He also suggested that a company should give training to its employees to raise the awareness of sustainability, and it should make posters, newsletters describing how individual can help in making the company more sustainable. Moreover, companies should encourage employees to give new innovative ideas that improve sustainability, and link them to financial and non-financial incentives to motivate employees to participate (Azapagic, 2003). Schmidt et al (2009) also mentioned that training,

awareness raising and motivating are important for successful sustainability implementation. Companies should give stakeholders and employees training about sustainability so they can easily make connections between their daily activities and improvement that they can make to the environment (Olson, 2008). Azapagic (2003) also suggested that reward systems should be there and companies should recognize people who achieve, or help to achieve, sustainable development objectives. Olson (2008) agreed with him that reward system should be there to encourage employees to participate in sustainability implementation. He also considered that creating an organizational cultural which is based on sustainability is an important step that facilitates the implementation of sustainability.

Effective Communication is essential for promoting sustainability and company's achievements, thus companies should develop useful internal and external reporting procedures. This will outline company performance toward its sustainable objectives. It can also work as a marketing tool (Azapagic, 2003). As per Harmon and Auseklis (2009), all stakeholders, internal and external, should be informed about how the company is doing regarding sustainability. Many companies have started a triple bottom line reporting, financial ecological and social performance. This will form trusted long-term relationships with the stakeholders. Schmidt et al (2009) also agreed that reporting is an essential part within the concept of corporate sustainability. It will show that efforts have been undertaken by the company to reduce risks and seize opportunities for improving competitive advantage. Reporting will communicate organization's commitment to internal and external stakeholders and it will satisfy their information needs (Schmidt et al, 2009). These reports can show challenges towards sustainability and the achievements to stakeholders which gives a good reputation to the company for its environmental concerns which is a good marketing tool. Azapagic (2003) has categorized them into two categories internal and external communication. Internal communication will help in promoting company's achievements regarding sustainability and the related benefits which will positively affect corporate culture. Summary of the progress should be communicated

to employees and they should be aware of reports produced to the external stakeholders. External communication is targeting the external stakeholders. They expect that companies expose their performance in sustainability, and many companies now start producing corporate sustainability reports showing their performance. Schmidt et al (2009) said that external reports will attractive investors and customers. Harmon and Auseklis (2009) consider stakeholders involvement and providing them with transparent information about company sustainability performance and achievements which are essential for effective sustainability strategy.

Schmidt et al (2009) and Azapagic (2003) agreed that Global Reporting Initiative (GRI) is the most used sustainability reporting framework. It provides principles and indicators that can be used by organizations to measure and report their economic, environmental, and social performance. GRI, which is emerging as the most widely followed reporting standard, recommends the following elements to be included in a sustainability report (GRI, 2006):

- Vision and strategy with a statement from the CEO;
- Overview of the company's structure and operations and of the scope of the report;
- Governance structure and management systems including stakeholder engagement;
- Sustainability indicators: economic, environmental, social and integrated.

More companies are producing their sustainability reports following the GRI standards. This will enable cross-comparisons between companies' performance (Azapagic, 2003). Having a standardized way of reporting will help in making comparisons between organizations' performance (Epstein and Roy, 2001).

Chapter 3 Drivers and Practices for sustainable IT:

3.1 Drivers for sustainable IT:

Murugesan (2008) argued that social, financial, and practical constraints will push the businesses and IT departments to reduce energy consumption of datacenters. Greening IT is an economic and environmental imperative and it will be a necessity, not an option (Murugesan, 2008). IT has a growing global impact on economy, ecology and the society, and that is why sustainable IT is becoming a challenge (Schmidt et al, 2009). Chen et al (2008) claims that using the resources in unsustainable way will make our economy unstable and will leave coming generations' powerless in the foreseeable future. He also added that economic and environmental benefits from eco-efficient application of technologies, such as telecommunication, going paperless and other technologies, are main drivers to adopt them (Chen et al, 2008).

Drivers will be explored in detail according to the three dimensions of sustainability:

3.1.1 Environmental dimension:

Environment is the main driver to go green and it has a direct impact on economic and social aspects such as saving cost and enhances the company's image. First environmental driver; the total energy consumption for servers and its associated infrastructure is increasing, which results in more electricity used and more carbon (greenhouse) emissions (Murugesan, 2008). Growing awareness of IT's impact on the environment: in 2007, there were about 44 million servers worldwide consuming about 0.5% of all electricity (Harmon and Auseklis, 2009). Secondly, End-of-life for electronics also damages our environment, since most of the computer and other electronic equipment end up in the landfills after three years of purchase and this pollutes the earth and contaminating water by its toxic materials (Murugesan, 2008).

Previous chapter talked in more details about the environment issues –greenhouse gases and e-waste effects-which are drivers for environmental sustainability.

3.1.2 Economical dimension:

Cutting cost in raw materials and energy and attracting external stakeholders are main economic drivers. Azapagic (2003) said that sustainability will achieve cost saving though improving material usage, energy consumption and product efficiencies. Sze´kely and Knirsch (2005) also agreed that implementing sustainable development will make the business more profitable. Secondly, reducing energy consumption and reducing operations costs are the major reason for using eco-responsible practices (Murugesan, 2008) and the rapid growth of the internet has increased data center demands. As a result energy cost increased and sustainability will reduce the cost (Wong, 2007). The rise of Internet and web application is causing fast growth of data centers, which have increased six times to 30 million in the last ten years and this will increase electricity demands Murugesan (2008).

In addition, the increased power density of IT equipment -even if they are using CPUs with latest power consumption technology - increase the total servers' power consumption as more servers installed with higher performance processors and more memory capacity (Harmon and Auseklis, 2009). The density has increased 10 times from 300 watts/ square foot in 1996 to 4,000 watts/ square foot in 2007 and it will continue to increase (Harmon and Auseklis, 2009). The increment in datacenter density also has resulted in more heat density and this requires more cooling, Servers require approximately 1 to 1.5 watts of cooling for each watt of power used (Goodin, 2006). The cooling power consumption will continue to increase as the servers' density increase (Harmon and Auseklis, 2009). Moreover the increased energy worldwide with the huge amounts of power consumption has sufficiently increased the operational costs of datacenters (Murugesan, 2008). Harmon and Auseklis (2009) claimed that costs of power and cooling for the useful life of a server can exceed the price of the server. In addition, the restriction to access power resources, large

companies such as Google cannot source their power needs in cities (Foley, 2007). Murugesan (2008) also agreed that companies, whose data centers are expanding steadily, have a critical issue to find power suppliers.

Another driver is low server utilization rates; using a small percentage of server capacity is a major problem in terms of energy use and the average rate is about 5-10 per cent for large data centers (Forrest et al, 2008). This means that companies are overpaying for operation support, maintenance and for energy if they are not using the full capacity of their servers (Tohmatsu, 2009). PC Energy consumption, both in enterprises and at home, is a growing cost, since most machines are left on most of the time even while they are not used (Nordman and Christensen, 2009).

Apart from the above, investors as an important external factor put real pressure on companies to engage in sustainability and companies, which showed good sustainability performance, attract those investors (Sze´kely and Knirsch, 2005). Moreover, when competitors adopt a sustainability strategy, it puts a real pressure on the business to adopt the same (Chen et al, 2008). Butner et al (2008) also declared that some businesses requested their partners to declare their carbon emissions.

3.1.3 Social dimension:

More public groups and organizations are pushing companies to show their environmental performance. There is public pressure to recycle e-waste, and that is why recycling is becoming one of the fastest-growing industries in the world (Krikke, 2008).Olson (2008) also agrees that community pressure is main reason for moving towards sustainability. Communities and groups put pressure on companies that have poor social performance (Azapagic, 2003). Increased customers' interest in ethical and socially responsible business is real pressure on organizations (Sze´kely and Knirsch, 2005). Azapagic (2003) also agrees that public criticism and negative publicity because of poor environmental performance is a driver for sustainability. Internalization of negative externalities (pollution and waste) and demands for

reduced material consumption are social drivers (Sze´kely and Knirsch, 2005). Secondly, new legislation has been made to reduce environment effects and customer safety concerns (Olson, 2008). Sze´kely and Knirsch (2005) also agree that national regulations and international standards governing the environment, labour standards, human rights, anti-corruption practice and corporate governance will force the companies to go for sustainability. Azapagic (2003) concurred that regulation is the main driver for sustainability.

Actually it can be seen that some of these drivers can come under two dimensions; such as energy consumption can be considered as environmental as well as economical. The same applies to regulations or public pressures as they can be an environmental driver for forcing companies to watch their footprint, or economic driver since it forms a risk to organizations' activities or social issues. In the agreement with the above, drivers, it can be seen that when organizations optimize their hardware usage and use it to its full capacity and by acting friendly to the environment, results will reflect positively on the economical situation by saving costs and by improving the image of the company in the society.

Appendix (C) contains more details about the regulations and standards regarding sustainability.

3.2 Practices to implement sustainable IT:

Moving to sustainability needs adopting practices that can help the organization achieve improvements on its triple bottom line: economic, environment and social.

3.2.1 Environment dimension:

IT needs to optimize computer efficiency to lower costs and reduce the impact on the environment. It requires many approaches such as changing the way assets are used, use of energy-efficient hardware, visualization, software and power and workload management (Murugesan 2008; Dietrich and Schmidt 2007).

PC manufacturers should use more energy efficient components such as processors which save power especially in the idle mode. This mode usess energy more than the sleep or off modes (Nordman and Christensen, 2009). The US Environmental Protection Agency (EPA) estimated that if a computer went into sleep mode, it will save energy use by 60–70 percent. Even it seems not that much to save energy costs per PC, but for an enterprise which is using hundreds of computers it will be considerable (Murugesan, 2008). Users can change their way of usage by configuring the computers to go for sleep mode instead of idle mode (Nordman and Christensen, 2009). We can make a sufficient reduction in power consumption by making small changes in the ways we are using the computers (Murugesan, 2008). Also Nordman and Christensen (2009) agreed that changing the power level and usage patterns will reduce PC energy consumption. They said that most of the saving can happen by changing users' behavior.

Enterprises can also change the machines used to reduce the power consumption. Instead of using PCs they can go for thin clients which are cheaper in terms of equipment purchase and management with modest energy saving. They can also switch to notebooks which save energy but does not reduce the total cost of ownership (TCO) (Nordman and Christensen, 2009). Murugesan (2008) also agreed that thin client consumes about a fifth of the power of a desktop PC. For PCs

connected to a network, they need to be up waiting for any outer request. This means that they are idle most of the time and they cannot go for sleep mode otherwise they will not appear for the other devices. Network connectivity proxy will be used to implement a network that makes sleeping PCs appear fully operational and connected. The same technology applies also to notebooks and printers (Nordman and Christensen, 2009). There is also software such as Surveyor from Verdiem (www.verdiem.com) that allows the IT staff to manage the power consumption of all the PCs in the organization. It will turn the unused PC to a lower-power consumption mode such as shutdown, hibernation, or standby, and monitors into a sleep mode. It also gives reports about power-consumption for each PC and monitor, and it allows network managers to remotely awake a PC for software upgrade or any other reason (Murugesan, 2008).

After PCs' end of life, Murugesan (2008) suggested that old PCs should be refurbished, reused or recycled in environmentally friendly ways, instead of throwing them in the landfill. PC can be reused if it meets requested requirements or it can be given to someone who can benefit from it or even from its parts. By extending the useful life of hardware, we reduce the total footprint caused by computer manufacturing and disposal. If a computer cannot be used in its current status, it can be refurbished by buying new IT hardware from the market and upgrade it to meet the requirements. Last option is to recycle the old PC, if it cannot be refurbished or reused. It should be disposed it in environmentally friendly way, and the e-waste can be a good resource for raw material. We should recycle PCs by taking component material and reprocessing it or breaking it down to constituent materials for reuse. GRI (2006) has suggested that the company reduce obsolescence by reusing or refurbishing and then by proper recycling. In addition, hardware with less hazardous materials should be used (GRI, 2006). Krikke (2008) also suggested that companies donate the old PCs, so they can be reused, or they can be recycled.

For data centers: enterprise should use new energy-efficient equipment. Energy costs are about 30 percent of datacenter operating cost and a sufficient amount is spent only

on cooling. Companies like IBM, HP, Cooligy and SprayCool are inventing new ways to reduce energy consumption such as liquid cooling, nano fluid-cooling systems, and in-server, in-rack, and in-row cooling. Enterprise should replace its old datacenter infrastructure, most data centers are ten years old and its equipment such as chillers, power supplies, storage devices, switches, pumps, fans, and network equipment reached its end of useful life. These equipment are power hungry and inefficient (Dietrich, 2007) and the best solution is to replace or retrofit these data centers to be more energy efficient. Enterprise should use new hardware technologies such as multiple cores and the development of dynamic frequency and voltage scaling technologies help reduce energy consumption. Multiple-core microprocessors run at slower clock speeds and lower voltages than single-core processors and can better leverage memory and other architectural components to run faster while consuming less energy. These new technologies, Dynamic frequency and voltage scaling, enable the CPU performance to match workloads, and this helps to design servers that consume energy in proportion to the workload (Harmon and Auseklis, 2009). Another way to make the datacenter green is to use a green power sources (Murugesan, 2008). Renewable energy (Biofuels, Ethanol, Hydrogen, wind) is the main power source to reduce greenhouse emissions (BSR, 2008). Butner et al (2008) stated that companies can buy renewal energy such as wind, solar and hydro energy.

One of the most used technologies in datacenters is virtualization technology. Virtualization will reduce the total power consumption of the servers and their cooling equipment (Murugesan, 2008). Enterprises can also benefit from virtualization technology to improve its performance. Virtualization is a main strategy in terms of energy efficiency and cost reduction for growing business computing needs. It increases the IT resources utilization while reducing the energy use, capital spending, physical space, and human resources costs (Ryder, 2008). It achieves better efficiency than standalone servers (Barroso, 2007). Virtualization technology developed by IBM to increase the utilization efficiency of mainframes then the concept has been applied on x86 servers for datacenters. Virtualization programs

enable running multiple operating systems concurrently on a host server. In large datacenters, the average server usage is between 5-10 percent of capacity, by using virtualization the server workload increases to 50-85 percent with more energy efficiency (Barroso, 2007). Virtualization means fewer servers, less operation cost, less cooling costs and better manageability. Virtualization technology affects four areas: server hardware and operating systems, storage, networks, and application infrastructure (Harmon and Auseklis, 2009). Virtualization technology enables one physical server to host multiple virtual servers, which mean better hardware utilization, less power consumption, less floor space and less cooling requirements (Murugesan, 2008).

Another area that organization should consider is power and workload management which can save a considerable amount of money per desktop per month as well as for servers (Wilbanks, 2008). Power management software adjust the processor power states according to the workload, it will make full use of processor in case of high workload and conserve power in case of low workload (Dietrich, 2007). Companies are shifting their employees from using desktops to laptops for their better power management capabilities (Dietrich, 2007). Enterprises should invest in energy management software and thermal load management (Murugesan, 2008). Moreover, increased server density has increased the head emissions, which requires more efficient heat dissipation and more power consumptions. New techniques are used for thermal management such as variable cooling delivery, airflow management, and raised-floor data center designs to ensure good air flow, more efficient air conditioning equipment, ambient air, liquid heat removal systems, heat recovery systems, and smart thermostats (Dietrich and Schmidt 2007, Schmidt and Shaukatallah). IT should improve airflow management in the datacenter to reduce cooling requirements (Murugesan, 2008).

