

AN EXPLORATIVE ASSESSMENT OF BUILDING SUSTAINABLE IT INFRASTRUCTURE IN NIGERIA



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Abstract

The current economic climate of Nigeria dictates that organizations be concerned about cutting costs and increasing profits. With the current challenge to cut the overall cost of building of Information Technology (IT) infrastructure on the operating environment, decision makers and IT Managers welcome initiatives that can help simplify their operations through infrastructure consolidation and automation of the Information Technology infrastructure. These vast new areas open a window for unlocking value costs savings, and improved efficiency of organisations in Nigeria. These solutions are also expected to be environmentally friendly and sustainable. This paper explores the concept of the unification of Information Technology platforms with emphasis on the Unified Data Centre, and how it can address the objective of reducing the cost of duplicating Information Technology infrastructure and in the process save the environment. The paper also examines the current Information Technology infrastructure (IT) requirements and how this kind of solution can improve or disrupt current delivery methods and infrastructure architectures. The concept of sustainability is heavily emphasised.

Keywords: Organisations, Information Technology, Infrastructure, Automation, Consolidation, Sustainability, Cost, Environment.

Background to the Study

Organisational efficiency largely depends on the speed and efficiency with which the organisation can be innovative. Innovation allow organisations to erect barriers and therefore increasing its competitiveness. Most organisations rely on their IT infrastructure to drive their innovation engine (Voigt, 2013). In recent years, however, cost and delivery of IT infrastructure has risen significantly. Maintenance of traditional IT infrastructure has become very expensive, gulping huge percentage of IT budgets (Marco *et al*, 2013). This has in recent years slowed down the pace of innovation in many organisations. Thus increasing their overall cost of operations and long-term capital expenditures.

According to the United States EPA data Centre report 2007, the US alone data centres consume a significant amount of energy. In 2006 alone, data centres consumed about 61 billion kilowatt-hours representing about 1.5 percent of the total electricity consumption in the US with the total cost of about \$4.1 billion. This estimation is similar to the electricity consumption of 5.8 million average U.S households

Significant rise in Information Technology (IT) spending is from investments in data centre infrastructure, which traditionally has accounted for 44 percent of overall Information Technology (IT) spending (Kooimey, 2011). This is in addition to the inefficiencies caused by a stacked infrastructure within the data centre. A high percent of the cost comes from personnel and software, with the energy and housing to power and house the existing IT infrastructure representing largest segment. (Cisco, 2012)

Additionally, virtualization and consolidation show potential in reducing Information Technology (IT) expenses, earlier implementations and solutions came with hidden costs. Increased server utilization were not very much accompanied by a reduction in costs and other overheads; the cost of Information Technology (IT) infrastructure management expenses also increased. This rise in expenses and costs, can be traced to the previous and traditional approaches to infrastructure management in so many IT departments in different organisations because a variety of servers, applications,, networks, and storage and resources have been implemented in the traditional silo approach, thus making data centre management highly complex and unsustainable because efforts were at integrating solutions and technologies designed to work independently.

This paper evaluates and discusses the benefits of building sustainable information technology (IT) infrastructure using unified infrastructure approach. It also discusses its threats, risks and challenges.

Objectives of the Study

1. To evaluate the success of the Unified Data Centre approach to building sustainable information technology (IT) infrastructure.

2. To establish how the approach has helped address the objective of reducing the cost of building a sustainable information technology (IT) infrastructure and simplify deployment and operations.
3. To recommend Unifying and or Consolidation of Data Centre as solution to managing cost of Building Information Technology (IT) infrastructure to organisations.

