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The Cloud and Sustainable Development in Developing Nations

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Abstract:
Sustainable development is an issue that global economies face in this century. Since from economics point of view, the productive resources are scarce while as the human needs are unlimited there is need of identifying ways of utilizing natural and capital resources in meeting effectively the unlimited needs of the current and future generations which require a concerted effort of global nations while safeguarding the environment. Cloud computing is one of ICTs model that greatly impacts upon sustainable development in nations which is in its latent stage in developing economies in terms of adoption by stakeholders such governments, learning institutions, business enterprises, consumers partly because of lack of knowledge about it and the challenge of adequate infrastructure. With cloud the resources which were utilized traditionally – software, hardware, storage facilities, computing are centralized and virtually accessed at any time from data centres. Based on this backdrop, this article theoretically defines cloud and describes its benefits and challenges before ending with a suggestive conclusion in relation to sustainable development in developing nations.

Key words*: Cloud, Sustainable Development, Developing Nations, Environment*

1.Introduction

ICTs are tied to economics, society development and environment protection. As both natural and capital resources are limited and the human needs are unlimited, there is a need for global economies to embrace a concerted effort for effective development and utilization of ICTs for sustainable development. ICTs enable resources to be determined, accessed, stored and effectively utilized today and in the future, while protecting the environment. ICTs entails technologies such as the internet which if well adopted are economically viable and socially embraced for the welfare of the global community. The internet and its integrated technologies are relevant for the production of goods and services, marketing activities, dissemination of information on how diverse people in terms of culture, religion, attitude and perception can live together as a global peaceful society and reap the gains of a protected environment. On this vein, this article examines a model whose bedrock is internet in providing resources such as software, computing, hardware and storage in a virtualized way for governments, business enterprises, consumers, society, education and research organizations though without challenges for the sake of sustainable development.

2.The Cloud Model

Cloud is an evolving model in ICT with interest growing from consumers and providers. For example, cloud service spending worldwide rose by over 20% in 2009 according to on Cloud Computing.com, in a year when overall IT spending dropped by about 4%.As of 2010, most cloud consumers were small enterprises, but large enterprises are exploring the paradigm. Input, the leading authority on government business, asserted that federal government spending on cloud computing will grow by a 27% compound annual growth rate between 2009 and 2014. Overall, Gartner asserted that by2012 one in five businesses could have owned IT assets; one of the reasons for this trend is the move toward cloud computing as a means to reduce IT hardware costs. More adopters would result more end-users seeing savings and thus working to reduce barriers to adoption. The grow thin cloud computing on the part of consumers could also puran increasing trend in the number of producers.

The cloud model was first used in an academic context by Prof. Kenneth K. Chellapa, at the Informs Conference in Dallas 1997, who described it as "a computing paradigm where the boundaries of computing will be determined by economic rationale rather than technical limits." The concept is also termed as cloud computing. It has been broadly defined by scientists and organizations and the following are selected definitions for this article: According to Buyyaetal. (2008), cloud computing is defined as "a market-oriented distributed computing system consisting of a collection of inter connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing gre source(s) based on service-level agreements established through negotiation between the service provider and consumers." The National Institute of Standards and Technology (2009), defined cloud computing as "a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort to reservice provider interaction. The model promotes availability and is composed of five essential characteristics, three service models, and four deployment models." Based on the above definitions cloud could be defined as a model whose bedrock is internet related technologies, that offer software, hardware, storage, networks and computing services to end users as they require them at a fee agreed between them and the service providers. Cloud is available for the public and private end-users. In view of this, there are two types of clouds. Public clouds are offered over an internet connection and require users to pay a usage fee. Private clouds are deployed inside firewalls and managed by the user organization.

3.Types Of Cloud Capabilities

One of the cloud computing capabilities is called Software-as-a-Service (SaaS) that provides users with business-specific capabilities, such as e-mail or customer management. In SaaS, organizations and developers can use the business-specific capabilities developed by third parties in the cloud. Some examples of SaaS providers are:

• Google Apps: provides web-based office tools such as e-mail, calendar, and document management;

•salesforce.com: provides a full customer relationship management (CRM) application;

•zoho.com: provides a large suite of web-based applications, mostly for enterprise use.

These cond type of cloud computing capability is known as Infrastructure -as-a- Service (IaaS).

The capability provides mainly computational infrastructure available over the internet (e.g., compute cycles or storage).

IaaS allows organizations and developers to extend their IT infrastructure on-demand basis. Some examples of IaaS providers are:

•Amazon Elastic Compute Cloud (EC2): provides users with a special virtual machine(AMI) that can be deployed and run on the EC2 infrastructure;

• Amazon Simple Storage Solution (S3): provides users with access to dynamically scalable storage resources;

•Go Grid: provides users with access to dynamically scalable computing and storage resources, as well as dedicated servers;

• IBM Computing on Demand (CoD): provides users with access to highly configurable servers plus value added services such as data storage;

•Microsoft Live Mesh: provides users with access to a distributed file system; targeted at individual use;

• Rack space Cloud: provides users with access to dynamically scalable computing and storage resources, as well as third-party cloud applications and tools.