Other technologies that achieve sustainability are cloud computing and cloud services technologies. Data centers are based for the internet, and the software technology enabled applications to be used when and where needed over the internet. Cloud

Computing means making high performance computing available over the internet (Ricadela, 2007). It enables the developers to create, deploy and run easily scalable services which will make user free from the location and infrastructure problems with reliable and high performance (Perry, 2009). Cloud computing is evolving many services utility computing, software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS).

Amazon.com, sun and IBM were the first companies to offer utility computing service. They offer virtual servers and storage that can be accessed on demand. Users pay for what they use when they need it. Second service called SaaS is cloud computing which offers applications over the internet to serve many customers through the browser interface (Guptill and McNee 2008; Harmon and Laird 1997; Reid 2009). Salesfore.com is an example of SaaS provider for automation, CRM, human resources and supply chain management, Google also provides GoogleApps as SaaS model (Knorr and Gruman, 2008). Customers will get many benefits such as no upfront investment in hardware or software, reduction in operations cost with leading-edge technology and less environmental impact (Reid, 2009). PaaS is also a cloud computing technology. It provides the required resources to support the entire life cycle for developing and delivering web applications and services over the internet. It is a normal result of SaaS growth (Knorr and Gruman, 2008). Leading PaaS companies are Force.com, Google AppEngine, and Microsoft Azure, where developers can create their applications as a service on the provider's platform and deliver it to their customers form the provider's servers. The benefits for customers include the speed and low cost (Urquhart, 2009). At the end, IaaS: Cloud infrastructure services which provide basic infrastructure, such as servers, storage, clients and networking as on demand. Amazon Web Services, GoGrid, and Flexiscale are the leading companies for IaaS providers (Sward, 2006). Customers will have more flexibility, lower cost, pay as you go, access to latest technology and better service delivery (Harmon and Auseklis, 2009).

Telecommunications is another efficient tool for achieving sustainability. According to Chen et al (2008), telecommunication is going to be a promising solution for sustainability in different dimensions. It will reduce the transportation emissions. Now businessmen can use the video conferencing technology, instead of travelling across the continents. This technology will reduce the emissions of the aviation industry as well as the travel cost. Flexible working and conferencing are solutions to reduce business travel and employee commuting (BSR, 2008). IT can also help business to go paperless by digitizing its documents and e-filing. This will reduce power consumption and waste generation of paper manufacturer (Chen et al, 2008). Moreover, IT can help to transfer the business to online business, e-business, this will increase the online transactions and reduce the number of retail stores, paper usage, and people transportations. This means reduction in the costs of the stores and reduction in waste and CO2 emissions (BSR, 2008).

Moreover, companies should identify the environmental impact of its supply chain such as material use, pollution, energy use, hazardous substances, waste water, solid waste and air emissions (BSR, 2008). Schmidt et al (2009) said that companies should measure the number of their ISO 14001 certified suppliers. GRI (2006) mentioned that companies should ask their suppliers about the used materials and energy consumption. According to Murugesan (2008), some companies are doing more than asking their suppliers about their sustainability performance. Dell, for instance, is forcing their suppliers to adopt environmentally sound practices.

3.2.2 Economic dimension:

It can be seen that previous environmental practices can be considered as economic practices. These practices result in cost savings and therefore better economic performance of the company. Other practices that can be extracted from the GRI indicators -which will be discussed in detail later- and apply to IT: firstly, comply with the existing regulations to reduce the financial risks. IT should set the financial implications and risks associated with climate change and non-compliance with

regulations. Secondly, IT can improve and support the local-economy by deal with local suppliers and hire local expertise. Chen et al (2008) claimed that organizations can adopt telecommunications, and it will have a good impact on the local economy and the economical situation of the organization. Companies should show diversity in its hiring policy through diversity in gender, age and employ from locally and from the head office country (BSR, 2008).

Telecommunications can give flexibility to employees to work from their home offices using remote desktop and Virtual Private Network (VPN) technologies. This will reduce the traffic congestion and office space, transportation costs and materials. Tele-working, video conference will help reduce the costs and enhance the economic situation (BSR, 2008). IT can provide software products that enhance the good governance and reduce the money lost because of corruption and bribery (GRI 2006; BSR 2008) which will damage the company's reputation. On-line business will help reduce office and retail stores (BSR, 2008). IT can enhance customer relations and increase customer loyalty by implementing reliable system, having fast disaster response and business resilience (BSR, 2008).

3.2.3 Social dimension:

As with the GRI indicators (2006), it can be argued that IT can afford training to the IT staff and sponsor employees to pursue their education. Secondly IT can set non-discrimination process for hiring and equal opportunities for all job seekers to join the department. Thirdly, IT can offer salaries and benefits to compete with lower salaries in the market. Lastly IT can give training to the IT staff about anti-corruption. Chen et al (2008) considered that adopting telecommunication technology comes under the social responsibility of the organization, since it will provide flexibility to employees by working remotely and reduce traffic congestion and the associated pollution. BSR (2008) suggested that these telecommunication technologies will facilitate flexible working options and improve the work-life balance. According to BSR (2008), this will enhance the employees' relation. IT is competitive and requires talented

employees, thus companies should have partnership with national universities. Moreover it should retain their current employees by maintaining a work-life balance (BSR, 2008). Work-life balance determined by the working hours, wages, benefits and it will reduce the turnover and absenteeism due to injuries and illness. IT should follow the standards for health, safety and labour work such as child labour, working hours, wages, benefits, occupational safety, industrial hygiene and ergonomics (BSR, 2008).

It can be seen that some practices will serve more than one purpose, such as telecommunications. It will reduce emissions (environmental), save costs (economical) and reduce traffic congestion (social). Also it can be seen that most of the practices have good impact on both the economic and environmental dimensions simultaneously.

Chapter 4 Sustainability Indicators and their Relevance to IT:

The Global Reporting Initiative (GRI) is a network-based organization that develops a sustainability reporting framework which is used worldwide. This framework has been developed with participations with business, civil, labour and professional institutions. GRI framework set indicators to measure for Environmental, Social and Economic performance of the organizations. It is used to benchmark organizational performance with laws, norms and standards and compare its performance overtime (www.grireports.org). The GRI presents three dimensions and with each dimension they reported several indicators. Research has reviewed the indicators and the following are the ones that are deemed relevant to IT.

4.1 Environmental Indicators:

The environmental dimension concerns the impact an organization has on all natural systems.

"EN4 Indirect energy consumption by primary source:" The amount of intermediate energy used such as electricity should be identified and the amount of primary fuels consumed to generate this intermediate energy. This information can be obtained from the electricity provider.

"EN5 Energy saved due to conservation and efficiency improvements:" this indicator reflects the results of improved energy efficiency and the total energy saved. It can result in cost savings and can lead to competitive advantages and market differentiation. Total energy saved after implementing the sustainable IT should be reported.

"EN6 Initiatives to provide energy-efficient or renewable energy based products and services, and reductions in energy requirements as a result of these initiatives:" the

taken initiatives should be reported as well as the energy saving results from these initiatives. Report should contain the initiatives taken to reduce the energy required to provide IT services, and quantify the reduction achieved in the power-consumption.

“EN7 Initiatives to reduce indirect energy consumption and reduction achieved:” Intermediate energy reported in EN4 is excluded here. Indirect energy use such as business-related travel and employees commuting should be identified. Reports should include initiatives implemented to reduce this energy consumption, the quantity of reduction and methodologies used to calculate the indirect energy used.

“EN16 Total direct and indirect green-house gas emissions by weight:” Greenhouse emissions should be identified according to direct and indirect energy use. Indirect emissions of greenhouse gases result from the generation of electricity. Sum of direct GHG has been identified in tonnes of CO2 equivalent.

“EN17 Other relevant indirect green-house gas emissions by weight:” this excludes the emissions produced from generating electricity. It includes other activities such as employees commuting and business travel from EN7. It should report the sum of indirect GHG identified in tonnes of CO2 equivalent. It should reveal the criticality of these emissions to the stakeholder and whether they can be reduced by adopting some actions.

“EN18 Initiatives to reduce greenhouse gas emissions and reductions achieved:” The possible emission reduction for all resources should be identified as well as the initiatives to reduce these emissions. It should report what has been implemented and the amount of reduction that has been achieved.

“EN22 Total weight of waste by type and disposal method:” the amount of hazardous waste and non-hazardous waste produced should be identified. Reports should identify the selected way of disposal (reuse, recycle, recovery and landfill) with the quantity and how the method has been selected.

“EN28 Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with environmental laws and regulations:” Total monetary fines and the number of non-monetary sanctions should be reported.

“EN30 Total environmental protection expenditures and investments by type:” Expenditures and investment paid to enhance the environmental performance. They include the cost of e-waste and emissions treatment, training and education for employees, certificate cost, hardware cost, operation costs, and related personnel costs.

These indicators need metrics to measure them. For example, EN7 indicator should report initiatives applied to reduce energy consumption such as the adaptation of telecommunication initiative to reduce the business-travel. This indicator should also report the reduction achieved after implementing the initiative, so metric is needed to measure the power consumption before and after implementing the initiative. Metrics, such as hours of electricity used by a company, are scientific information that is useful to the company. This information might not be useful for stakeholders. It is usually complex and complicated for public and private decision-makers. They want a communication tool to translate this information to more understandable information. This tool is the indicator, such as whether the energy consumption is more or less than the previous year consumption. Indicators translate these metrics to policy-shaping tools. More simple information that is understandable by Stakeholders and decision-makers (Sze´kely and Knirsch, 2005).

For Environmental indicators, there are environmental metrics. They are related to resource usage, waste generation and the cost saving and revenue that is achieved by increasing the process efficiency (Sze´kely and Knirsch, 2005). Sze´kely and Knirsch (2005) have presented some metrics used by various German companies. Some of these metrics can be used in IT field. The table 4.1 will present them with metrics used by Dell, an American firm.

Metrics used by German Companies	Metrics used by DELL in its GRI report
Percentage of employees in environmental management. Environmental protection costs and investment.	
Energy consumption (MJ/employee/year, GWh and GWh/unit produced, fuel tons). Direct energy consumption by type emission of greenhouse gases. CO2 emissions (tons). Emission of greenhouse gases (kg/employee/year, tons and tons/unit). Business travel (km/employee/year, CO2 emission).	Electricity and green electricity Million kilowatt-hours (kWh). GHG emissions before and after use green electricity (Metrics tons).
Waste (kg/employee/year, tons and kg/unit)). % of waste recycling. Recycling (tons). Industrial and hazardous waste (tons). Processing of material that is treated or untreated waste from other sources.	Hazardous waste generated Metric (tons) Nonhazardous waste generated Metric (tons) Waste recycling and reuse rate
Paper consumption (kg/employee/year, tons). Paper and glass recycled.	
fines and sanctions for non-compliance with applicable international declarations, conventions and treaties, as well as with national, regional and local regulations relating to environmental issues reduction of greenhouse gas emissions energy consumption (GWh). Complaints from neighbors.	

Table 4.1Environmental Indicators used by German Companies

Most of the metrics used in the green computing area are the power-related metrics which will help IT Organizations understand and improve data centers' efficiency (Harmon and Auseklis, 2009). For example, Power Usage Effectiveness (PUE): equal to data center power consumption divided by all IT equipment Power consumption which is the load associated with computers, storage, network equipment and peripherals (Rawson 2008; Reid 2009). Other metrics which are used for measure datacenter efficiency are Data center infrastructure efficiency (DCiE), Data center performance efficiency (DCPE) and Data center performance efficiency (DCPE) (Sward, 2006). In addition, there are energy efficiency benchmarks: like Analysis

tool, EnergyBench, SWaP, Energy Star, SPECPower, and JouleSort. It will monitor the energy efficiency at the data center level to build energy efficiency into the initial design of components and systems and to manage power consumption in response to changes in workload and environment (Rivoire et al, 2007).

4.2 Economic Indicators:

The economic dimension concerns the organization's impact of the economic conditions of its stakeholders and local, national and global economic.

"EC1 Direct economic value generated and distributed, including revenues, operating costs, employee compensation, donations and other community investments, retained earnings, and payments to capital providers and governments:" Reports should show operation costs such as the used material and electricity, and the total outflow for employees, wages and benefits.

"EC2 financial implications and other risks and opportunities for the organization's activities due to climate change:" many regulations now make organizations responsible for their emissions and waste cause a direct risk and opportunity. Risk and financial implications for energy cost, and the cost of new physical components required to comply with these new regulations. In addition, cost of activities to comply with regulations.

"EC5 Range of ratios of standard entry level wage -salary per hour- compared to local minimum wage at significant locations of operation:" economic well-being requires that organization invest in its employees. Reports should identify whether wages given to its staff is above the minimum wage rules and the entry level-wage at significant locations of operation. For organizations which offer monthly salaries, they should convert the salary into an hourly estimate.

"EC6 Policy, practices, and proportion of spending on locally-based suppliers at significant locations of operation:" improving the local economy can be done by

supporting the local businesses. Local sourcing will build stable local economy thus attracting additional investment to the local economy. So report should show what the geographic meaning of 'local' is. It can be measured by the number of invoices. The policy of supplier selection should be cleared (e.g. based on costs, environmental and social performance). Moreover, the percentage of the procurement budget used to purchase from the local suppliers should be stated.

"EC7 Procedures for local hiring and proportion of senior management hired from the local community at significant locations of operation:" Selection of staff and senior management from the local residents will bring the economic benefits to the local community and enhance local human capital. Moreover, it will help the organization understand the local needs and help the local economy. Report should include the policy whether to hire globally or from the local community, and the percentage of the local residents hired as senior management using the full time employees.

Same as the environmental indicators, economical indicators has economical metrics. The table 4.2 will present the economical metrics used by German companies that can be applied on IT with metrics by used Dell.

Metrics used by German Companies	Metrics used by DELL in its GRI report
Total expenditure on purchased goods, services, materials Investment R&D Capital expenditure Cash flow Equivalent monetary value of all benefits to staff Personnel cost (wages, salaries, social welfare contributions, pension plan expenses, employee benefits).	Net revenue. Number of Tier 1 suppliers audited.

Table 4.2 Economical Indicators used by German Companies and Dell

4.3 Social Indicators:

The social dimension concerns the organization's impact on the social system within which it operates.

"SO3 Percentage of employees trained in organization's anti-corruption policies and procedures." This training is important to build awareness and capacity necessary to prevent incidents of corruption. It should identify the percentage of total number of management and non-management employees who got this training.

"SO8 Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with laws and regulations:" in case of failure to comply with regulations (emissions or e-waste), consequence sanctions should be reported as well as total monetary value of significant fines and number of non-monetary. If there is no non-compliance with regulations and laws, it is good to mention it in the report.

The table 4.3 will present the social metrics used by German companies that can be applied on IT with metrics by used Dell.

Metrics used by German Companies	Metrics used by DELL in its GRI report
Employee total number Staff in training (number) Average participation of employees in education measures (days) jobs, classified by type and country average fluctuation and net change in employment practice of documentation of industrial accidents and illnesses lost days/absence rates due to injuries in industrial accidents and work-related deaths average hours of training/further training per employee (differentiated by staff categories) proportion of female/male employees in management and executive positions lost time accidents workforce profile	Number of employees.

years of service in company
no. of trainees
personnel cost (total & per employee)
percentage of disabled employees
accidents per 200,000 hours worked
participation in employee training programs
employee commitment
percentage of 25 largest suppliers that fulfill social criteria
percentage of part-time employees
health rate
total number of apprentices

Table 4.3 Social Indicators used by German Companies and Dell.