Literature Review

Information and Communication Technology (ICT)

ICT's are a significant part of networks and services that impact on local and global gathering, accumulation and delivery of public and private information. According to the United Nations Economic Commission for Africa (1999), ICTs encompasses Internet service provisioning services, telecommunications and information technology equipment and services, commercial information providers, media and broadcasting, network-based information services, libraries and documentation centres and other related information and communication activities. (Posu, 2006)

Information and Communication Technology in Nigeria

The indigenization decree of 1977 led to the increase in the number of local vendors in the computer businesses in Nigeria, this further stimulated marketing by the vendors, further increasing significantly the number of computer installations and use in Nigeria. (Federal Ministry of Information Technology)

Prior to the return to democracy in 1999, minimal level of development was recorded in the IT sector of Nigeria. The entire regular internet users were less than 200,000 out of a total population of over 160 million people. The government of the day embarked on major reforms in the ICT sector which included the launch of a National Policy on Information Technology in the year 2001. The government went further to establish an agency called the National Information Technology Development Agency and charged it with the responsibilities of implementing the policy, co-ordinating, and regulating all information technology related development in the country. To further increase the presence of Nigeria and Nigeria's businesses, the government established the Nigeria Internet Registration Association (NIRA) in 2006. (Federal Ministry of Information Technology, 2012)

Concept of Sustainability in ICT:

Information technology and equipment and resources contribute at least 2% in greenhouse emissions, with data centres at the forefront with 1.3%. Yet research has shown that information technology can provide solutions to reduce an organization's footprint fivefold. (Curry, 2012). The application of the concept of sustainability will ensure sustainable use of information technology resources and sustainable best practices aimed at saving the environment.

According to Google, the large majority of a data centre's environmental footprint is not created on-site but rather at the power plant producing the electricity that powers the grid. The embodied energy of the servers and building is small in comparison. The opportunities are significant, savings every year in electricity costs and avoid emitting tens of thousands of tonnes of gas emissions, due to investments in energy efficient computing infrastructure. (Wheilet al., 2011).

Sustainable I.T Infrastructure Building Blocks

IT Infrastructure:

Information Technology (IT), infrastructure is defined as the hardware used in interconnecting computers and users. IT Infrastructure incorporates the transmission media, including telephone lines, terrestrial lines, cable television lines, satellites, antennas, and also routers and other devices that control transmission paths. IT Infrastructure, also include the applications employed or used in sending, receiving, and managing the signals being transmitted.

According to (Seker, 2016) Information Technology infrastructure is roughly defined as a set of necessities for a system to exist and maintain its existence. For any system, the presence of an underlying infrastructure is a necessary condition. Therefore, when any essential service incurs a disruption due to a failure in the Infrastructure, we feel the drastic effects in our daily activities (e.g., consider a power failure lasting for a few days).

The term IT infrastructure is defined in Information Technology International Library v3 as a combined set of hardware, software, networks, facilities, etc. (including all of the information technology), in order to develop, test, deliver, monitor, control or support IT services. Associated people, processes and documentation are not part of IT Infrastructure. (Seeker, 2006)

The Data Centre:

Data centres are the backbone for communication, cloud services, search, email, storage, collaboration tools, and scientific computing. A Data Centre can range from stacked machines in a closet to much larger, special purpose massive buildings populated by thousands of servers. These dedicated computing facilities consume a lot of energy, contributing about 14% of ICT's total carbon footprint. Even so, it is incumbent on data centre operators to make computing infrastructure as sustainable as possible. (Weihl B, 2011)

A win-win situation will be created, thus making operations more sustainable saves money, giving those deploying 'green' and, or sustainable infrastructures a significant competitive advantage.

Why Unify? - Key Benefits of Unifying Information Technology (IT) Infrastructure. In this paper key benefits of unifying and or consolidating an organisations IT

infrastructure were identified. Concerted efforts in discussing them. This is in the hope that decision makers and IT managers alike, can justify the viability of consolidation.

Computing Power.

Computing power is primary motivation for unifying the data centre to consolidate IT resources. This will further increase computing efficiency and more computing per watt of power consumed by the data centre. The reduced power consumed by the consolidated IT Infrastructure load itself, however, is only the first step of the accruable savings that can be claimed when consolidating workloads to a much smaller set of physical equipment.

