# How Cloud Computing and Business Intelligence support UAV Technology

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**In recent years, the majority of UAVs are implemented using technologies that require a lot of effort, budget and time. This will consume the available resources in an exaggerated manner and will therefore affect the overall performance of the UAV itself. In this paper, we present the use of cloud computing in conjunction with business intelligence for the aim of adding more efficiency to the UAV technology in the high speed era and the use of 5G technology. The recent introduction of the cloud computing is a very good opportunity which can support business intelligence. Through this paper, we will discuss the procedure of mapping cloud computing to the UAVs and the challenges that will be emerged when doing so. Many of these challenges are not limited to the UAVs energy levels, motion, and GPS settings.**

***Index Terms*—UAV, Cloud Computing, Business Intelligence, Knowledge Management, Internet.**

## I. Introduction

THE use of Unnamed Aerial Vehicles (UAVs) are getting a huge attention nowadays as it becomes so popular not only with the military missions but also with civil tasks as well. This new era of technology has proven to be effective in the duties that it accomplishes. This paper describes how this new innovation has totally changed people's lives in terms of how we work and interact. The field of Information technology has rapidly grown within a short time. The innovation of internet has even brought world very closer. Indeed information technology has saved both time and resources; a duty which needed one to travel several miles (consuming money and time) to undertake can now be done by just a click at the icon. Advancement of IT has played an instrumental role in helping business grow. Through the use of internet, many business transactions can be performed without face to face interaction between the seller and the customer. Business Intelligence refers use of computer techniques to maintain data within a business enterprise. It is where the technique is used in analyzing data related to day to day running of business like, sales revenue, purchases, productions and other associated incomes and costs within different departments. Business intelligence is very important for any company because it shows the status of the company from the past, present and can also be used in the prediction of the future. The main aim of Business intelligence is to help the management in making informed decisions. Cloud computing is defined as the transformation of the known computing landscape through shifting both hardware and cost of managing a computer center to a third party like goggle, yahoo and other providers. Cloud computing is a service that enables business owners and companies to deploy world scale services through paying a marginal cost of actual resource usage. Bose, R. [1] described cloud computing as an extensive collection of web services which are aimed at providing the users with a wide range of functional capabilities that tremendously required professional skills, hardware and software investments to acquire in the past. The researcher continued to describe cloud computing as the realization of earlier ideas of efficacy computing without complicated deployment uncertainties or any technological complexities.

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## II. Advantages of Cloud Computing to Business Intelligence

### A. Time saving

Business intelligence needs a software that is both efficient and effective, unlike the software maintained by the companies, cloud computing is a one stop shop where a wide range of programs can be obtained [8]. In addition, it saves the company time needed to acquire new programs for its operations, one only need a computer which is connected to interned and the whole program will be set.

### B. Less glitches

Through cloud services, different departments are able to integrate various forms of applications like word processor, management systems, and e-mail [1]. It has been proved that applications which are connected to cloud services require fewer versions. In addition, the fewer the glitches, the more the employees are expected to be productive [1] . Computers connected to cloud services needs less upgrades, this is because upgrades are typically done by the service providers.

*1) Cost cutting*

The aim of every business id to maximize profit. Literally, to have a high profit, the business must make high sales and cut on costs i.e. the sales must be higher than the expenses. Cloud computing service is one way through which business can use to cut the cost [1]. First, connecting to cloud services will save the business on the cost of buying both software and hardware which are underutilized. In addition the company will need to cut the number of IT staff.