The following table (4.4) will link between indicators and its metrics. It will map them with the drivers and the practices.

Dimensions	Drivers			Practices	Metrics
Environmental	Climate change Global warming GHG emissions E-waste natural resources used	Energy efficiencies	Regulations Public groups pressure Attract investors Mimics competitors Customer interest	Change the users' usage pattern [EN6,EN18] Change to efficient machines [EN6,EN18] Optimize the datacenter design and cooling [EN6,EN18] Virtualization [EN6,EN18] Energy, workload and thermal management [EN6,EN18] Cloud computing [EN6,EN18] Telecommunications [EN7,EN18] Online business (e-commerce, e-services) [EN7,EN18] supply chain sustainability Choose product with minimal hazardous waste Reuse, Refurnish, Recycle [EN22] Paperless Renewable Energy [EN6,EN18] Provide solutions [EN6,EN7,EN18] Training, education costs [EN30]	Environmental protection cost [EN30] Investment [EN30] Energy consumption [EN4,EN5] Green energy consumption CO2 and GHG emissions [EN16,EN17] Waste , % of hazardous waste [EN22] Reused and recycled waste [EN22] Paper consumption Recycled paper [EN22] Fines for non-compliance [EN28]
Economic	Power access Profit Cost saving Operation cost			Financial implications and risk [EC2] Local-hiring [EC7] Local-suppliers [EC6] Training, education costs [EC1]	No of suppliers audited Cash flow [EC1] Personnel cost [EC1] Personnel salaries [EC5]
Social	Company reputation Company Image	Business ethics International standards Talent Acquisition and Retention		Environmental management Anti-corruption training [SO3] Enhance Working conditions Non-discrimination hiring Telecommunications Online business (e-commerce, e-services) privacy and security increase Health and safety enable work-life balance reduce bribery and corruption Training, education	No of employees No of staff in training [SO3] % of employees in education % of turnover and absenteeism % of female/male employees in ex-positions Years of service in the company Personnel costs % of disabled employees Fines for non-compliance [SO8]

Table 4.4 Drivers, Practices and Metrics Mapping

Table (4.4) links between the drivers, practices, indicators and metrics for sustainable IT. Some of them are related to one dimension and others are for more than one dimension. Regarding the social indicators, they are included under "Labor Practices & Decent Work" and "Human Rights" aspects in the GRI Guidelines and not under the social indicators. But some organizations, such as EAD in their sustainability report, consider them as part of their social responsibility and they report accordingly. Moreover the same indicators have also been identified by Global e-Sustainability Initiative (GeSI) as social issues for IT, but GeSI has not linked these social issues with its corresponding GRI indicators. The research will also consider them as social indicators, not "Labor Practices & Decent Work" and "Human Rights" aspects, so they will remain within the three dimensions of sustainability.

Table (4.4) shows that for IT, it has good participation in the three dimensions. It also shows that for the environmental and economical dimensions they are almost integrated; each dimension is serving the other one. Regarding the social aspect, it has less integration with economical and environmental dimensions. Most practices for sustainable IT are environmental practices and they lead to economical benefits. It can be seen that IT is part of the problem because of its emissions and e-waste, but it can offer solutions in different areas such as telecommunications and online businesses.

Environmental Indicators:

- "EN4 Indirect energy consumption by primary source:"
- "EN5 Energy saved due to conservation and efficiency improvements:"
- "EN6 Initiatives to provide energy-efficient or renewable energy based products and services, and reductions in energy requirements as a result of these initiatives:"
- "EN7 Initiatives to reduce indirect energy consumption and reduction achieved:"
- "EN16 Total direct and indirect green-house gas emissions by weight:"

- “EN17 Other relevant indirect green-house gas emissions by weight:”
- “EN18 Initiatives to reduce greenhouse gas emissions and reductions achieved:”
- “EN22 Total weight of waste by type and disposal method:”
- “EN28 Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with environmental laws and regulations:”
- “EN30 Total environmental protection expenditures and investments by type:”

Economical Indicators:

- “EC1 Direct economic value generated and distributed, including revenues, operating costs, employee compensation, donations and other community investments, retained earnings, and payments to capital providers and governments:”
- “EC2 financial implications and other risks and opportunities for the organization’s activities due to climate change:”
- “EC5 Range of ratios of standard entry level wage compared to local minimum wage at significant locations of operation:”
- “EC6 Policy, practices, and proportion of spending on locally-based suppliers at significant locations of operation:”
- “EC7 Procedures for local hiring and proportion of senior management hired from the local community at significant locations of operation:”

Social indicators:

- “SO3 Percentage of employees trained in organization’s anti-corruption policies and procedures.”
- “SO8 Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with laws and regulations:”

Chapter 5 Research Framework and methodology:

5.1 Overview:

The aim of this dissertation is to increase the awareness of the sustainable IT in organizations in the UAE region and help them implement it successfully. The research will investigate the drivers for sustainable IT, best practices, difficulties, benefits and lessons learnt. To address the research objectives and answer the research questions, a case study approach has been select and it is based on qualitative technique. Interviews have been conducted to give in-depth information and empirical data about organizations adopting sustainable IT. Then a critical analysis of collected data is presented to achieve the research goals.

As mentioned in the first chapter, the dissertation has three main questions which have been derived from the dissertation's objectives. These are the following questions:

RQ1. What are the main drivers for sustainable IT in UAE organizations?

RQ2. How effective are the practices and metrics used by UAE organizations attempt to implement sustainable IT?

RQ3. What are the core elements and factors needed to successfully incorporate sustainable IT strategy into the corporate strategy?

These three questions focus on why and how to implement sustainable IT to enhance the competitiveness and improve the organization's performance. The First question will explore the drivers for a company to go for sustainable IT. It will find the internal and external triggers considering the three areas: social, economic and environmental dimensions. The second question will show the practices and metrics that are used to implement sustainable IT. The third question is to find the core elements and factors for implementing sustainable IT strategy.

5.2 Selection of research approach:

The research paper will demonstrate and examine three case studies based on qualitative techniques to gather empirical data that help in finding answers to the research questions. The case study method has been chosen because it can provide intensive investigation and in-depth knowledge of sustainable IT in these organizations. The case study approach is suitable for this research since the research consists of descriptive and explanatory questions (Yin, 2004).

According to Saunders et al (2007), there are two approaches to build a research; deductive and inductive approach. Deductive approach is more suitable for scientific research where a researcher develops a theory and hypothesis based on the research questions and then tests them. Inductive approach which is used for this research requires collecting data and developing the theory according to results, analysis and observations. Researchers who use the inductive approach tend to adopt the qualitative approach. They will interview people, collect information in different ways, and observe the case then they reach a conclusion after analysis of the gathered data.

There are two techniques to collect data; quantitative research use numbers, statistics, charts diagrams to describe the phenomena, whereas qualitative approach uses discourse to describe the problem. There are many research strategies that can be used to answer the research questions such as experiments, surveys, case studies and other strategies. Selection of the strategy is based on the nature of the research.

All the dissertation questions have the same nature; that all of them are difficult to measure and the small existing population makes the qualitative approach the best approach for this research. Few companies have implemented IT sustainability, and case studies will help get depth and breadth of details about sustainable IT in these companies. This information cannot be obtained by conducting a quantitative

approach such as questionnaires. Whereas case study approach, as per Yin (2003), will give a holistic and meaningful characteristics of a real life situations.

In this paper, qualitative data will be gathered through interviews with companies already implementing sustainable IT to address the previous three questions. Then analyses and discussions of the data will follow to attend the dissertation purpose as a whole. Semi-structured interviews will be used for the qualitative research method.

5.3 Primary research:

5.3.1 Case studies:

The case study strategy has been chosen, since it gives a real life context and empirical examination of the organizations adopting IT sustainability. Case studies will give explanation and description of the real life situation. This research paper is considered as a pioneer research in the field of Sustainable IT in UAE, since no such research has been conducted in Sustainable IT previously. The case studies have been built according to the Information collected from the interviewees. The research paper has three case studies, which will strengthen the results of the analysis. It will help generalize the findings when reach common patterns. It will show different approaches of implementation for different companies. Moreover, studying more than one case will avoid the weakness and the bias. It will make the study more robust and accountable.

5.3.2 Case study protocol:

Yin (1994) stated that case study protocol is more that an instrument, he said that researcher should state the rules and procedures in the case study protocol which will increase the reliability of the case study research. The protocol should include the following sections:

- An overview of the case study project: such as research objectives, issues and other information about the research topic.

- Field procedures: procedures, access to case study sites and other data sources.
- Case study questions: the questions that researchers will raise to the interviewee, or keep it in his mind while reviewing organization's documents.
- A guide for the case study report: the format for the final report with all documentation and referential information.

The main characteristic of case studies is that they strive to understand the set of actions and activities engaged by the participants in a real life situations. Having a protocol set is important for the overall progress and reliability of the study and it will keep the investigator focused on the research goals.

5.3.3 Advantages and disadvantages of case studies:

Case study as a qualitative research method has many advantages and disadvantages. Case studies allow exploring in-depth information and intimate details about study being studied. It helps understand the social phenomena and the cultural system which may not be understood through the quantitative approach. It helps to see if framework or the literature can be applied on the individual level.

Since case study is conducted on specific groups or cases, the generalization of the study cannot be applied to society. Moreover, multi-operations of the observations, interactions, interviews or content analysis are based on the researcher's opinion. Some organizations may give limited access to resources which may lead to inaccurate findings.

5.3.4. Semi-structured interviews:

This research paper is based on case studies and to build the case study, interviews have been selected as a primary research method. Face to face interviews were conducted with employees in managerial level and they were selected according to their involvement and qualifications in Sustainable IT.

Semi-structured interview is used as a data collection method. It is flexible and allows the researcher to come up with new questions as a result of what interviewee says. List of required topics and specific questions should be prepared in advance to get the required information. New question could be populated through the discussion. Interview will be based on the questions which were defined in the case study protocol. It is an open framework which allows for conversational and two- way communications rather than a rigid structure (Yin, 2003). Interviews were used instead of survey because there are only few companies who have sustainable IT.

Topics which were covered in the interview:

- Differences between sustainable IT and green IT.
- Drivers for adopting sustainable IT.
- Sustainable IT practices.
- Requirements for smooth implementation.

5.3.5 Interviews: Advantages and Disadvantages:

In this paper, interviews are the base of building case studies. Interviews have advantages such as interviewers can briefly explain to the interviewee the research topic and the objectives of the research. During the interview, the researcher can raise open-ended questions which will allow the interviewee to give deeper information (data richness) which will help the research to correctly understand the answers. Moreover, the questions are flexible and can be modified according to the respondent's answer to previous questions. The interview is a faster tool to obtain information compared to running a survey.

In case of complex questions, the respondent can ask for more explanations and researcher can explain the questions to the interviewee. The interviewer can help the respondent in understanding by repeating and rephrasing the question thus clearing any doubts. In the interviews, the researcher can also observe the nonverbal cues from the interviewee, such as facial expressions, stress, nervous and other body language.

The interviews could build a positive relationship between the interviewer and the interviewee, which will help in acquiring more information in later stage.

Interviews have also disadvantages such as the selection of the interviewee is limited by the number of respondents for the interview request. In addition, it is mostly difficult to schedule an interview in appropriate time for the interviewer and the interviewee, especially for respondents from the management level. Interviews can be very time consuming to both the interviewer and the interviewee and it is always takes more than the planned time due to the development of questions and answers.

The interview method is used with a limited number of people may cause biased results. Interviewee's responses might be also misunderstood or biased by the interviewer. Credibility of responses can also be doubted. There is always a question: "is the interviewee doing what he is saying". In addition, some interviewees may not feel good about the anonymity of their responses. Apart from the above, interviews have geographical limitations that survey does not have since it can be done nationally and internationally.

5.3.6 Interviews questions:

What does sustainable IT mean to your organization?

- Could you explain your role in implementing Sustainable IT in this organization?
- Knowledge about Sustainable IT, size of IT dept, his experience.
- Green IT vs. Sustainable IT.

What are the drivers for sustainable IT in your organization?

- This should cover the previous drivers (in table 4.4).
- Why others have not been considered?

What are the sustainable IT practices in your organization and how effective are they?

- This should cover the previous practices?
- And why others have not been considered?

- What are the sustainability issues for the company?
- What metrics are they using and how they relate to GRI?
- The main difficulties and challenges you are facing?

What management should do to help your organization be sustainable?

- The alignment of sustainable IT strategy and corporate sustainability strategy.
- Management commitment to sustainability and sustainable IT?
- How important is the clear identification of sustainability issues?
- Was the culture changed required? What practices were taken to change the culture?
- Does your staff have a sufficient expertise in sustainable IT? Is there Awareness?
- Are you communicating your results? To whom? And how critical are they?

5.4 Sample selection:

It is clear from the research topic that organizations which adopted sustainable IT should be interviewed. Since most of the companies are still not aware of sustainable IT, any organization that has Green IT was selected to be interviewed. Nine organizations were contacted to participate in this research and most of them were governmental entities. Only three out of these agreed to be interviewed. Other organizations claimed that they have the strategy but they did not start the implementation and others did not respond at all.

The Best person to be interviewed in this research is the IT manager, since the research contains a mix of managerial and technical questions. Four employees interviewed from three organizations. Each interview took about one and half hour. Organizations asked to keep the privacy of their identity, and therefore an alias name is given for each organization.

Organization A:

Organization Description:

Organization 'A' is one of the biggest governmental organizations in Dubai and it is growing fast as a result of Dubai's growth. It consists of many agencies that provide and manage the infrastructure services in Dubai. Their customers are the citizens of Dubai, business and investors.

Their IT department is considered to be one of the best departments in Dubai government evidenced by the many awards they have received for their efforts and accomplishment in IT. They follow high standards in their works and best practices in providing services considering even the disabled people. It has vital contribution in developing the services provided by the organization.

The Organization consists of Headquarters which contain the shared services such as IT, HR, finance, QHSE. Under the headquarters, there are agencies. Each agency has also its own IT, HR, finance and QHSE departments. The corporate IT consists of 50 employees while the IT department for the agencies is about 30 employees. It can be considered as interface between the agency and the corporate IT. Moreover, their infrastructure, support and help desk is out sourced. This organization has a sufficient impact on the environment because of its GHGs emissions. As per the interviewee, the IT has less impact comparing to the other sectors. In addition, this organization does not have competitors in Dubai.

Person Interviewed:

The interviewee is an IT manager in one of agencies. He has three years of experience in this organization. He is responsible for the entire agency's IT needs and requirements and represents them to the corporate IT. He has to ensure that all IT services and projects for this agency are moving in the right direction and aligned

with the corporate strategy. Sustainable IT implementation is one of his responsibilities.

Organization B:

Organization Description:

Organization B is one of Abu Dhabi's governmental departments which has been established in 1996. They set the environmental regulations. Their main concerns are the environment such as the air quality and waste management and sustainable development such as putting the strategy and creating awareness. Its IT department consists of five employees, and an outsourced company provides IT support and services to help manage their infrastructure. It is the direction of the government to outsource services hence they function with a small internal team of five people.

Person Interviewed:

The meeting with organization B was conducted as group. The meeting included two interviewees: Green IT consultant and the IT manager. Green IT consultant has been working with this organization since the inception of the Green IT Strategy project. He has been working for two years with this organization to develop the Green IT Strategy. He is working for leading Green IT focused consulting company which is based out of California, USA and which is a pioneer in this field since 2002. He has been working on Green IT Projects since Jan 2009. The IT manager has been working for this organization for ten years, two of which are as an IT manager. She reports to the management board.