The third type of cloud computing capability is Platform-as-a-Service (PaaS) where application development platforms allow users to leverage there source so established organizations to create and host applications of a larger scale than an individual or small business would be able to handle.

4.Benefits Of Cloud

4.1.Virtualized

In this case, each user has a single view of the available resources independently of how they are arranged in terms of physical devices. Based on this backdrop, the resource provider could serve a greater number of end-users with fewer physical resources.

4.2.Service-Oriented

Cloud is implemented using service-oriented architecture design. All users have the ability to access resources they need at any time through a standard internet connection.

4.3.Elastic

Resources, that is, computing, storage, and network capacity, required for cloud applications can be dynamically provisioned and varied i.e., increased or decreased at runtime depending on user QoS requirements. The major cloud providers such as Amazon provide services for automatic scale-out and scale-in based on hosted application requirements.

4.4.Dynamic and Distributed

Cloud resources are virtually distributed to enable the delivery of high-performance and/or reliable cloud services. There sources are flexible and can be utilized according to end-user requirements such as software and network configuration.

4.5.Shared Cloud
Clouds are shared infrastructure where resources serve multiple customers with dynamic allocation according to their application's demand. This sharing model is also termed as "multi- tenant" model. End-users neither have any direct control over physical resources nor are aware of the resource location and with whom they are being sssshared.

4.6.Metered Services
In cloud computing, customers pay for services on a pay-per-use (or pay-as-you-go) basis. The pricing model can vary depending on the QoS expectation of application. Cloud IaaS providers such as Amazon price resources using market models such as commodity or on-spot pricing models. A pricing model proposed by Alleno for & Thulasiram (2008), for grid resources, could be used as a base for cloud resources. This characteristic addresses the utility dimension of cloud computing. That means, cloud services are offered as "metered" utilities where providers have an accounting model for measuring consumption are critical in pricing plans and models

4.7.Autonomous
The cloud providers offer highly reliable services by adapting themselves in case of failures or performance degradation.

4.8.Operational Expenditure
The cost of cloud is an operational expenditure rather than a capital expenditure. With the expenditure, decision making is shorter and less complex; risks are lower and easier to anticipate. Financing of the model is not external.

5.Challenges Of Cloud

5.1.Data Protection
Data Security is a crucial element that warrants scrutiny. End-users such as business organisations could not be associated with cloud unless vendors assure them of business data security. They fear losing datato competitors and the data confidentiality of consumers. In many instances, the actual storage location is not disclosed, adding onto the security concerns of enterprises. In the existing models, firewalls across data centres (owned by enterprises) and other innovative techniques could be applied to protect sensitive information. The Service providers are responsible for maintaining data security and end-users would have to rely on them.

5.2.Management Capabilities
Despite the existence of multiple cloud providers, the management of platform and infrastructure is still in its infancy. A feature like auto-scaling is a crucial requirement for many enterprises. In view of this, there are need to improves calability and load balancing features of the model.

5.3.Government Regulations
Government regulations do not allow customers' personal information and other sensitive information to be physically located outside the state or country. In order to meet such requirements, cloud providers need to set up data centres and/or storage sites exclusively within a country or region to comply with regulations.

5.4.Energy Consumption and CO_2 Emission
The cloud model is faced with the challenge of utilising energy in an effective and efficient manner. Cloud resources such as servers, networks and data centres consume a lot of energy. In view of this, there is a need for a concerted effort of all stakeholders such as governments, regulators, network and service providers, producers, consumers, and research institutions, to come up with strategies of utilising energy and minimising greenhouse emissions from data centres, cooling plants, servers while availing cloud resources for the sake of sustainable development.

5.5.Other Challenges
No universal set standards and/or interfaces have been defined, resulting in a significant risk of vendor lock-in.
All access to the cloud is done via the internet which has not been well developed and accessed by the majority of the end-users especially in developing nations.
Some cloud providers support specific platforms and languages only.
The amount of control that the user has over the cloud resources varies greatly between providers.

6.Conclusion
Cloud is an evolving model that utilizes internet to offer software, hardware, storage and computing resources to various stakeholders such as business enterprises, consumers, governments, and the society in general. The model justifies efficiency and effectiveness of natural and capital resources for sustainable development. Despite the challenges facing the model there is need for world nations with a concerted effort to establish a working policy that would govern ICTs in their economic plans, adopt renewable resources of energy

such as the sun and wind in order to minimize carbon emissions and set aside resources for further research and innovation for development of ways of utilizing energy, minimizing waste and developing equipment, Storage Area Networks that consolidates all storage. The use of energy efficient disks such as tiered storage (solid state) allows better energy efficiency utilization and environmental protection. There is also need to educate the global population on the need of utilizing ICTs in the production, provision of services, living harmoniously though diverse in terms of culture, perception, social status, educated or non-educated as part of sustainable development.

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