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Utilisation of Green Cloud Computing: A Way towards Sustainable Environment

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Abstract

Cloud computing refers to utilising different computer systems at the same time. GCC can be regarded as a differentiated cloud computing system that helps to promote environmental sustainability. The present study has been carried out to evaluate the impact of using Green Cloud Computing or GCC for fostering environmental sustainability. The research has been conducted by following a secondary qualitative data collection method and the collected data has been analysed by thematic analysis. The Materials and Methods section consists of the appropriate methods and techniques chosen by the researcher. The findings of the study suggest that the functions of GCC highly differ from "traditional cloud computing technology" and help to foster sustainable practices. The main contributions of GCC have been observed to be reducing energy and power consumption, increasing "energy efficiency", decreasing costs and increasing operational efficiency. Therefore, this technology can be considered to be among the technologies with an effective impact on the surrounding environment. The following research has been aimed to assess the influence and effectiveness of GCC in order to foster sustainability. It has been observed that utilising GCC can help to integrate potential tools and systems for encouraging sustainability within the operations and can reduce operational costs by reducing energy usage. Though it consists of several drawbacks, such as expensive implementation costs and comparatively low knowledge among the employees, promoting effective strategies and practices can prevent these issues. Integration of GCC is crucial for lowering the carbon footprint of a business and increasing the efficiency of technology and systems.

Keywords

Environment Friendly, Environmental Sustainability, Green Cloud Computing, Traditional Cloud Computing Technology.

INTRODUCTION

Green cloud computing refers to a specific environment-friendly cloud-based information technology service. The main purpose behind using this technology is to enhance environmental sustainability by fostering recyclable resources and decreasing the usage of harmful technical components. Using ***green cloud computing*** or GCC provides several advantages to enhance environmental sustainability, such as optimising resource provisions, "multi-tenancy environment" and most crucially, reducing carbon emissions. The present study has been carried out to assess the sustainability impact of using GCC by exploring associated aspects. This study has highlighted the importance of using GCC along with exploring issues and potential solutions. GCC has become a major practice for improving environmental sustainability and regarding this, many previous studies have been focused on evaluating the sustainability impact of GCC.

Aim and objectives

The aim of this research is to illustrate and assess the effectiveness of using green cloud computing for enhancing environmental sustainability.

Objectives

- To evaluate the factors differing green cloud computing from traditional cloud computing systems.
- To illustrate the importance of using green cloud computing for promoting environmental sustainability.
- To identify issues of using green cloud computing and recommend potential solutions.

MATERIALS AND METHODS

Research design

Research design can be referred to as the framework consisting of the techniques and methods selected for the research procedures. This method can be categorised as experimental, correlational, explanatory and exploratory. ***An exploratory research design*** has been selected to investigate and gain a clear understanding of the research problem. An exploratory research design is used for investigating a particular phenomenon and developing new knowledge [1]. This research design will help to explore available data and identify potential issues for future research. Considering the advantages of this research design, it has been chosen to follow in the study.

Research approach

Choosing an appropriate research approach helps to guide the data collection and analysing procedures effectively. Using an inductive approach enables the researcher to gather potential data to develop answers to the research questions [2]. Considering this, ***an inductive research approach*** has been chosen to use in the present study for collecting data in accordance with the research subject and guiding the research procedures towards achieving the research objectives.

Research philosophy

Research philosophy is regarded as the philosophical assumption that guides the methods and processes. ***An***

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interpretivism research philosophy has been chosen to interpret the aspects of the research phenomenon. Using this particular research philosophy will help to interpret the collected data to evaluate the importance of GCC for environmental sustainability.

Data collection procedure

In the present research, the researcher has decided to use ***a secondary data collection method*** to collect qualitative data associated with the research subject. A secondary qualitative data collection will help to explore existing data on the research phenomenon and gain in-depth insights. The secondary data collection method is cost-effective and provides access to a large amount of structured data potential for the research problem. In addition, it provides an effective opportunity to access large volumes of data.

Inclusion/exclusion criteria

Inclusion criteria

- Websites and journals published on or after 2018 have been used for data collection
- Journals and websites published in the English language have been used
- Reliable journals with relevant data for the research subject have been included

Exclusion criteria

- Journals and websites published before 2018 have been excluded
- Journals and websites published in other languages than English have been excluded
- Websites and journals that are not reliable or do not contain relevant data have been excluded

Data Analysis

Data analysis is among the essential procedures of research that involves structuring, assessing and interpreting the gathered data. A secondary qualitative data collection method has been selected in the present study and in order to analyse the data, ***thematic analysis*** has been chosen to conduct. Thematic analysis is used for gaining a better understanding of the internal patterns of the collected data [3]. Therefore, the researcher has chosen this particular data analysis method to analyse and illustrate the aspects associated with the environmental sustainability impact of GCC.