Organization C:

Organization Description:

Organization C is one of the first departments of Dubai government since 1954. They provide services to the Dubai citizens as well as the businesses. Its IT department consists of 5 sectors information security system, infrastructure section, application section, support section and e-transformation section which is responsible for putting IT strategies. IT is providing the public with more than 400 e-services. They have one of the biggest IT infrastructures in Dubai government. It consists of 5 datacenters and about 300 servers. They have about 180 employees between main, outsourced employees and managers.

Person Interviewed:

The interviewee is the head of platform service unit. The Platform service unit plays a vital role in the IT department because it is used to manage the operation of IT department. He has been in this organization for 5 years, and he is considered in the mid-management reporting to the head of IT infrastructure section.

Full transcript of the interviews is in Appendix (D).

Chapter 6 Data Analysis:

6.1 Introduction:

This chapter discusses and analyses the data collected from the conducted case studies. It will summarize the collected data in a way that address the research questions and fulfils the research objectives.

Since the research approach applied is qualitative, the qualitative data analysis will be used. First step is to classify the data into categories based on similarities or differences. This will help to organize and analyses the data. Categories will be identified depending on the research objectives and questions. Then the analysis will be initiated by searching for key patterns of relationships within and between the categories. Moreover, the collected data will be reorganized according to these categories in a matrix or table.

According to the research questions and objectives and the data collected from the conducted case studies, the identified categories are the following:

- Awareness of Sustainable IT.
- Main drivers for adopting sustainable IT.
- Main practices and metrics for Sustainable IT.
- Requirements for effective sustainable IT practices.

Rearranging the collected data according to these categories in tabulated form will help in comparing the organizations and finding the relation between and within these categories.

6.2 Interviews' details:

The Interview with representative from organization A was responsive but his responses avoided the real questions. Interview with organization B was not so

friendly and it was clear to me that the green IT consultant was trying to show that they have perfect sustainable IT implementation without faults especially in front of the IT manager. The IT manager was also doing the same. She was working around some questions rather than directly answering them. Interview with organization C was friendly and the interviewee was direct and clear in his answers.

All of the organizations are governmental organizations which do not have competitors that provide same services. Organization A and C have a huge IT department compared to organization B. From here on, organization means IT management or IT department. If organization and IT come in the same sentence, each word refers to its respective meaning.

Category a. the extent to which sustainable IT is recognized, formalized and accepted.

From the discussions, it was clear that only organization B has defined sustainable IT correctly, while others defined it as Green IT. Anyway, all of them did not express it correctly in their strategy. It is more about the environmental dimension for organization B as they stated "sustainable environment for sustainable future". For organization A, it is more about the economical dimension, since they stated "The corporate strategy of our organization clearly identified the finance sustainability and assets sustainability in its strategic directions". Organization C did not include sustainability in its strategy as they declared "Actually we do not have a corporate strategy or IT strategy that clearly declares sustainability". It is clear that all of them did not mention the three dimensions of sustainability in their strategy.

Apart from their strategy and by focusing only on the definitions that they gave, all of them agreed on the environmental and the economical aspects, but only organization B added the social responsibility of IT. Even Organization B has defined sustainable IT correctly, it could not identify the social responsibility of the IT clearly.

Regarding the GRI indicators and publishing the sustainability reports, only organization B is publishing its sustainability report, others still did not hear about GRI reports. Organization B is the only one which has a sustainability department and a clear sustainable IT strategy. All of them do not know the Global e-sustainability initiatives (GeSI). Table 6.1 will summarize their answers.

Organization	What does sustainability means to your organization?
Organization A	Saving the environment by reducing the IT activities impact, and the cost saving results from saving the environment. Green IT is same as sustainable IT
Organization B	Sustainable IT covers environment, economical and social aspects, whereas Green IT focuses on environment and economical aspects only.
Organization C	Green IT is same as Sustainable IT

Table 6.1 Sustainable IT definition (Category a).

Category b. Main drivers for adopting sustainable IT.

All organizations have agreed on the following drivers: cost saving, reducing operation cost, energy efficiencies, company reputation and image and mimic competitors (competitors for governmental awards). Organization C has one more different driver; the limited power access which drives it to reduce its power consumption. These drivers are more about economical dimension.

Regarding the environmental drivers, organization A and B have mentioned the environment as driver. From the discussion, organization A mentioned that "The corporate strategy of our organization clearly identified the finance sustainability and assets sustainability in its strategic directions" which means sustainable finance and sustainable assets are part of its strategy and not the environment. As the researcher, I think that the main driver of organization A is the economic aspect only and this what I could understand from its strategy. Its strategy clearly declared the sustainable finance and sustainable assets but not the environment. It is also declared that there is

pressure from the government to reduce their operation costs. In addition, organization A measures the cost saving of most of the initiatives but they do not measure their CO2 emissions or the percentage of the recycled papers which also proves that their concern is the economical aspect only and not the environment. In contrary, organization B's mission clearly states "sustainable environment for sustainable future". Environment is a main driver for organization B and it is a core business for it as they stated "environment is our core business". While as organization C, even it implements some green initiatives but it clearly declares that environment is not a driver for them. In organization C, following the international standards is driver for them and not the environment as they stated "we adopt Green IT because it is a condition of international standards and not because of the environment". Using environmental measures by organization B only shows that environment is driver for organization B only. Table 6.2 will show that only organization B is using the environmental metrics.

Regarding the social aspect, it has less force on the organizations to adopt sustainability. They claimed that company reputation and company image are drivers for them, but what the organizations meant is their reputation and image from the government's perspective and not the society because they linked company reputation and image with the governmental awards. All of them agreed that public audience does not have any influence on them.

Organization A stated "Enhancing our image is strategic objective and a main driver for sustainability since we compete with other governmental organization for governmental awards", and organization B stated "Our reputation and image is important since we are custodians of sustainability. Last year we got Shaikh Khalifa excellence award as best government department. What we are doing is looked by other governmental departments seriously". Whereas organization C stated "Company reputation and Image drives us to be green, since being certified for Green IT or Green datacenter will give us more credits in the government."

Regarding the regulations as drivers, only organization B has declared that UAE is part of the Basel convention. This makes them more responsible about their e-waste. According to the Waste management Center (WMC) in Abu Dhabi, there is no regulation regarding the e-waste in UAE.

The most important driver is that the three organizations should follow the strategic directions of different governmental sector, which is responsible for setting the IT strategy for the whole governmental sectors. E-government department is responsible for the IT strategy for the whole Dubai government. Organization C stated "now the new e-government center, which consists a centralized IT management, will direct all government sectors to be green. It is new center that put the IT strategies for all government sectors and they have to adopt it". Abu Dhabi Systems and Information Centre (ADSIC) is also responsible for putting the IT strategy to the whole Abu Dhabi government. Organization B stated "security policy developed by ADSIC because they are assessing us as an IT. They are putting directions for the whole Abu Dhabi and we have to follow it".

Table 6.2 summarizes the drivers as per the interviews.

Dimensions	Drivers	Organization A	Organization B	Organization C
Environmental	Climate change	X	X	
	Global warming	X	X	
	GHG emissions	X	X	
	E-waste	X	X	
	natural resources used	X	X	
Economical	Power access			X
	Profit			
	Cost saving	X	X	X
	Operation cost	X	X	X
Social	Company reputation	X	X	X
	Company Image	X	X	X

Environmental / Economical	Energy efficiencies	X	X	X
Economical / Social	Business ethics			X
	International standards			X
	Talent Acquisition and Retention			
Environmental / Economical / Social	Regulations		X	
	Public groups pressure			
	Attract investors			
	Mimics competitors	X		X
	Customer interest			

Table 6.2 Drivers for sustainable IT (Category b).

Category C. Main practices and metrics on sustainable IT.

For the three organizations, it was clear that they easily mentioned the practices that are related to the economical and environmental aspects, but they could not identify any social practice for IT. In general, they are doing well regarding the economy and environment and most of the practices are covered in the environmental and economical aspects. They are doing some social practices but they agreed that most of these practices are the responsibility of the human resources department and IT is part of the former.

Organization A and B are switching off idle PCs, whereas Organization C did not adopt the same practices. Organization A has calculated the cost saving from adopting this practice as they told this practice save 4500 AED monthly, while organization B and C do not measure their cost saving. Organization A is replacing its PCs with thin clients and laptops according to the nature of the position and nature of the work, and it has clear process for PCs' end-of-life. Organization B has changed all to laptops to save power. Organization C is using thin clients and laptops to save power. No organization is calculating the reduction in CO2 emissions resulting from adopting this practice, but they do calculate the percentages of the recycled PCs.

For datacenters, all of them have adopted the green datacenter design. Organization B measures its datacenter emissions and the achieved reduction, whereas Organization A and C do not measure their datacenter CO2 emissions. Moreover, organization C does not measure their datacenter power consumption. Organization C clearly declared that they make the green design just to follow the international datacenter standard and not for the environment as they stated "We do not measure our CO2 and GHGs emissions. We do calculate the in and out cash flow for the datacenter". All of them calculate cost savings.

None of the organizations use cloud computing from a private company provider. As organizations declared, that cloud computing is still not mature and its security and privacy are main concerns for them in adopting it. Anyway, Dubai government is centralizing the HR, finance and procurement for all government departments. It is putting them in one system under the control of the office of governor. This can be considered as cloud computing, that all government sectors take these services from the governor's office and they are not responsible for datacenter maintenance or system upgrade. Organization A stated "Government Resource Planning (GRP) which centralizes HR, finance and procurement for all governments sectors is under Dubai government". Organization A and B are included in this initiatives, but organization C is not since it is from Abu Dhabi.

Organizations A, B and C all provide sufficient number of e-services which save a lot of time, reduce traffic congestion and paper consumption. What is clear is that implementing e-services is to improve the e-government not for the sustainability purpose, because the only measurement used is the number of the e-services. They know the benefits of implementing the e-services but they are not measuring the positive impact of these e-services to the environment, economy or the society. Anyway, although implementing the e-services was not for the environmental purpose, it has a good impact on the society like reducing the traffic congestion and saving time. This is also considered as part of sustainability, which they do not realize.

All of the three organizations have initiatives to reduce the paper consumption, but again only organizations B and C are measuring their paper consumption per employee and only organization B measures its recycled papers and paper usage reduction. Organizations A and B use double side printing and organizations B and C are using recycled paper. Only Organization B is measuring the percentage of the recycled papers. All of them are not using papers in their internal communication, and they are using systems to automate the internal process. In addition they provide sufficient number of e-services which also reduce used papers.

Regarding the telecommunications technology, Organizations A and B are using video conferencing. They have some applications that are accessible remotely but employees are not allowed to work from home instead of coming to office. In Organization C some employees can work from home and they do not have to come to office. Moreover only organization B is measuring the CO2 emissions reduction and organizations A and B are calculating the cost saving from this initiative. This also supports the point that Organization A focuses on the economical dimension more than the environmental one. As organization A stated "video conferencing saves 1,285,900 AED yearly for one agency" and organization B stated "approximate save about 150 tons of C02 from reduced air travel, and cost savings of about 734,000 AED".

Organization B is developing the Environmentally Preferable Procurement (EPP) and they are looking for hardware which is environmentally friendly. They are using hardware with EPEAT standard. Organization A has a green procurement policy, whereas Organization C is not looking for the environmentally friendly product. It is just looking for the best products in the market, which are environmentally friendly as they have stated "we are looking for the best in the market which is usually an environment friendly product". No organization is checking its suppliers if they adopt sustainability or not and Organization B commented "market is not mature enough and not ready for sustainability". All of them have defined process for PCs' end-of-

life, and they all measure the percentage of reused, refurbished or recycled PCs as table 6.4 is showing.

Socially, all of them have initiated many campaigns for the environment. IT was part of these campaigns. These campaigns will help in creating awareness in the society. Organization A has initiated many campaigns targeting the public including private companies and schools. Organization B has initiated the paperless day campaigns at UAE level and other small campaigns in malls. Organization C has initiated campaigns to encourage people to collect printer cartages and other campaigns that cover even the schools. It also ran a "day without cars" initiative.

Regarding the training, no organization is doing training regarding the environment such as Green IT training, but they offer some workshops. All of them are doing well regarding the professional training to the IT staff. They conduct professional courses. Special budget is reserved for training according to the coming projects. Information about the people who got or will get training can be obtained from HR. They also conduct general workshops, for environment, Green IT, security. For security and privacy performance, organization A and C are ISO 27001 certified and organization B stated "the plan to be certified by the end of 2011". All of them are adopting ISO 27001 to enhance their image and reputation of the government and because they are competing for governmental awards not for sustainability, they even do not think that privacy and security is a social responsibility for the IT. Organization A stated "Our good performance in Green IT, privacy and security is reason to get this award". Organization B stated "the security policy developed by ADSIC because they are assessing us as an IT" while as organization C did not mention reason to be ISO 27001 certified, but any way they did not mention security as part of IT social responsibility.

They gained the knowledge about sustainable IT from different resources, but there is no training. Organization A uses the internet and other companies' practices as source for sustainable IT. Organization B has a green IT consultant who already has

experience from his mother company. Organization C considers both the best practices for the big companies as well as the international standards main sources for sustainable IT.

The three organizations have dedicated environment departments; they told that these departments do not help IT in their work. IT is responsible for its initiatives. These departments are giving general initiatives to the whole organization. Organization B is the only one that has sustainability department which is also not giving initiatives to IT as they stated "We have a sustainability team in our organization and we are working directly with them. They do not have to come to us because we are aware of what sustainable IT is and we are doing our job in the right direction". Organization A and B have health and safety department which is working with IT, and train them to enhance the safety. These departments are targeting the whole company and not only the IT. Only organization C has declared that there are safety standards in IT, from Uptime institute, and they have to implement them to be certified form this institute.

For the social metrics, all of them have adopted some social metrics. The issue is that these metrics are used by human resources department. Interviewees do not know the values of these metrics, such as turnover and absenteeism, for their departments. They tried to estimate the values, but they ensure that the correct values are with the human resources department. Table 6.4 summarizes the metrics that is used by the three organizations.

In Organization A, IT is working with other departments to provide solutions that enhance their performance such as the e-services and video conferencing. On the other hand, Citrix technology is provided to other departments in organization C to help them work remotely as well as the e-services. Organization B also provides some solutions to other departments such as e-services and GIS application. All these activities help other departments have better environmental impact, but these activities are not coming under sustainable IT strategy, or for environmental purpose.

It is more about improving the provided services and increasing the customer satisfaction. It is coming under the economical or social purposes not the environmental one. In addition no environmental metric is used to measure these practices except for organization B which measures the environmental impact of some practices as shown in Table 6.4.

To reduce corruption in IT in organization A, there are segregation of duties, clear identification of responsibilities, IT auditing and system that controls the operation and monitors all financial transactions. The same is for organization C, whereas organization B considers corruption as finance issues rather than IT as they commented "For the anti-corruption, it is about finance more than the IT". Organization C does not consider IT audit as anti-corruption practice, because IT audit can identify the corrupted projects when budget is already gone. They also consider reporting a tool which helps to cross-check the system and reduce the corruption.

All of the organizations have a percentage of disabled people. It is a governmental direction. Organization A is also providing services especially for disabled people. All of the organizations give training to its staff. In addition, organization B is sponsoring its staff to pursue their education and organization C is giving scholarships.