Cost Savings on Infrastructure Investments.

A unified or consolidated infrastructure means a leaner network and of course application infrastructure. As a result, organizations will need less hardware items like servers, routers, etc. Cost reduction on these critical equipment's specifically, servers' resource and scaling on a few critical software applications, will allow organizations to cut down the costs of operations.

Furthermore, with the explosive growth recorded in Software-as-a-Service (SaaS) options, data center unification and consolidation brings many potential for beating down operations costs. Such infrastructure consumes less power and is much easier to cool, further cutting, considerably utility bills. This further paves the way for sustainable infrastructure.

One major benefit of unifying IT Infrastructure is the reduced burden on ICT and operations personnel. With a drop in activities recorded at remote locations, the management and communications requirements for those sites drop considerably. This further allows IT and operations staff to narrow and solve critical issues faster and at less of an expense. Thus, reducing and freeing significant resources for other organizational priorities and needs.

Dynamic resource Sharing.

This particular characteristic of a unified and consolidated infrastructure can help organisations share resources, dynamically over a consolidated infrastructure. This will further increase the performance of operational personnel, especially in today's complex, and dynamic industries.

Dynamic resource Availability.

From another perspective, using the unified and consolidated infrastructure, organisations ensure resource availability during crunch periods. A great number of personnel can be able to easily use video with HD quality using an enterprise-wide based application.

Security.

Unification means doing away with some locations completely, while other locations will see reductions in size and scope. With fewer locations to secure, manage and maintain, the responsibility of physically securing the organisation becomes far easier, less

expensive, and requires the allocation of fewer resources. Compact or leaner organisational architecture relies on a limited number connections between facilities and or locations. Simplifying transport layer connectivity, increases the effectiveness of information security in the data centre.

Power Usage.

Data centres typically cost millions of dollars to build but the energy costs to run them can be many times more. The efficiency of data centres is typically determined by their power usage effectiveness, a metric designed by the Green Grid, it is used to express how much of the power in the data centre is actually used by the computing equipment.

With a PUE start point of 1.0 indicating maximum energy efficiency, the majority of data centres are currently operating at well above 2.0, which would indicate there is still considerable room for improvement, especially if the need to be sustainable is to be achieved.

According to Green Grid, TFE or Total facility Energy is defined as the energy dedicated to the data centre. The ITEE or equipment energy is defined as the energy consumed by equipment that is used to manage, process, store, or transport data within the compute space.” (Grid, 2013)

$$\text{Is expressed as } PUE = \frac{\text{Total Facility Energy}}{\text{IT equipment Energy}}$$

Control

Infrastructure unification promotes several avenues to peaking and optimization, like transport. With centralized approach, there are fewer pipes to monitor. Unification and consolidation of platforms offers the flexibility to deploy more sophisticated and advanced protocols and management strategies that increase bandwidth utilization and performance of the overall network. This is achieved without straining the network and its applications.

Recovery and Disaster Management

With a more unified and consolidated data centre, the process of planning, implementation, and execution of recovery and disaster management solutions are flexible and far less complicated. This is because all necessary and vital segments are in a single location, thus, further reducing the tasks of replication and failover initiation processes.

Compliance

Another benefit of data centre unification and or consolidation is it supports compliance efforts. One, by promoting process and system automation, this takes the possibility of human error out of the loop and captures the functions that must be executed to be consistent with relevant regulations, policies, Quality of Service (QoS) and standards.

It also, promotes the implementation of auditing capability that can allow for the conclusive demonstration of operational compliance, over short and long term periods.

Possible Threats and Risks of Unifying I.T Infrastructure.

Unification of IT infrastructure comes with many unplanned challenges, while it makes a great deal of sense to unify, these challenges should not be overlooked. Listed below are major areas that may be viewed as drawbacks regarding data centre consolidation.

Threats of Security.