RESULTS

Green Cloud Computing or GCC and its difference from the traditional cloud computing system

Green Cloud Computing or GCC can be considered an innovative type of cloud technology that is environment-friendly. This technology has combined environmental sustainability with information technology and provides several benefits and advantages. Cloud computing technologies have become essential for services associated with information technology [4]. However, GCC differs from other cloud computing technologies and involves using recyclable resources including energy for operations. GCC uses minimal harmful resources of computing technology for ensuring less environmental impact. On the other hand, the components of GCC are "consuming energy for computing", "physical infrastructure of the data centre" and "communication" [5]. GCC is used for improving economic capability and reducing the usage of harmful technical resources and enhancing "energy efficiency". Apart from this, using GCC helps to utilise "environment-friendly" technology and tools as well as enables the management of power systems more effectively. These aspects have turned GCC to be an essential technology in business organisations.

Using GCC in business organisations helps to reduce carbon emissions and also enables the integration of less-energy-consuming practices. GCC can be regarded as designing the “cloud computing” technology to reduce harmful impacts on the environment [6]. Traditional cloud computing refers to using different computer systems and materials together, which have a major impact on the surrounding environment. GCC involves utilising “environment-friendly” resources and technology that decreases the harmful impact and promotes sustainability. Using GCC in the business organisation provides several advantages, such as reducing technical costs, “energy consumption” and integrating “biodegradable material” [7]. Therefore, it can be stated that GCC is a term involving IT services and technology that differs from traditional cloud computing systems and reduces environmental impacts. It involves “environment-friendly” tools and services and fosters sustainability. Thus, GCC differs from “traditional cloud computing technologies” and can prevent the hazardous impact of traditional technologies.

Evaluation of the impact of Green Cloud Computing on environmental sustainability

Cloud computing systems have become essential for business sectors and other areas to access IT services. However, cloud computing systems involve using different techniques that have a major impact on the surrounding environment and contribute to the carbon footprint. Due to the increased use of the internet and advanced technology, the environment has been rapidly affected and GCC has the potential to reduce this impact [8]. GCC is also termed “green information technology”, as the term “*green*” involves reducing energy consumption and “environmental impacts”. This technology also reduces the usage of harmful chemicals and materials for computer systems and uses “biodegradable materials” with the aim of increasing “energy efficiency”. Using GCC enables the conservation of energy along with reducing carbon emissions and e-waste [9]. Additionally, it reduces e-wastes, such as harmful chemicals, polluting gas emissions and hazardous parts that can affect the environment, human health and the network as well.

GCC mainly involves decreasing the harmful impact on cloud computing systems and other advanced IT systems and

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helps to integrate reusable energy, recyclable materials and practices that can improve environmental sustainability. This technology allows access to IT services and is environmentally conscious at the same time. The main aspects associated with the impact of GCC on the environment are "e-waste" and "energy efficiency" which help to integrate "energy-efficient" technologies and systems. Apart from this, using GCC helps to promote environmental sustainability as it decreases carbon emissions and other harmful impacts, including consuming a high volume of energy and leaving hazardous waste and harmful gases. GCC involves reducing energy consumption by optimising the energy-consuming practices of the server [10]. Thus, utilising GCC have a major positive impact on the surrounding environment and fosters environmental sustainability that can benefit business organisations.

Illustration of the importance and advantages of Green Cloud Computing

GCC is mainly used with the aim to reduce environmental impacts posed by UT systems and tools. It involves reducing the energy consumption and the carbon footprint of technical tools and provides various advantages for business organisations to promote environmental sustainability. The main purpose of GCC is to increase "energy reservation" in IT tools and devices [11]. Along with that, it enables to utilise the minimal amount of "computing materials" for completing a task that involves less energy consumption. Using GCC enables business organisations to achieve economic goals by reducing costs in technical operations. It has been observed that in order to integrate GCC within the IT system of an organisation, "energy consumption" practices have to be monitored effectively [12]. This technology helps to decrease the usage of harmful materials, such as non-disposable waste materials and harmful chemicals that poses a direct positive impact on the surrounding environment.

GCC helps to increase "energy efficiency" and enables the management of power in order to establish a sustainable conscious business. On the other hand, the most emerging concern of global businesses is "environmental sustainability" which is affected crucially due to the high use of advanced technology and energy consumption. "Stakeholder integration" and concerns play a crucial role in fostering "environmental sustainability" in business organisations [13]. One of the major advantages of using GCC is that it reduces the "carbon footprint" which enhances the reputation of an organisation. Additionally, it also improves waste management and disposal practices. Integrating GCC not only decreases "energy consumption", but also reduces associated costs; hence, it is regarded as a cost-effective technology. GCC helps to prevent the challenges of IT tools and systems [14]. These are the major advantages provided by GCC and it helps to improve the sustainability practices of an organisation along with fostering "environmental-friendly" resources and materials. Maintaining GCC can provide economically beneficial impacts for an organisation.

Identification of the issues of using green cloud computing and potential solutions

Using GCC in business organisations enables the improvement of "environmental sustainability" and provides several effective advantages; however, integrating this technology has some drawbacks too. Cloud computing technologies face several issues such as cost, "resource management" and management of big data [15]. The major issues associated with the integration of GCC are as follows,

High integration cost: The integration process of GCC is highly expensive and requires huge investments. Hence, it can be an issue for medium or small-sized business organisations. In addition, GCC involves consuming green or clean energy, integrating which can be costly also.