Since all the companies are governmental organizations, all of them adopt local-hire. There is no discrimination in hiring, since they have female employees as well as male employees. They also adhere to the laws of the Ministry of Labor. Their working day is 7 hours and they offer good salaries. They also have many social activities for the whole organization. All these enhance the work-life balance. They also have social activities for their staff and reward systems. Organization B and C also have a schedule for meeting with management which organization calls a communication plan. Organization A and B accept students as summer employees to train them as part of their social responsibility. Organization A is doing one more

good initiative which is it enforces its suppliers to hire fresh graduates. Most of their suppliers are international suppliers who have local agencies in the UAE.

In general, they could not define any social practices. I had to mention the practices which I found in the literature and they confirmed if they adopt these practices or not.

As for Organization A, it does not have any difficulties in implementing their initiatives. From their strategy "sustainable finance and sustainable assets", I think they have a financing problem as they also stated in the interview "it is only the government pressure to cut our cost, maximize utilization and reduce our budget". Organization C, which is also part of Dubai government, has clearly declared the financing problem after the recession. It added to it that some technologies are still not availabe in the Middle East. Organization B has no difficulties in their implementation. It has good budget, management support, sustainability strategy and its employees are aware of sustainability. Depending on the literature, it can be said that Organization B has the ideal environment for sustainable IT implementation. Actually organization A and C have more serious difficulties than the budgeting. They do not have a corporate sustainability strategy or sustainable IT strategy. Organization C stated that "actually we do not have IT strategy that clearly declares sustainability. It is only initiatives on the operation level" same organization A has focused on the economical sustainability only. In addition, their IT should raise the management's attention toward sustainable IT and its benefits to the whole organization to have more support. Table 6.3 will summarize the practices of the interviewed organizations.

Practices	Organization A	Organization B	Organization C
Change the users' usage pattern [N6,EN18]	X	X	
Change to efficient machines [EN6,EN18]	X	X	X
Optimize the datacenter design and cooling [EN6,EN18]	X	X	X

Virtualization [EN6,EN18]	X	X	X
Energy, workload and thermal management [EN6,EN18]		X	X
Cloud computing [EN6,EN18]	X		
Telecommunications [EN7,EN18]	X	X	X
Online business (e-commerce / e-services) [EN7,EN18]	X	X	X
Supply Chain Sustainability			
Choose product with minimal hazardous waste	X	X	
Reuse, Refurnish, Recycle [EN22]	X	X	X
Paperless	X	X	X
Renewable Energy [EN6,EN18]			
Provide solutions [EN6,EN7,EN18]	X	X	X
Training, education costs [EN30]			
Financial implications and risk [EC2]			
Local-hiring [EC7]	X	X	X
Local-suppliers [EC6]	X	X	X
Training, education costs [EC1]	X	X	X
Environmental management	X	X	X
Anti-corruption training [SO3]			
Enhance Working conditions	X	X	
Non-discrimination hiring	X	X	X
Telecommunications	X	X	X
Online business (e-commerce, e-services)	X	X	X
privacy and security	X	X	X
increase Health and safety		X	X
enable work-life balance	X	X	X
reduce bribery and corruption	X		X
Training, education		X	X

Table 6.3 Sustainable IT practices (Category C).

Table 6.4 will summarize the metrics used by interviewed organizations.

Metrics	Organization A	Organization B	Organization C
Environmental protection cost [EN30]			
Investment [EN30]			
Energy consumption [EN4,EN5]	X	X	
Green energy consumption			

CO2 and GHG emissions [EN16,EN17]		X	
Waste , % of hazardous waste [EN22]		X	
Reused and recycled waste [EN22]	X	X	X
Paper consumption		X	X
Recycled paper [EN22]		X	
Fines for non-compliance [EN28]			
No of suppliers audited			
Cash flow [EC1]	X	X	X
Personnel cost [EC1]	X	X	
Personnel salaries [EC5]	X	X	X
No of employees	X	X	X
No of staff in training [SO3]	X	X	X
% of employees in education		X	X
% of turnover and absenteeism	X	X	X
% of female/male employees in ex-positions	X	X	X
Years of service in the company	X	X	X
Personnel costs	X	X	X
% of disabled employees	X	X	X
Fines for non-compliance [SO8]			

Table 6.4 Sustainable IT metrics (Category C).

Category D. requirements for effective sustainable IT practices.

All of them agreed on the management support for successful implementation, organization A and C has environment department, whereas organization B has a sustainability department. Organization A has sustainability mentioned in its corporate strategy, while organization B has clear sustainable IT strategy aligned with corporate strategy as they stated “we rolled out green IT strategy”, but organization C does not have sustainability in its corporate strategy neither in its IT strategy. Organization B has obtained financing from the management and the management has adopted some practices on the personal level to show their support to sustainability as they stated “we have a good budgeting behind us” and “our Secretary-General Office had three printers last year and now he has zero printers in his office. He is a good model in the organization”.

Organization A claimed that if sustainability issues are not defined clearly, they cannot be measured and managed as they stated “If you cannot define it, you cannot measure it, and so you cannot manage it”. Organization B also agreed that sustainability issues should be clear. Organization C does not address the sustainability issues and they only implemented the standards’ requirements as they stated “We identify the sustainability issues from the international standards and best practices”. Organization A divides its infrastructure into categories and then applies the best practices for each category. It does not know the GRI indicators. Organization B is doing the same, but the difference is that they use GRI indicators and they include its achievement in the GRI reports. All of them are not aware of the GeSI.

All of them agreed that changing the culture is required for implementation, and all of them have adopted different type of practices to change the culture. All of them provide training, but no organization is providing incentives to employees to participate in sustainability. Organization A has conducted workshops, sent emails and printed broachers. Organization B has also conducted introductory session about Green IT and its benefits. It targeted the whole organization including the management. Organization C also has conducted some sessions such as security session. As per organization A, these practices will show that organization is serious about sustainability and it will enhance its image. For organization B, introducing Green IT will help getting management support as they stated “All our staff, management and CEO pledged to comply”. Only organization B has realized that sustainability is not an added work and it should be part of how they are doing their work. It clearly declared that sustainability must be integrated into the rhythm of the business as they stated “it should be integrated to day-to-day activities”. This level of awareness is present because environment is core business for them as they stated “The difference between us and others that environment is our core business is not just an aspect to take care of it”. This level of awareness and culture change cannot be seen in organization A and C.

Regarding the Green IT training, they agreed that there is no need to such training. Organization A declared that IT should implement initiatives which are aligned with the strategic directions otherwise it will not be noticed by the management. It can select these initiatives from the best practices. Organization C is also applying its initiatives according to the best practices, but they are not practiced well as they stated “My staff are aware of green IT but they do not practice it”. Only organization B has a Green IT consultant.

Although all of them agreed on the importance of communicating the achievement, only organization B is reporting periodically. Organization A is communicating only internally to the management as per request, whereas organization B is communicating to the whole organization. Organization B is communicating to the whole staff this will encourage the staff to change their behavior to be more green. Organization C is reporting the achievement to the management as per their request. Externally organization A is communicating IT’s achievement as part of the organization achievements. They are sharing their achievements in conferences, magazines and governmental awards. Organization B is communicating to the public through various ways such as conferences. Since it considers itself as a model for sustainability, so it needs to communicate its achievements as they stated “We have to be model for others”.

For organization A, communicating the results will make management more supportive to green IT and it will show the organization commitment to the government. Organization C has also agreed that communicating the results will help in getting management support. For Organization B, sharing the achievements will help promote sustainability which is part of their strategy. Organization B considers itself as the model for sustainability for all the governmental entities. It claims that other governmental sectors can learn from them, since they know the pros and cons of the implementation.

Table 6.5 will summarize the required issues for successful implementation as it is answered by organizations not as they actually have implemented.

Requirements for implementation	Organization A	Organization B	Organization C
Alignment between sustainable IT and corporate strategies	X	X	
Management support	X	X	X
Clear sustainability issues	X	X	
Culture changed	X	X	X
Sustainable IT training			
Reporting	X	X	

Table 6.5 Sustainable IT requirements (Category E).

Chapter 7 Conclusion and recommendations:

This chapter will summarize the research results and the applicable recommendations. It will also present the research conclusion and suggest future related work.

7.1 Results:

After discussing the three case studies, it is important to present the results according to the research objectives and the data collected.

To evaluate the organizations awareness regarding sustainable IT.

Only one organization out of three has a clear idea about sustainable IT. This organization has a sustainability department and sustainable IT strategy. It is also the only organization which knows and uses GRI indicators, but still none of the organizations are aware of the GeSI. It has a specialized employee dedicated only for sustainable IT initiatives, whereas others use internet and best practices for other organizations to initiate some practices. Regarding the social aspect, none of them could clearly define the social responsibility of IT. Anyway, all the organizations have environmental departments and one organization has sustainability department. This may reflect that their management is aware of the importance of the environment and sustainability. However, IT performance in these areas is still poor. This may indicate that they do not realize the impact of the IT and the important solutions that it offers, the concerned departments are not doing their job in a proper way, or they still lack the experience.

Investigate the drivers for sustainable IT in UAE.

Economic drivers, competition on the governmental awards and the governmental strategic directions are the main drivers for all of them. Most of the metrics used are economic metrics and very few environmental and social metrics are used. This shows that they concentrate more on the economic aspect whereas environmental and

social have less impact on adopting sustainable IT. Having no competitors for the interviewed organizations in their business field have made them less conscious about the environmental and social concerns. Moreover, current environmental regulations are not enough to force companies to adopt sustainability. Low public awareness about sustainability has also made organizations careless regarding sustainability and especially their social responsibility.

Identify best practices and new technologies for sustainable IT.

Since the drivers are the economic drivers, most of the practices are economic practices. Even some practices have economic and environmental benefits, I consider them as economic practices since economic metrics and not the environmental metrics are used. Regarding the social practices is more about HR responsibility toward the whole organization and IT is part of it. No organization could identify the social responsibility of the IT even though they engage in some practices such as security and privacy. In general, their IT social responsibility and their knowledge about how IT could improve the society are weak. They do not realize how IT could help to reduce corruption. They tried to respond to the questions about the social responsibility of IT but failed to address the real issues.

Organization A and C have implemented random initiatives. For instance, in using papers, organization A is printing double side but not using recycled papers, whereas organization C is using recycled papers but not using double side printing. The same applies for other initiatives which are also selected randomly. This is because there is no clear strategy, experience or knowledge in sustainable IT. No use of environmental measures also proves the lack of experience in sustainability. According to the literature, these two organizations still did not reach the proper method of Green IT implementation since many of environmental aspects are still missing in their practices and metrics used.

Investigate how a sustainable IT strategy can be incorporated into a corporate strategy.

It was clear that the organization that has a sustainability department, a person who is responsible for implementing sustainable IT (Green IT consultant) and a sustainability strategy has a better performance and implementation than others. Having management support and cultural change are essentials for successful implementation. A Good budget also helps in implementing latest technology. These all have made Organization B better than the others.

7.2 Conclusion:

This research shows clearly that there is lack of awareness regarding sustainability and its dimensions among public and organizations in UAE. It showed that only few organizations have adopted this concept - the governmental organizations. Even that these organizations still did not impalement sustainable IT in a proper way, or they just select the dimensions which enhances their image to the government or support their economic situation. Actually, creating the awareness about the importance of the sustainability and its three dimensions is very important. An organization that does not realize the importance of sustainability to its triple-bottom line will not have a proper implementation even if regulations have been imposed.

In addition to the lack of awareness, there are many obstacles for companies to become sustainable such as: lack of renewable energy, lack of cloud computing in this region, lack of consultancy companies, lack of experience, lack of sustainability culture and absence of regulations.

The research shows that even the organizations have environmental and sustainability departments but their IT performance is still weak. This requires that IT should raise management's awareness about the benefits of sustainable IT and how it can contribute to enhance organization sustainability performance. It also shows that

organizations without strategy, department and an employee specialized for sustainability has lower performance than the ones which do.

Practices that have been implemented by the interviewed organizations and the metrics used by them showed that they tried to mimic others' practices. They could not identify their sustainability issues clearly, in particular the social responsibility of IT. This makes it obvious that the UAE market needs consultancy organizations that help other companies have proper methods of sustainability implementation.

The research shows that economic dimension benefits from the environmental dimensions which will make investment in environmental attractive for organizations even in the current downturn. This should be promoted with the sustainability concept. It will encourage organizations to adopt sustainability even if regulations are lacking.

7.3 Recommendation:

In the UAE level: it took long time to find companies that have sustainable IT to conduct an interview with them. Actually this reflects lack of awareness about sustainable IT and even sustainability in some organizations. It was also evident that social drivers have low impact on organizations which adopt sustainability. The government should raise awareness among the organizations and the public audience about sustainability and its benefits for all. The government should also build this culture in schools to build a new generation who realize the importance of sustainability. In addition, some areas need to be regulated such as the e-waste and CO2 emissions. Regulations and standards will help organizations be more environmentally responsible. Organizations that collect and recycle e-waste and provide sustainability consultancy should be available in UAE before publishing such regulations. The government should also initiate projects to creating renewable and clean energy sources. Abu Dhabi, represented by MASDAR, is working to explore, develop and commercialize such future energy sources.

Governmental organizations should be models for sustainability to private organizations, and their achievements should be communicated to other private organizations. Moreover, giving government rewards regarding sustainability will encourage organizations to enhance their performance in sustainability.

For organization A: the corporate strategy should focus more on the environmental sustainability. Sustainable IT strategy should be present and aligned with the corporate strategy. Clear environmental objectives should be there. They should measure and create their baseline. They should measure their environmental performance after each implemented initiative to know the achievement. It should periodically communicate the results to management and the whole staff. This will help in getting their support. Communicating the achievement to the whole staff will also help in changing the culture and having smoother implementation. Developing a business case before implementing any initiative will also help in getting the management support and raise their awareness about the benefits of sustainable IT.

IT departments should start using GRI and GeSI to help address their sustainability issues especially the social issues. Having a sustainability department or a sustainability officer, as a start, will help in running and implementing the initiatives.

For organization B: In General, organization B is doing well environmentally and economically. It should use the GeSI to address the social responsibility of IT. Organization B has a good budget to adopt sustainability. It should, as a model for sustainability in Abu Dhabi, show the cash invested for sustainability and the savings from this investment. It should show that the ROI is high. Otherwise there is no attraction for other organizations to invest in environment with small ROI, since there main business is not related to the environment and there is no regulation to force them to go sustainable. For example, they replaced all PCs with laptops. This practice will reduce the power consumption, but it will increase the total cost of ownership (TCO). In this way organizations will not be attracted to adopt sustainability.

For organization C: It should raise the awareness about the importance of sustainability and its benefits to organization then its corporate and IT strategies should focus more on sustainability. It should measure the achievement from the current practices and results should be communicated to the management and the staff. This will create awareness in the management about sustainable IT and help in getting their support. Developing a business case before implementing any initiatives will also help in getting the management support. Actually organization C is still at the early stages, they need to build a culture of sustainability, develop a strategy, and create awareness among the whole staff.

IT should identify their sustainability issues clearly using GRI and GeSI or best practices of other organization. IT should also communicate its results to its staff. This will help in changing the culture and having a smoother implementation. Also having a sustainability department or a sustainability officer, as a start, will help in running and implementing the initiatives.

7.4 Research limitations:

This research faced some limitations. The main limitation is the lack of previous research in the same subject in the UAE. Very few companies have some initiatives regarding sustainability and that is why this dissertation is based on only three case studies. This limitation does not give a clear picture of sustainability in UAE. Moreover companies did not consent to share their documents that show their results and savings after adopting these initiatives. This raises some question about the organizations credibility and whether the interviewee is describing the actual situation in his organization.