*2) Mobility*

With the advancing world, some employees would like to continue working even when they are out of office. Through cloud services, employees are able to access their offices anywhere in the world provided they have a computer connected to the interned [1].Thus, cloud services have helped the business to become mobile. Cloud services provides business with all the services they need anywhere in the world. It enables employees to make sales over the phone. Indeed cloud services has open a whole world of wireless devises which can be used to access any application; thus sales persons are motivated to do their work without even reporting to the office on daily basis. With the advancing world, some employees would like to continue working even when they are out of office. Through cloud services, employees are able to access their offices anywhere in the world provided they have a computer connected to the interned. Thus, cloud services have helped the business to become mobile. Cloud services provides business with all the services they need anywhere in the world. It enables employees to make sales over the phone. Indeed cloud services has open a whole world of wireless devises which can be used to access any application; thus sales persons are motivated to do their work without even reporting to the office on daily basis [1]. Through use of Cloud services, the business is able to expand on their customer base. Through cloud services, entrepreneurs can utilize social networks and social media like Facebook, Twitter, and LinkedIn among others to intensify their productivity. In addition, blogs are also important in displaying the products of the company and collecting customers views on the products. Through these social networks businesses are able to send information about their products and receive feedback on return. Through the cloud services, businesses are also able to use new advertising techniques through other sites; businesses which have employed these techniques have been seeing the advantages associated with this modern technique. In the past, companies have been involved in regular purchasing of new/ latest software hoping that the new software will improve efficiency and sales. In this case the old software will become redundant [1]. Sometimes, the new software fails to meet the needs of the company because some of the company's require a personalized touch that ordinary software does not provide. Through cloud services the business is able to change to appropriate software without any additional cost. Moreover, the cloud computing technology is easy to install and run [2].In addition, companies have been losing both time and money in sorting out software problems, reinstalling programs or when updating software. With the introduction of cloud services, these problems are highly reduced since there is no need to reinstall new programs or update software since they are done by the service providers.

## III. Disadvantages of Cloud Computing to Business Intelligence

With the numerous rewards that come along with the cloud services, numerous studies have revealed that many companies fear venturing into this new technology mainly due to security reasons. Other works have categorized security concerns into three; Traditional security, Third- party data control, and Availability.

## IV. Security

Traditional security involves network attacks or intrusions that will be made easier if a company moves to cloud services. Business secretes are very important, and once leaked out, the competitors might use the same against the business. In response to this concern, cloud services providers have been arguing that they have put in place security measures that are more mature and have been tested as compared to those of average companies[10]. It is the duty of the cloud user to protect the infrastructure which they are using to connect and interact with the cloud service, a task which is complex since the cloud is outside the firewall in many cases [5]. Even through the cloud computing is cheap at the long run as compared to the traditional technologies, it is true that it is a new technology which is still under research and improvements which makes it expensive The service providers have to invest a lot of money in setting up and running of the cloud service, the same costs are transferred to the business in terms of startup cost which is always very expensive.

## V. Methodology

Due to the type of information required in this study, which will be both qualitative and quantitative, questionnaires will be used. In the organizations that have not yet integrated cloud computing into their systems, the questionnaires will have questions that wish to find the challenges that the organizations face in knowledge management and the perceived benefits they expect when they embrace cloud computing[11]. In addition, the questionnaire will also gather information on the challenges that these organizations faced if they had contemplated integrating cloud computing in to their knowledge management. Questionnaires will also be administered to the organizations that have successfully implemented cloud computing into their knowledge management practice to determine how it has benefited them in responding to the challenges that they faced prior to them embracing the technology[6]. In addition, the questionnaires will seek to find the challenges that they face in using the technology currently and how they think those challenges can be addressed. Quantitative data will be collected from the bureau of statistics to determine the levels of awareness of the benefits that come with integrating cloud computing into the knowledge management system, in addition, information on the usage rates of the cloud computing in knowledge management across different organizations in different industries will be sought.

## VI. Mapping Cloud Computing to UAVs

Cloud computing is considered to be one of the current revolutions in the information technology field[9]. It has the ability to spread and reach users in a convenient way as well as to its efficiency in getting what is needed to be done smoothly which is the case when used in combination with UAV [10]. As we already know cloud computing has three main services;

Software as a Service (SAAS), Platform as a Service (PAAS) lastly Infrastructure as a Service (IAAS). The (SAAS) includes software that are available online via third-party and can be accessed by APIs. Some applications are required to be implemented to request certain functions to be done by UAVs as in the case of spraying crops in large farms[12]. Here, the user requests the application to determine the location and the land size before the process of spraying the crops by UAVs. The other advantage to this is; it allows the user to observe the progress of the mission until it is completed [10]. The shared services can play a role also in managing other different functions such as; the cameras for observing; GPS for location and filling tanks with fertilizers for yields spraying. Another example is scanning the forest for bushfires to find the cause of it [10]. The UAVs here can use customized functions for sensing temperatures, taking photos and updating other services that need real-time information. PAAS on the other hand has both hardware and software tools available over the Internet. It allows functions integrations involved by the cloud to the UAVs [10]. The resources are either needed services or customized one. Essential services are services required for the collaborative UAVs such as scheduling missions and ensuring security for the sake of protecting UAVs resources [10]. Customized services on the other hand are dealing with advanced services that offer specific functions required by some tasks as in creating 3D maps. Then we have (IAAS) which work with cloud-based and pay as you go service and is divided into static and dynamic components. Static components include transceivers and monitor devices and well as to the cloud computing storage. Dynamic components has the UAV hardware with its payload, sensors, memory and processors; which are managed by PAAS. [12] describes the structure of this concept further as shown in figure.1