According to (Pfleeger, 2006) the “IT Security” can be split into three sub goals: *Confidentiality, Integrity and Availability*. Apart from general threats to these security sub goals, in a unified and consolidated environment where cloud computing is the norm, each aspect of security is faced with unique risks. *Confidentiality* is usually achieved by encryption. However, as for example, an organisation's information is stored in a Cloud and virtualised environment. The long term confidentiality will have to be considered. This means that past and present encryption protocols or designs may be insecure in a long run. Moreover, when processing data in the Cloud, consolidated environment, data is decrypted which also poses a threat to *Confidentiality*. According to (Ristenpart, 2009; Boukercha, 2007) Information leakage vulnerability in third-party compute Clouds pose threats to *Confidentiality* as well.

Threat of Disruption

In the course of unifying an organisation's IT infrastructure, day-to-day operations could be disrupted. This can happen if the project implementation is not properly planned. Any change undertaken during a consolidation move adds risks and complicates the project. Although worthwhile, consolidation is a significant project in itself, attempting to implement unification and or consolidation of IT Infrastructure while still trying to keep up with operations means attempting to carry out two very difficult tasks at the same time. It could be disastrous. Therefore, changes should be highly minimised during the planning and execution periods.

Threats of Privacy

Privacy is a source for concern in a unified, consolidated and cloud environment, from the perspective of organisations, regarding legal compliance and consumers' trust. A taxonomy of privacy has been produced that focuses on the challenges and harms that arise from privacy violations (Solove, 2006) and this can provide a helpful basis on which to develop an organisational risk/benefit analysis. Sharing an infrastructure with other departments, units and maybe even sister companies off premise is not the only aspect of a unified or consolidated environment, but it enables new services and opportunities to be made available in the shared infrastructure by combining other services.

According to (Mouline, 2009) cloud services process users' data on machines that the users do not own or operate, this introduces privacy issues and has the potential to limit user's control. The same is applicable to a consolidated infrastructure in an organisational setup.

Latency and Bandwidth:

There are two essential characteristics users and management would want to be ensured in a unified and consolidated infrastructure: latency and bandwidth guarantees. This is necessary to get access to resources in a fast and efficient manner. Latency depends on the physical location of servers and the CDN services implemented on the infrastructure.

Base-lining:

When unifying infrastructure and or consolidating, organisations need to carry out a base-lining task. This is to ensure that real quantifiable benefits are measured. It's on to say that you can't improve what you can't measure. Comparison will become extremely difficult if expectations cannot be measured against results after the consolidation project.

Method

This research work heavily relied on secondary research sources. Relevant literature relating to the concept of sustainability, information technology (IT) infrastructure, data centres and the environment were critically analysed. Informal discussions were held with IT managers and employees of companies in Telecommunications, Government MDA's and the Banking industry in Nigeria to ascertain if they are willing to consolidate their IT infrastructure.

Conclusion

Building sustainable information technology (IT) using unification and consolidation solutions and technologies, especially unified, has come to stay. It is a reality. It is a solution that works – it also saves financial resources by increasing computing power for every watt of power consumed, freeing space, and allowing head room for growth. It also simplifies load migration, and disaster recovery. In this paper, considerable effort was made to explain the landscape of a sustainable IT infrastructure, describing what Sustainable IT infrastructure is about, and what kind of services that are offered in a unified and or a consolidated infrastructure environment.

Attempt has also been made to explain the advantages of building the infrastructure in a sustainable manner and cut the contribution of IT to global gas emission while cutting down utility bills of organisations. The key benefits were identified, also possible threats and risks that come with a unified and a consolidated infrastructure environment were also discussed. Specifically, the implementation of trust and reputations systems in consolidated or unified environment has been recommended. As each data centre consolidation outcome is unique, care should be taken to examine the impact on power and cooling. The approaches and options discussed in this paper should be examined with an eagle eye towards maximizing the overall efficiency of the consolidated data centre.

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