7.5 Future research:

This research was the first research to investigate sustainable IT in UAE. It shows that creating the awareness about sustainability and its benefits is the main need for the foreseeing future. I suggest that future research could concentrate on companies that do not have sustainable IT and develop case studies on how sustainability practices will bring benefits to these companies. This means creating business cases for some organizations. For example:

- Conduct a study on the datacenter of some organizations and show the benefits of having the Green datacenter economically and environmentally.
- Develop a business case for going paperless for some organizations and the benefits of such initiatives.
- Identify the social responsibility of IT that can be applied in UAE.

Appendix (A)

Potential environmental contaminants arising from E-waste disposal or recycling (Robinson, 2009):

Contaminant	Relationship with E-waste	Typical E-waste concentration (mg/kg)	Annual global emission in E-waste (tons)
Polybrominated diphenyl ethers (PBDEs) polybrominated biphenyls (PBBs) tetrabromobisphenol-A (TBBPA)	Flame retardants		
Polychlorinated biphenyls (PCB)	Condensers, transformers	14	280
Chlorofluorocarbon (CFC)	Cooling units, insulation foam		
Polycyclic aromatic hydrocarbons (PAHs)	Product of combustion		
Polyhalogenated aromatic hydrocarbons (PHAHs)	Product of low-temperature combustion		
Polychlronated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs)	Product of low-temperature combustion of PVCs and other plastics		
Americium (Am)	Smoke detectors		
Antimony	Flame retardants, plastics (Ernst et al., (2003))	1700	34,000
Arsenic (As)	Doping material for Si		
Barium (Ba)	Getters in cathode ray tubes (CRTs)		
Beryllium (Be)	Silicon-controlled rectifiers		
Cadmium (Cd)	Batteries, toners, plastics	180	3600
Chromium (Cr)	Data tapes and floppy disks	9900	198,000
Copper (Cu)	Wiring	41,000	820,000
Gallium (Ga)	Semiconductors		
Indium (In)	LCD displays		
Lead (Pb)	Solder (Kang and Schoenung, (2005)), CRTs, batteries	2900	58,000
Lithium (Li)	Batteries		
Mercury (Hg)	Fluorescent lamps, batteries, switches	0.68	13.6
Nickel (Ni)	Batteries	10,300	206,000
Selenium (Se)	Rectifiers		
Silver (Ag)	Wiring, switches		
Tin (Sn)	Solder (Kang and Schoenung, (2005)), LCD screens	2400	48,000
Zinc (Zn)		5100	102,000
Rare earth elements	CRT screens		

Appendix (B)

Environmental conventions and protocols on international and regional levels:

At International Level

Date of Ratification/ Accession by UAE	Convention/Protocol
1989	Vienna Convention for the Protection of the Ozone Layer of 1985 and Montreal Protocol on Substances that Deplete the Ozone Layer of 1987.
1990	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973.
1990	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their disposal, 1989.
1995	United Nations Framework Convention on Climate Change for the year 1992.
1998	United Nations Convention to Combat Desertification for the year 1994.
1999	Convention on Biological Diversity for the year 1992.
2002	Convention on Persistent Organic Pollutants (POPS), 2001.
2002	Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (PIC Convention), 1998.
2005	Montreal Amendments (London 1990, Copenhagen 1992, Montreal 1997, Beijing 1999).
2005	Koyoto Protocol, 1997.
2007	Ramsar Convention

At Regional Level

Date of Ratification/ Accession by UAE	Convention/Protocol
1979	Kuwait Regional Convention for cooperation on the protection of the marine environment from pollution, 1978.
1990	Protocol concerning Marine Pollution resulting from Exploration and Exploitation of the Continental Shelf, 1989.
2003	Convention on Conservation of Wildlife and its Natural Habitats in the GCC countries.
2005	Protocol on the Control of Marine Transboundary Movements and Disposal of Hazardous Wastes and Other Wastes, 1998.

Appendix (C)

Regulations and standards:

The European standards are focused on e-waste and control of hazardous material, and US standards are more related to energy efficiency (Harmon and Auseklis, 2009). These standards and regulations can help to design green IT hardware and classify them based on their environmental impact (Murugesan, 2008).

WEEE: The European Waste Electrical and Electronic Equipment Directive became law in 2003. It imposes the responsibility of the electronic waste to the manufacturers and producers must take back the equipment as free of charge (Hanselman and Pegah, 2007). WEEE puts the responsibility for the disposal of e-waste with the producers, importers, and retailers of EEE goods (Krikke, 2008). They have to take back their end-of-life products and refurbish them or dispose them in an environmental friendly manner (Krikke, 2008). The purpose of this directive is to reduce the e-waste and encourage the manufacturers to design environment friendly product in its full life cycle. Producers should join the compliance scheme and register in every EU country. Violations are actionable and prosecutable (Hanselman and Pegah, 2007). As per Krikke (2008) companies should register in the waste disposal program and tack their products to pay for their disposal. WEEE is most likely to be a worldwide legislation, China has adopted it and India is most likely to do the same (Krikke, 2008). Murugesan (2008) said that WEEE aim is to increase the recovery and recycling rate and decrease the amount of e-waste going to landfills. The WEEE regulations deal with the following major areas firstly, separate collection, disposal, and recycling. Secondly, standards for e-waste treatment at authorized facilities; and thirdly collection, recycling, and recovery targets. Electrical and electronic manufacturers can also apply WEEE regulations (Murugesan, 2008).

RoHS: This is directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS). It restricts using of six hazardous

materials in electronics (lead, mercury, cadmium, exavalent chromium, polybrominated biphenyls, and polybrominated diphenyl ethers). It is closely linked with the WEEE directive. It also bans placing electronic products in the EU market if it contains more than the agreed level of these materials (Murugesan, 2008). RoHS is a directive in EU and it is becoming more popular in Asia such as China RoHS (BSR, 2008).

EPEAT: The Green Electronics Council created the Electronic Product Environmental Assessment Tool (EPEAT). It enables buyers to evaluate, compare, and select desktop computers, notebooks, and monitors on 23 required and 34 optional environmental criteria. EPEAT categories products into bronze products which meet the required criteria, silver products which meet the required and at least 14 of the additional criteria, and last one are the gold products which meet the required and at least 21 of the additional criteria (Harmon and Auseklis 2009). As per Murugesan (2008), EPEAT Allows the selection of electronic products based on their environmental performance, and helps the manufacturers promote their products as environmentally sound. It evaluates the electronic products on 23 required criteria and 28 optional criteria, which are group to eight performance categories: reducing and eliminating environmentally sensitive materials, selecting materials, designing for the product's end of life product longevity, energy conservation, end-of-life management, corporate performance, and packaging.

Energy Star 4.0 Standard: Desktops, notebooks, and workstations manufactured after July 20, 2007 that bear the Energy Star label meet the more stringent 4.0 requirements (www.energystar.gov). The standard regulates energy performance for external and internal power supplies in all modes which are idle, sleep, and standby. Computers meeting the standard save power in all modes of operation (Murugesan, 2008). Regulations for computer in idle mode are new and these new specifications require the OEMs (original equipment manufacturer) to educate user about the power management (Murugesan, 2008).

ISO 14001 is part of the ISO 14000 family of environmental management standards to help organizations minimize how their operations affect the environment. ISO 14000 is about how a product is produced rather than a product itself. ISO 14001 is generic and can be applied to any organization producing any product or providing any service anywhere in the world. It also covers specific environmental aspects, including labeling, performance evaluation, lifecycle analysis, communication, and auditing (Krikke, 2008).

Kyoto Protocol: is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC). It is an international treaty that obliges 37 industrialized countries and European community to reduce greenhouse gas emissions. It is adopted in Japan on 11 Dec 1997 and entered into force on 16 Feb 2005. These countries have agreed to reduce their emission by 5% from the 1990 level. UNFCCC encourage these countries to stabilize their emissions, whereas the protocol commits them to do so. It offers them three mechanisms that help them meet their GHG emissions reduction commitment: Emissions trading, Clean development mechanism (CDM) and Joint implementation (JI).

Basel Convention: it is a UN treaty signed in Basel, Switzerland on 22 march 1989 and went active on 5 may 1992. It is is Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. It is international treaty to protect the human health and environment against the generation, movement and disposal of hazardous waste. It designed to prevent the hazardous waste movement from developed countries to less developed countries, minimize the hazardous e-waste generation and ensure environmentally disposal of these e-waste. 173 countries has signed the treaty but still come countries that did not obliged to it, such as United states of America.

Global e-Sustainability Initiative (GeSI): was born in 2001 to further sustainable development in ICT sector. In June 2008, GeSI became an international non-profit association with an office in Brussels, Belgium. It s main objectives are to improve

sustainability performance of its members and promote to technologies that foster sustainable development. In addition, it aims to involve ICT in the socio-economic development and apply these technologies in rich and poor countries to achieve global sustainable development.

The Universal Declaration of Human Rights:

Article 19:

Everyone has the right to freedom of opinion and expression; this right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers.

Article 23:

(1) Everyone has the right to work, to free choice of employment, to just and favourable conditions of work and to protection against unemployment.

(2) Everyone, without any discrimination, has the right to equal pay for equal work.

(3) Everyone who works has the right to just and favourable remuneration ensuring for himself and his family an existence worthy of human dignity, and supplemented, if necessary, by other means of social protection.

(4) Everyone has the right to form and to join trade unions for the protection of his interests.

Article 24:

Everyone has the right to rest and leisure, including reasonable limitation of working hours and periodic holidays with pay.

Appendix (D).

Case study 1, Organization A:

This interview has been conducted in Arabic and translated to English.

Response to interview questions

What does sustainable IT mean to your organization?

Our Organization consists of Headquarters which contain the shared services such as IT, HR, finance, QHSE. Under the headquarters, there are agencies - business unit. Each agency has also IT department, HR, finance and QHSE. The corporate IT consists of 50 employees while the IT department for the agencies is about 30 employees. It can be considered as interface between the agency and the corporate IT. Moreover their infrastructure, support and help desk is out sourced. This organization has a sufficient impact on the environment because of its GHGs emissions. As per the interviewee, the IT has less impact comparing to the other sectors. In addition, this organization does not have competitors in Dubai.

I am IT manager of one of the agencies. I have been working here for 3 years. I am responsible for all the agency IT needs and requirements and represent them to the corporate IT. I have to ensure that all IT services and projects for this agency are moving with the right direction and aligned with the corporate strategy. Sustainable IT implementation is one of my responsibilities.

Sustainable IT, for us, means save the environment by reduce the IT activities impact on it. It also means the cost saving coming from saving the environment and from using the IT assets to its maximum capacity. I think that green IT and sustainable IT are synonyms. My experience in sustainable IT came from reading about best practices or assistance from experts.

What are the drivers for sustainable IT in your organization?

IT has gone for sustainability because the corporate strategy of our organization clearly identified the finance sustainability and assets sustainability in its strategic directions. IT is an important asset in organization and it has to align with the strategic objectives and that is why it is adopted sustainability. Current environment issues such as climate change, global warming, GHG emissions and e-waste generation are drivers for going sustainable. That is why saving the environment is a part of the corporate strategy and it is also there in the IT strategy. Huge power consumption of the datacenter is also a driver and going sustainable will save cost and reduces our CO2 emissions. Energy efficiencies and increased energy cost are also main drivers for adopt sustainability. Enhancing our image is strategic objective and a main driver for sustainability since we compete with other governmental organization for governmental awards. We have got 2010 e-government award. We also got Green IT compliance award. We are the first governmental department to get this award. Our good performance in Green IT, privacy and security is reason to get this award. There are no regulations or public pressure to force us to implement sustainability, it is only the government pressure to cut our cost, maximize utilization and reduce our budget and this pressure is increased after the recession started.

What are the sustainable IT practices in your organization and how effective are they?

We have a job on the network level that hibernate all PCs after 5 pm or put them on standby mode after of 30 minutes of being idle, and same policy is applied on laptops. This saves us 4500 AED monthly. Users are not involved in this policy. We are using desktop PCs, thin clients and laptops. When PCs reached its end-of-life we replace it with a thin client. Laptops are given according to the position and the nature of the work. Actually laptops and thin clients are more energy efficient than normal PCs. One more policy is there to determine the Life for each PC in 5 years, and it was 3 years before the recession. Even if new manager joins the organization, he should use old laptop, if exists, till laptop complete 5 years. After 5 years PC is

refurbished and reused. If it cannot be reused after refurbished we use to donate it, but now after the recession we are selling the old PCs. We may also recycle the IT equipment and ensure that TCO and ROI are achieved and then upgrade to more efficient hardware.

Our datacenter is located in Muhaisena, it is designed to be green and it saves about 172,369 AED in three year. We are not using virtualization with the old applications. When we change the infrastructure for an application, we adopt virtualization. Virtualization is saving about 2% of the power consumption. We are using white racks that reflect light energy and thus reducing the power consumption by 3%. In addition we also adopted well-planned rack layout with innovative cable solution which also saves power consumption. Motion sensors are also installed in DC to limits lightning to times of occupancy which eliminate the additional heat from the normal lightning.

We have some IT services outsourced and managed by providers, such as Government Resource Planning (GRP) which centralizes HR, finance and procurement for all governments sectors is under Dubai government. This will save cost and reduce emissions. We also provide 164 e-services, in 2009, which can be done through the internet and mobile. We achieved 75% customer satisfaction, and we got many awards for our e-services such as the Arab technical award 2009.These e-services will save time, cost, space and reduce traffic congestion.

All our printers are configured to print on its double side, and we are recycling the used papers. We are archiving all papers in DMS application and papers are disposed according to its importance like some papers disposed of after two years and others after 10 to 20 years. In our internal official communication, we are using emails and corresponding system (Trasol), e- brochures, portal like our pay slip is not printed we send it as SMS. Our e-services save a lot of papers for us and for our customers.

As I mentioned first, each agency has its own IT department which is responsible for all IT needs and requirements for this agency and have direct contact with the business of this agency. This will help IT provide solutions for sustainability. Such as services for disables, integration with Ministry of Interior for people inquires. We are also making awareness sessions about how to save power, how to extend your laptop life, and other initiatives, but there is no training. Some users can work from home and use the blackberry tech, but most of the applications are not allowed to be accessed from home. We also use video conferencing which save reduce travel expenses, lower Hydrocarbon emissions and reduce Cost of Billable Consultation Time. It has been estimated that video conferencing saves 1,285,900 AED yearly for one agency.

We are using the standard measures for our datacenter Power Usage Effectiveness (PUE) and Data Center Infrastructure Efficiency (DCiE).

We also have a green procurement policy and we are also conducting supplier education programs.

All our environmental initiatives have good economic impact, such as cost saving. We have a clear policy for local hiring. Our suppliers are international companies, since applications, that we are using, are not available in our market, but all our suppliers have local representative agencies and local support. Regarding training and education, we are doing training to our staff and specific budget is determined for each year. We are doing PMP training to our managers, ITIL training for IT services and operations employees and COBIT training for our IT staff. Moreover workshops are conducted each three months by corporate IT to all staff about privacy, security and hacking for the physical documents as well. Another Workshop is taken to create awareness about laptops power consumptions and how to take care of the laptop charger and the battery to extend their life. This workshop is called Laptops clinic.