Less awareness and knowledge: The implementation procedures and operations of new and innovative technology require experienced and trained professionals. The GCC is a relatively new term in cloud computing technologies and there are very fewer courses and training available on GCC.

Time-consuming: The sudden implementation of "energy-efficient" technologies and tools within the IT services can be a challenge for an organisation [14]. These issues have been addressed as the most pertinent issues that can emerge in the implementation processes of GCC and in order to mitigate these issues, the organisations have to adopt effective strategies.

Business organisations have to support GCC in order to promote "environmental sustainability". In this regard, using "energy star-labelled" materials and products can be an effective suggestion. Organisations have to decrease "energy consumption" and switch off the "computing devices" in spare time can be a solution. GCC involves reducing the harmful impact and associated challenges of cloud computing systems, integrating "cloud virtual machine" can help to simplify the procedures [16]. In addition, organisations aiming to integrate "green information technology" have to arrange training programs for employees before installing GCC tools and systems. This practice will help to manage the implementation process efficiently and will also increase the flexibility of the responsible employees.

DISCUSSION

The present study has been focused on evaluating the influence of ***Green Cloud Computing*** on promoting a sustainable environment. In this regard, secondary data has been collected and analysed and the results indicate that GCC is crucial for reducing the harmful impacts of advanced technology and associated devices. GCC differs from traditional cloud computing systems and comes with various opportunities. It is cost-effective and decreases the "energy consumption" of IT servers. Apart from this, using GCC rather than traditional technology enables the reduction of "energy consumption" as well as "carbon emission" of business organisations. GCC involves providing "green service" to decrease harmful impacts on the environment [17]. In addition, it also helps to reduce the technical costs of

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business organisations, though the implementation process has been observed to be expensive for middle and small-sized organisations.

GCC mainly involves the technology and tools of IT systems that are "environment-friendly" and helps to reduce "energy consumption". It has been observed that using GCC in business can help to integrate "environment-friendly" practices and systems. Cloud computing systems increase the efficiency of security and operations of IT tools and activities [18]. Apart from this, using this technology allows the organisation to focus on integrating "biodegradable materials" rather than harmful and hazardous materials and resources. The "energy-consumption" practices of GCC influence the reduction of e-waste and hazardous chemicals that can pollute the environment. Hence, it can be stated that utilising GCC helps to promote a sustainable environment and it also has the potential to improve the reputation of a business organisation. Nowadays, customers are most concerned with sustainable practices of business organisations and integrating GCC tools can help an organisation to achieve its intended financial capability.

The key aim behind integrating GCC into the IT systems of an organisation is to decrease harmful impacts as well as increase the efficiency and flexibility of the "product lifecycle". It also helps to decrease costs associated with technical expenses due to reducing "energy consumption". The main difference between GCC with "traditional cloud computing" technologies is that cloud computing tools have a major issue of extra costs due to power consumption [19]. Another differentiating factor has been observed to be "carbon emission" and GCC reduces both of these aspects. GCC is an innovative technology that has emerged to reduce "environmental impacts" by reducing "carbon emission" and "energy consumption" in different technologies and computer systems [20]. It has been observed that utilising GCC provides several effective advantages such as minimising operational costs, integration of "computing materials" and increasing "energy reservations".

GCC provides various advantages, however; several drawbacks of this technology have also been identified. Among the issues of GCC, the major challenge is a high integration cost and relatively low awareness and knowledge. The term is comparatively new in cloud computing and IT systems and regarding this, the knowledge in this particular area is also low. Due to this a lack of suitably skilled professionals for maintaining this technology has been observed. However, preventing these challenges can promote a higher level of efficiency and flexibility. It has been observed that integrating cloud computing systems efficiently can help to establish a sustainable and "green society" [21]. In this regard, business organisations can focus on utilising "star-labelled products" and decrease energy usage along with reducing operations costs. The tools and systems empowered by GCC are dynamic and have the potential to minimise "power consumption" [22]. Organising training programs for potential candidates can help to prevent the lack of suitably skilled employees to maintain GCC tools and systems.

CONCLUSION

The following research has highlighted the influence of using ***Green Cloud Computing*** or GCC technology on promoting a sustainable environment. Considering the overall discussions, it can be stated that GCC is among the emerging technology that has gained significant popularity and acceptance due to its effective influence on reducing harmful impacts posed by "traditional cloud computing technology". An exploratory research design has been used to gain a better understanding by exploring potential aspects associated with the research phenomenon. The inductive research approach has been used for collecting reliable data and an interpretivism research philosophy has been used for interpreting the collected data. A secondary qualitative data collection method has been used for collecting reliable data from existing studies and the findings reveal that using GCC provides various advantages and opportunities for business organisations, including minimising "energy consumption", "operational costs" and harmful waste.

This technology can be regarded as one of the most innovative technologies that have the potential to promote a sustainable environment by preventing the harmful impacts of other advanced technologies. Several issues associated with GCC have been identified, such as very little awareness and availability of trained professionals, expensive integration costs and high time consumption. It has been observed that arranging training programs and focusing on reducing energy usage and associated costs can help to prevent these issues.

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