We do not have a sustainability department, but we have Quality, Health, Safety and Environment (QHSE) department. We have a corporate QHSE and a QHSE department in each agency. They work with IT and they may raise some initiatives, but in general most of the initiatives are from the IT .Regarding the corruption, there is no training for anti-corruption, but a segregation of duties and a clear definition of responsibilities will reduce corruption. Audit department is also there to audit IT and it is reporting directly to the chairman. In addition, we also have a regular DC audits to preserve the green driver and maintaining the best practices and standards. Moreover the systems that cover most of the operations in the organization have the control and the monitor for all financial transactions. This will reduce bribery and corruption.

We force our suppliers such as WIPRO, which provides us the IT services and help desk, to hire locals and fresh students. This will ensure that knowledge transfer and best practices are done to the fresh graduate. WIRPO is an international company with high standards of working and best practices. This small initiative may not bring a direct benefit to our organization, but it will enhance the quality of the society. Moreover we accept university students as summer employees and we train them. We are working 8 hours daily in a good place with international standards even for the temperature. We also offer salaries are equal to average Dubai Market. Another initiative is to reduce the stress and tension of our IT staff from the business units; we have clearly defined the response time and resolution time for each issue such as PC problem, printer problem or application is down.

We have a fun team consists of three employees. It is responsible for arranging social activates such as bowling and IT gathering. We have many awards such as employee of the month. Regarding the non-discrimination hiring, no policy is mentioned about this point. In general the nature of the vacancy will determine the gender and the nationality of the seeker like some vacancies required Arabic speaking person. For the security and privacy, we are ISO 27001 certified and we also got the Information Technology Governance Assurance Forum (ITGAF) award in Nov 2009. In addition

a code of conduct is there and employee should sign it before joining our organization. Moreover as I mentioned before, workshops are conducted each three months by corporate IT to all staff about privacy and security. They covered their risks and impacts on the organization. We also publish newsletters with security tips.

What management should do to help your organization be sustainable?

Management is supporting sustainability and our corporate strategy clearly mentioned the sustainability in its strategic objectives. Having QHSE department is also clear evidence of management commitment to environment. There are reports, measurement, follow up.

Our Sustainability issues are identified correctly and they cover everything. If you cannot define it, you cannot measure it, and so you cannot manage it. That is why a good definition of sustainability issues should be there. We are dividing our infrastructure into parts (datacenter, PCs, laptops, printers, etc…) and then checking the best practice for each part. We are not using GRI Indicators, actually I have not heard about these indicators before.

Building culture that support sustainability is necessary for smooth sustainability implementation. Many initiatives has been taken to build culture for sustainability such as brochures, footer in email, sticker on printers think before you ink and the session taken to the staff like Laptop clinic session. This is essential to create the awareness and build our image in the government. It will also show that company is serious about the sustainability.

We did not have a training in sustainable IT. Our experience came from reports and awareness sessions for the environment, which show the best practices and initiatives like power saving and switch of the light and AC if you are out of the office. Our initiatives and best practices are aligned with the strategic directions.

Corporate IT are making the reports which showing our performance in sustainable IT. They consult each IT department in the agencies, and the report goes to CEO for shared services. These results are communicated to the management and IT staff. Externally it is declared in the conferences, government awards, press released and IT magazines interested in this subject. IT results are communicated externally as part of all sectors and not individually. It is important to communicate these results since it shows our commitment to the government.

I believe that IT can raise its own initiatives regarding the environment and the economy. They should be aligned with the strategic directions otherwise management will not realize it. You should be able to measure it and provide the results. Regarding the social responsibility, organization should drive its social responsibility and IT can be part of it. IT cannot do the social responsibility itself, it is more about the environment and economy.

Case study 2, Organization B:

This interview has been conducted in English.

Response to interview questions:

What does sustainable IT mean to your organization?

Our IT department consists of five employees, and an outsourced company provides IT support and services to help manage our infrastructure. It is the direction of the government to outsource services.

I have been, Green IT consultant, working with this organization since the inception of the Green IT Strategy project. I have been working for two years with this organization to develop the Green IT Strategy. I am working for leading Green IT focused consulting company which is based out of California, USA and it is a pioneer in this field since 2002. I have been working on Green IT Projects since Jan 2009. I, The IT manager, have been working for this organization for ten years, two of which are as an IT manager. I am reporting to the management board.

Sustainable IT goes beyond the operation aspect it covers the product life cycle from manufacturing to end-of-life. Sustainable IT should cover three aspects, environmental, economical and social aspects. People usually focus on the environmental and economic aspects which I call it as green IT and they forget the social aspect, which then helps it make a comprehensive and sustainable IT policy. Green IT is not just about reducing the carbon footprint of the organization by use of IT but also about how IT can help other sectors to reduce their footprints such as logistics.

What are the drivers for sustainable IT in your organization?

We are spreading sustainability culture in UAE and ME and environment is our core business. This is main driver to be sustainable. Our mission is sustainable

environment for sustainable future, so environment is driver for us to adopt sustainability. Climate change, global warming, GHG emissions and e-waste all are environmental drivers. We has financial drivers such as reduce operations costs, reduce papers and energy use.

Social drivers are there, we have a corporate green policy. We have developed Environmentally Preferable Procurement (EPP) it will be equivalent to the global standards. We drafted it last year and it is under review internally. We will use it as IT procurement policy, we will ask our supplier to evaluate themselves according to the EPP like safety and employees practices within the company, it is our responsibility to ensure that our supply chain are adopting the laws and practices as mandated by the law in the country.

Another social norm is we do not want our e-waste to be shipped and dumped in other countries such as is being reported in China, Nigeria or India. This practice will have bad impact in their society; we are a responsible organization in responsible country. There are some aspects driven by law (Basel convention) which mandates that e-waste cannot be shipped to any other country. Moreover hazardous waste should not be dumped, it should be treated. This law needs some amendment since it is not clear that e-waste is coming under the hazardous waste or not.

Also there is no clear definition of e-waste. In Japan, It is considered that electronic goods outside the traditional realm of laptops, servers, network gear are also considered to be electronic waste and this may include many house hold gadgets.

Our reputation and image is important since we are custodians of sustainability. Last year we got Shaikh Khalifa excellence award as best government department. What we are doing is looked by other governmental departments seriously.

All our employees are working for the environment and they are aware of the environment issues. We have our own culture like every week or two weeks there is a campaign about the environment. The difference between us and others that

environment is our core business is not just an aspect to take care of it. Our employees are aware of environment issues and they always develop themselves since this will enhance their career path.

No public pressure exist in this part of the region, because it needs awareness form the people and if you find awareness you will find organizations that can treat e-waste or remanufacture the cartages.

What are the sustainable IT practices in your organization and how effective are they?

We have been awarded the best Green Initiative award in the Middle East for our Data Center recently. The prestigious award is instituted by the London-based international consulting firm BroadGroup for organizations demonstrating outstanding service quality. Management excellence and technical achievement in data centre industry was presented to us at the 2nd Data Centre Strategies Middle East Conference in Abu Dhabi recently in June 2010.

Cooling is the main concern in the datacenters and we are using water cooling racks which significantly help reduce cooling costs.

We used the virtualization technology to reduce the number of our servers from 60 to 9 servers, which will have good environmental and economic impact, by reduce maintenance, cost energy cost and emissions. Regarding the workload, servers are utilized to their maximum capacity they are only 9 servers and they are always working. Our Power usage effectiveness (PUE) is 1.5. We have also done a datacenter load impact sensitivity analysis to measure impact of load on chilled water usage. We do measure our CO2 emissions and power consumption for our datacenter.

Policy in the network level to switch off the PCs is already there. We also replaced all desktops PCs with laptops, not thin client, thin clients are still not mature in this region and we have to evaluate them before adopt them. Having laptops will increase

productivity, since that employees can take them for meeting or when they travel, reduce power consumption be 50% compared to Desktops.

We have extended the warranty terms on our hardware procurement, so we can use it for more years; actually we extend the working life of our hardware which will reduce our cost. Extending the lifecycle of our machines will directly affect the costs of our devices.

Regarding the paper, we print in the double side by default and we initiate a paperless day campaign three years before. In paper day campaign, we agreed with other companies to stop un-necessary printing only the necessary documents to be printed and this will not stop the operations. In 3rd Jul 2009, we run this campaign on the level of Abu Dhabi and about 12 organizations have been participated, we calculate the paper saving and the reduction in emissions. This year we ran this campaign on UAE level and we were successful in that. We ran the whole campaign electronically, so we have e-manual and website that enables participants to register online and submit their reports. The results of this campaign are 4.2 CO2 emissions reduction and reduce 70% of our printing. Paperlessday.ae will give ways of how to reduce the consumption in individual and organization level. About 126000 individual has participated in this campaigns and 213 companies. This website will show the result of this campaign. Those who have been participated agreed that they will not use unnecessary papers, on this day. The campaign was a big success locally and in our partnership with UNEP we intend to take this as a global day.

We are also using 100% post-consumer recycled paper internally. We used to have 97 printers and we reduced the number to 21 printers out of which 13 are Multi Function Devices. Moreover, we also installed meter so we know the paper consumption per month per employee, which make our employees think twice before print. Moreover we do not print the pay slips for the employees. We use about 2200 sheets currently per day. Last year we used about 3600 sheets. All of our waste paper is recycled. We measure the paper we waste on a daily basis.

Cloud computing is still under study, we did not adopt it because of the security issues, we want to ensure that government data is not exposed to anyone. Regarding the telecommuting, the law mandates 8 hours of work hence employees should commit from 7.30 to 2.30.

As far as employee self services are concerned, and online web based system is available to access Employee Self Services where users can download their salary slip, vacations and their personal information from wherever they are. Hence employees have the flexibility to work from home as well and access their personal information from where they are.

Supply chain sustainability policy is there but we are not using because market is not mature enough and not ready for sustainability. We do not want to lose our good suppliers just because they are not sustainable or not aware of sustainability, like Dell has sustainability but the middle supplier may not yet be having a comprehensive sustainability policy. We need to be sure that market is mature and ready before rolling out such conditions. We do not want to end up with dealing with suppliers which are not qualified but have sustainability policies in place so we need to strike a balance.

We are using EPEAT standard to procure our Laptops and Desktop computers. We refurnish laptops after 4 years of usage then we sell it to our staff with low price, and when they do not want it they can give it back to our organization. We used to sell old computers but now we will look at giving it to a charity after they are refurbished and in working conditions so that more people can benefit from them. If we end up with something which is not working we will provide it to an e waste recycling company. In UAE, still lack of organizations that handle e-waste and there is only on country in MENA that has an e-waste recycling facility and it is Tunisia, any other country is shipping there e-waste to other countries. We have heard of similar steps being taken in Qatar.

In the internal communication, we are using email, DMS, and we are implementing an e-correspondence system, we have a lot of services online and we also have e-services portal. We have online permitting and licensing such as industrial licensing and hazardous and chemical licensing. Customers can apply online and when permit is ready they will get SMS then they can come and collect it or we can send it to them.

We use Polycom Videoconferencing system. As systems have recently been procured cost savings and reductions in emissions still need to be measure although we had calculate approximate save about 150 tons of C02 from reduced air travel , and cost savings of about 734,000 AED.

Renewable energy is not there, there is only one pilot project in MASDAR and we will see how this will benefits for UAE. We provide solutions to other sectors such as GIS applications and water saving devices which are used on the country level not only in our organization. We need to buy our energy from ADWEA, but as they use natural gas our source of energy is cleaner in comparison to most other sources to generate electricity commercially.

On improving employees understanding on Green IT, we made an introductory workshop for all staff including the management to explain them the concept of Green IT, why we implement it and what the benefits of it to the organizations are. We also made a session to communicate the results and the strategy of green IT. Regardless of the IT, there was a workshop conducted for Greening our organization and it covered all areas, and that is why we have recycle bins everywhere and water coolers instead of small individual water bottles that were used earlier.

IT staff are aware of the required technology changes, and their impact before implementation. Like for implementing shared printers, every staff has been trained that when they want to print they have to use their ID card to print and this make

people conscious about what they print since it is audited. Employee can print anywhere he just shows his ID to the printer and it will print.

We use the specification sheet for each device being used in our organization, to measure the operational energy consumption of our IT usage. This is done for all IT equipment right from the data center servers, network gear, and desktops. We also separately measure the air-conditioning requirements for our data center. Based on the approximate usage per day we measure the total operational use. We also have meters to measure electricity consumption and then evaluate the % from Information Technology use,

We convert the kwh used to GHG. As we have moved into a completely new setup here, we would need to revaluate our baseline and then re-measure the reductions. Our infrastructure in our new premises is very different from what we had earlier, much of which has retired. We have also made significant reductions in equipment and energy use due to our new green data center.

Economical:

Every technology we apply we calculate the saving for the environment and cost in a full study. Now we use only 9 servers since it is virtual environment we estimate that we will not implement any new server in a three years time, and the saving we have done to the organization in terms of cost and emissions. Each server costs from 15 to 35 thousand, we have excel file showing cost and it cover all areas within IT.

There is policy for local hiring. Our suppliers are from the local market, as most international companies currently partner with local entities here. Training costs is also considered in our budget.

Social:

We have a sustainability team in our organization and we are working directly with them. They do not have to come to us because we are aware of what sustainable IT is

and we are doing our job in the right direction. We report to the management on regular basis and they are giving us strategic directions. I am as an IT manager report our achievement to the management board and they are giving us the directions.

For the anti-corruption, it is about finance more than the IT.

Regarding the privacy and security, we have information security coming in the board on October 2010 and we will look to this issue, the plan to be certified by the end of 2011. We are now developing our IS plan for the whole organization. It will be extracted and customized from the security policy developed by ADSIC because they are assessing us as an IT. They are putting directions for the whole Abu Dhabi and we have to follow it.

We have EHS department which looking for staff health and safety, we are working directly with them especially in e-waste advice. EHS will ensure that each department have champion who will take care of EHS issues in his department. We have a health and safety champion in our department who is part of the technical committee of EHS. All staff is trained for the fire Extinguisher. Moreover we have e-waste committee; there are two people from IT in it. They will look how e-waste is recycled and managed.

In our department, there are two females out of five employees.

First of all we are working here for 8 hours a day only. We have football championship and our departments reach the final. We have awareness gathering and joins, social activities, and campaigns in malls. HR also offers discounts to employees at certain health clubs. We have monthly breakfast for the whole organization including the secretary general, we have annual gathering and also there is iftar party in Ramadan.

Our organization supports its employees who are pursuing their education. We have one employee went to get master in GIS and she came back and another employee is

still doing his bachelor. I am as an IT manager; it has sponsored me for the LEAD program. They also have sponsored many employees in different areas.

When we select our hardware the environmental concern is the main parameter to select the hardware. Then from the available choices we select the best choice according to the finance concern. Environmental and non-environmental hardware are almost cost same. We have recently moved into a new building, and have moved in with new equipment, including laptops, servers, data center racks, network gear, CISCO IP Phones etc. All of our current equipment is not expected to be discarded at least in the next 4 years. After which they could be donated or recycled based on their current use.

Regarding the sustainability supply chain, EPP is not yet rolled out. We are not checking our supplier since they are not aware of sustainability, so we only consider that equipment is sustainable. There is nothing to force the supplier to adopt sustainability, and in case they publish their sustainability report, no one is checking or validating their report. The market is still not mature, and before we audit our supplier we need to educate them regarding sustainable IT.

We calculate the personnel cost, and salaries in government organizations are based on the grade, each grade has its range. Our salaries are very competitive when compared to that offered at the private sector.

Regarding the training, each year we have priority areas we have to meet. Like we want integrated water management, then we communicate these to all departments and IT will do its part. We will check what is required from IT, who will do it and what training he needs. Training is designed according to objectives priorities. The number of people who have got training can be taken from the HR application.

Each month we have sessions about marine life, plastic bags, etc. and its impact on the environment and everyone is trained. There is no green IT specific training that is currently being offered. Also the workshop offered last year was comprehensive.

I as an IT manager have been working here for ten years; one employee has also been working for ten years and another employee for three years. Disabled people are in reception only, not in IT.

The percentage of turnover and absenteeism is very low. In the last 16 months, our team has remained the same. Absenteeism is negligible unless on health or personal emergencies. We have a committed and dedicated team.

What management should do to help your organization be sustainable?

We have aligned our strategy to corporate strategy. We aligned with the mission "sustainable environment for sustainable future". We are, as IT, doing our part of sustainability. IT can do its own initiatives provide solutions and technology that help our organization to achieve its vision and minimize IT operations impact on the environment. IT cannot achieve sustainability alone; IT can help the organization to achieve sustainability and it should be integrated to day-to-day activities. We want to reduce our impact on the environment what we call it sustainable. You can say that you are sustainable when you reduce impact on the environment, you can say you are green when you reduce the energy consumption you can say you are lean when you reduce the number of hardware.

Management is very much committed and we have a good budgeting behind us and that is why we are reporting regularly to the management. We have the buy-in, our Secretary-General office had three printers last year and now he has zero printers in his office. He is a good model in the organization. If management is not behind me and helping me to achieve sustainable IT they will not achieve their vision to get sustainable environment.

We are aware of environmental problems and we need to have operations that are not interrupted without increased our equipment. First of all we categorize our infrastructure to what it is consisting and then we can enhance its performance without affecting the day-to-day operations.

We need to balance between environmental and the operation, you cannot say that I want to minimize my impact by having only one server and affect the whole operations but I met my target by minimize my IT impact. You need to balance between the between both then you try to measure then to evaluate to see If it is successfully implemented. Like we reduce our printers from 97 to 21 and we may reduce them again next year to the half. Sure that same solution will not work, and we have to find new solutions like heavy duty printers with same capacity and same environmental features. All these combined and in same time do not affect the operations of our organization. We look to the objectives then we find the solutions.

We use the GRI framework for our sustainability reporting. Annual report will mention the initiatives that have been taken. We also implement DMS and our report we mention the number of documents have been digitalized, so far we converted about 200 thousand documents to digital copy.

Culture change is required to implement sustainable IT. We make introductory workshop to all the staff including the management to introduce the concept of green IT and what benefits it brings to the organization. When we completed our strategy, we rolled out green IT strategy by having one hour without IT event, where we ask everyone to shutdown his computer and turn off the lights and come done to the lobby. We showed them a video about how much energy they consuming and what impact it has on the environment and we celebrated. On that day we gave them a mug made of corn and we asked people to pledge to do three things:

- Reduce reuse recycle
- Turn if off: if you are not using your computer, switch it off. Moreover if you are not in office, switch off the light and the AC.
- Think before you buy. You have to use it to the full capacity and you buy it if you really need it.

All our staff, management and CEO pledged to comply with these points, and we will make an audit in October to measure how effective these pledges and whether people really changed their behaviors or not.

We are communicating our achievement to the whole staff and to the public. We are participating in different conferences like we presented our Green IT to the Korean delegation in a session organized by ADSIC to all governmental entities. We had ADSIC coming to our organizations and we walked them through the IT. Department of commerce are planning to visit us and we are planning to show our experience. NBAD has also come here and we are in discussion with them on many different issues such as the managing e-waste. We gave in the data center conference on 27-JUN-2010 two sessions about the sustainability in Datacenter. It is very useful to communicate your results and every day we are receiving calls for advices, recommendations and how we are doing about IT, what we have done to the organization is consider commonly acceptable practices in Abu Dhabi. One example is recycled paper, all organizations asked from where we ordered this paper and some organizations went through recycling paper and some of them cut off newspapers that come into their organizations. By Sharing your experience, you will get feedback and you will know how will you are doing your work.

For external entities we are trying to raise awareness about these issues, so when they implement it we reach our vision for sustainable environment. When we communicate our results, people will be aware of financial and environmental benefits and they will start thinking about it. We have it as objective to minimize the impact of IT operations on the environment. We have a major issues such as climate change so we have to be sustainable in our practices then we promote for this concept. We have to be model for others. We will be the model for other government entities because we have implemented so many things and we know the pros and cons and we can share it with them.

Case study 3, Organization C:

This interview has been conducted in Arabic and translated to English.

Response to interview questions:

Could you explain your role in implementing Sustainable?

Our IT department consists of 5 sectors information security system, infrastructure section, application section, support section and e-transformation section. E-transformation section is responsible for putting IT strategies. IT is providing the public with more than 400 e-services. Our infrastructure is one of the biggest IT infrastructures in Dubai government. It consists of 5 datacenters and about 300 servers. We have about 180 employees between main, outsourced employees and managers.

I am the head of platform service unit. My unit is managing the operation of the IT department. I have been working in this organization for five years, I am reporting to the head of IT infrastructure section.

We run our internal initiatives like when we want to get rid of old hardware, we send it to contractors and they refurbished it or dispose it in proper way. One more example is the initiatives for the datacenter, we run the initiatives and our suppliers are implementing them. Actually it is hard, in this region, to find experts in datacenter. We are operating and managing the datacenter, but support, implementation and maintenance is done by other partners. Now we have a project to build a new datacenter "3 tier datacenter". In this datacenter, we will adopt datacenter standard from the uptime institute. One of the main conditions in this standard is to be a green. We run initiatives and the outsourced companies are implemented these initiatives.

I think Green IT and sustainable IT are same or may be green IT is part of sustainable IT. I am not sure. Sustainable IT is a new topic in this region, and you will not find it

in most government sectors. Actually we do not have corporate strategy or IT strategy that clearly declares sustainability. It is only initiatives on the operation level. I have got my knowledge about Green IT from international seminars and events. They are giving good idea about Green IT. We also learn from the best practices of big companies such as HP which have Green strategy, objectives and implementation of Green IT. Moreover internet and international standards such as the standards from the Uptime institute are good resources for this topic.

What are the drivers for sustainable IT in your organization?

There is no enforcement to adopt Green IT, it is more about culture. Green IT is part of international standards and we have to adopt when we adopt these standards. We do not have a direct concern about the environment, so we adopt Green IT because it is a condition of international standards and not because of the environment. Like even we have a Green datacenter, but we do not measure the CO2 emissions, our services providers and suppliers are also same.

Power access is a driver for going green, since our infrastructure is extended and power consumption is increased as well. This forces us to reduce our consumption, so we do not exceed our power quota from DEWA. Cost saving and reducing operation cost are also drivers for being green as well as the energy efficiencies.

Company reputation and Image drives us to be green, since being certified for Green IT or Green datacenter will give us more credits in the government.

We have adopted safety standards, like people who are working directly with datacenter should wear jackets. This is part of our business ethics. Following the international standards is the main driver for us to go green.

There is no regulation for going green, but now the new e-government center, which consists a centralized IT management, will direct all government sectors to be green. It is new center that put the IT strategies for all government sectors and they have to

adopt it. Previously, the office of the governor was taking this role. It was directing all the IT departments for all government sectors and all sectors should report to it. For example, adopting COBIT was one of the directions of the Governor's office.

Having competitors is one of the main drives to be green. We consider other government sectors as our competitors, since all of us compete for Sheikh Mohammed bin Rashid award for the best government sector. We have got this award for two years. This award will look for many aspects such as e-services, customer satisfaction and Green IT.

What are the sustainable IT practices in your organization and how effective are they?

Environmental:

We had run many awareness campaigns. One of these campaigns was to encourage people to collect printer cartages, and then reward the one who collects most. These campaigns cover all society from schools to companies.

We do not have any policy on the network level to switch off the PCs or move them to standby mode, we just asked our employees to switch off the PCs when they are not used. Anyway, we are using thin clients which are not using much power and by default when user logs out the thin client will be in standby mode. This thin client consists of monitor, keyboard and mouse. It is using the Citrix technology though browser to access the applications. We are also using laptops which are power efficient. We give laptops to managers and IT staff.

Our datacenter is design to be green, and cooling issues are also considered in the design time. We also have adopted the virtualization technology. We are the first government sector to implement this technology. We are running one project to change our datacenters and we have completed phase one, two and three and phase four is still running. We minimized the number of servers form 240 server to 60

physical servers. We have a workload balancing which means if one server has a huge load, it will share it with another server. Any way the standby server is always on. We do not switch off any server. We do not measure our energy consumption, but we have UPS reports that show you the power load for DC. We do not measure our CO2 and GHGs emissions. We do calculate the in and out cash flow for the datacenter. Like the cost of the datacenter and the value that datacenter brings to the organizations.

We are still thinking of cloud computing, actually cloud computing is not there in our region. I think there is one cloud computing project in Riyadh, KSA to serve the Middle East. I think virtualization can be considered as kind of cloud computing.

Our employees can work remotely using Citrix technology and they can use their laptops and even their mobiles. We have one initiative from HR that allows some employees to work from home like designers. Each department in the organization should determine some users that can work from home and their presence is not required. Most of employees who are benefits from this initiative are women. We are not using the video conferencing to reduce our business travel.

We have more than 400 e-services that help customers apply for services without coming to us to apply for it. This will save paper, reduce the congestion and reduce the GHG emissions.

We are not auditing our suppliers that they are applying sustainability or not. Actually we are dealing with local agencies for international companies such as HP. These companies are auditing their representative but we are not. When we are going to buy a laptop we are looking for the best in the market which is usually an environment friendly product.

We have one initiative is to refurbish PC. It is through the PC refurbish center. This center responsibility is to collect old hardware, refurbished and then send it to charity, poor countries, reuse or even sell it. This is part of our social responsibility, so for old

PCs we refurbished and reuse them. If they cannot be reused, we give them to refurbish center and they will give them to charity, sell or dispose them. Previously we used to sell them in a caution. Now there is no one buying the old hardware because it is becoming costly to repair the old hardware. We do not measure our hazardous waste of e-waste generation, but we do calculate the percentage of reused and recycled PCs.

We have a filenet system, it is a documentation system. All internal communication between departments in the organization is through this Trasol system. It is one of the best practices that we have to reduce the paper consumption. All official letters should be through this system and it should have the digital signature. Our external communication is through email, but some of them are imperative to be on paper. In addition, the e-services that we offer are also reducing sufficient amount of used paper. Each procedure have e-voucher, user may print it or comeback to us with its reference no. We use a recycled paper and we do not use double side print as default printing, it is as per user preferences. We also measure the paper consumption per employee. Every employee is authorized to print in specific printers and he has a limited number of pages to print. We can know if he exceeds his limits in printing. We do not print our pay slip and all employees can access the HR system and see their salary details, leaves and other personal information. In Contract department, they are printing their documents, it is compulsory for them to have hardcopies of some documents for legal issues. We gave paper shredder for each unit manager and we gave bin for each employee for paper only and a special company will take it and recycle it. We measure our paper consumption but we do not measure the percentage of recycled papers.

There is no renewable energy to be used, it is only from DEWA or our own generators.

We are, as IT, provide different solutions to other sectors to reduce their environmental footprint such as paperless initiatives, e-services and Citrix technology that allow them to work from home.

We do not have training regarding the environment. We have awareness sessions and campaigns initiated by environment department for all the employees and IT is part of it. these campaigns are targeting the public audience such as schools and public sectors. Awards are given at the end of these campaigns.

Economical:

We got fixed power access from DEWA, even our infrastructure is still. When we got a new project we realized that we exceed our power limit, then we decided to reduce our power consumption. There are generated reports from the UPS system for power consumption and power load each month. These reports do not declare the power cost. Limit power access is risk for us.

We have a local-hiring in the IT department. Our suppliers are international companies which have local representatives.

We are doing many training for our staff such as PMP, ITIL training, and I am an ITIL certified. We have training center that for any new product we are running training for IT staff for this product through the training center. For each new project, the suppliers have to do the required training to our staff. There is specific budget for training and each department has to send a training plan for its employees to HR.

Social:

We have an environmental management in our organization. They do not give us initiatives, we run them by ourselves. They create awareness to all staff not only for IT. They are running corporate level initiatives like they changed the lights to a power saving lights in the whole organization.

There is no training for anti-corruption. I consider failure projects as kind of corruption, since huge budget is lost for a failure project. Even IT audit is there, but it will not help in reducing the corruption since it will give you the feedback only and the budget has gone. Reporting will help reduce the corruption and help to cross check the system transactions. In addition, automating the organization process will reduce the bribery and corruption.

In the new datacenter, we have emergency alarm and alerting system that in case of any problem will send SMS to the in-call engineer and in case of electricity problem it will shut down the power. We worked with civil defense to teach the employees how to use the emergency exists in emergency cases and they help us in adopt safety equipment for IT and other departments. We also have a fire extinguisher in the datacenter.

We have a non-discrimination hiring. As I mentioned before, telecommunications are used which will reduce the traffic congestions. One more initiative was there, it is called day without transportation. The organization closed all the parking and all employees had to come using public transportation and they provide buses for employees from Sharjah and Ajman. They overlooked the lateness and absenteeism in that day. I mentioned also that we provide many e-services which also help reduce the traffic congestions.

We are ISO 27001 certified and we are working for ITIL and COBIT certifications.

We have social activities but not that much. We have communication plan that each unit manager has to meet his staff weekly. Section head has to meet his staff and unit manager monthly and award the outstanding employees. We also have two meeting yearly for all staff with the IT director. We also had journey to Hatta and we had camping there.

We have scholarships program for our employees who are UAE national. We also make one year training for students who finished the secondary school. We give them

salary and we offer them to join us at the end of the training. They can also work in other companies without any cost

HR is calculating the personnel cost, and I do not know how much my team members are costing. Our salaries are equal to the Dubai market average salaries. HR has the number of employees and they know the percentage of employees how have training. They also know the number of people who pursue their education, but actually there is no report that gives this information. We also measure the percentage of turnover and absenteeism. We have percentage of female to male as 1 to 3, and ten years as average years of experience.

There is a direction from the Dubai government that each government sector should have percentage of disabled employees. This will give us some credits and in IT we have one disabled employee.

We identify the sustainability issues from the international standards and best practices of the large companies such as HP as I mentioned before. We faced some difficulties during implementation such as some technologies are not available in our region as well as support. After the recession, we had new difficulties regarding the financing issues. Now each project that will cost more than one million AED should have approval from the director general which may cause delay to these projects. In addition culture change and how employees will adopt these changes are also difficulties.

What management should do to help your organization be sustainable?

We do not have a sustainable IT strategy, we have only IT strategy that apply some practices. Actually it is more about culture than a strategy. Like there is no strategy to reduce power consumption, but we are doing it in the operation level. We are as IT run green initiatives on the operation level but as strategy there is no vision, mission or objectives that mention green concern, it is more about business value.

Management are supporting to these changes, if you convinced them.

Culture change is required. We put slogan in emails to create environmental awareness like “Do not print this email….”, or security awareness since we are ISO 27001 certified. This is a corporate awareness and IT is part of it. It is more through emails than sessions. In case of giving sessions, we coordinate with the training center which has the month plan for training and IT is part of it.

My staff are aware of green IT but they do not practice it, and some of them have experience on it. We communicate our results to management upon request and not periodically. Actually this practice is necessary because it will show that IT is working aligned with the corporate strategy. Moreover this will make management more supportive for the coming projects.

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