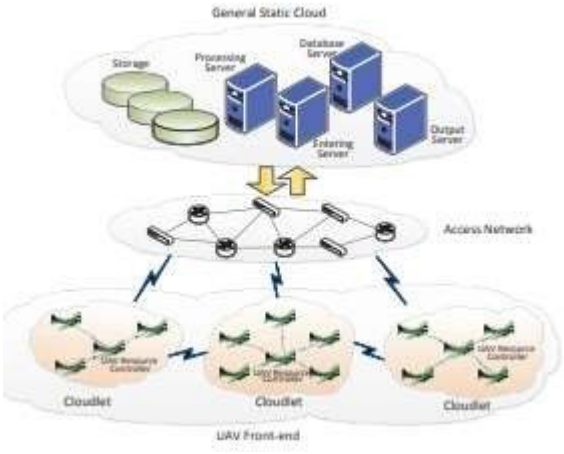


Fig.1 The structure of the cloud based multi UAV System

## VII. Challenges

There are some challenges that need to be mentioned when applying collaborative UAVs cloud; which are as follows[10]:

- Energy supply: It is expected to assume that in some cases UAVs can run out of Energy. This in return can affect different collaborative UAVs cloud features. This requires us to build a balanced-energy system that can deal up with such emergency situations.
- Security: Using many UAVs in conjunction with the cloud increases the potential of security flaws to occur. In addition to the fact of being the UAVs are extensively deployed in sensitive operations especially when used in military cases. Getting infected by malware is very common when dealing with unsecured connections and collaborative UAVs cloud is not an exception. Therefore; it is important to ensure the reliability of the connections before using these two combinations.
- Resources Management: Some UAVs have limited capabilities. So when combining those capabilities with the cloud it is expected to be consuming the available resources. This in turn will require algorithms to be scheduled and allocated effectively.
- Transport Protocols: When applying transport protocols while using UAVs in conjunction with the cloud; it is expected to have some communication errors. The use of Transmission Control Protocol (TCP) can lead to high traffic and resources consumption. While using User Datagram Protocol (UDP) on the other hand; can generate less overhead and traffic as well as to not ensuring the delivery of the packet. Therefore; it is preferable to implement a new efficient transport protocol in order to solve this challenge.

## VIII. Related Work

Chmaj and Selvaraj [3] mentioned a study about distributed UAVs applications. The applications they addressed are objects detection and tracking. This is done where UAVs are searching and detecting a specific entity then track it using a group of UAVs interconnecting with each other[2]. Varela et al [11] presented an example where UAVs are used for environmental monitoring aiming in collecting data on air quality of the different layers of the atmosphere. The reason of them choosing the atmosphere is because of the fact that some information cannot be gathered by ground system since gases and fire smokes are spread over specific regions. On the other hand, Fausto et al [4] suggested an architecture for implementing UAVs and a Wireless Sensor Network (WSN) in agriculture applications. The authors built a system of Collaborative UAVs to be able to spray fertilizers in farming areas [9]. These areas can be reached with struggle by people[4]. The benefit of this approach is ensure that the spraying process is not repeated and are not done outside the farming boundaries. Luo et al.[8] proposed a cloud supported UAV architecture where UAVs are implemented with a real-time data processing ability by uploading video data to the cloud servers. This may cause high communication latency in some cases [7]. Moreover; Kalatzis et al [6] suggested the edge and fog computing concepts aiming to reduce the energy consumption in UAV applications. The downside to their approach is the inability to edge servers to offer redundant computation capability to handle complex missions.

## IX. Knowledge Management Support

Cloud computing has brought insurmountable benefits to the field of knowledge management with issues such as server outages, which before would affect the operations in an organization being a thing of the past now since data is retrieval is now not based on the servers. In addition, due the dynamic nature of organizational operations that requires employees to be always on the move, it is necessary that these employees can be able to access databases belonging to their company and cloud computing has brought this benefit to them therefore making their work easier. For knowledge management to evolve in the future of cloud computing, managers of knowledge management in an organization should try to look outside to other sources of knowledge in addition to external applicability of the knowledge that is present within the confines of an organization. Managers should be ready to be innovative, experiment with tools like social media and co-creation, and combine them with the old search and database facilities. This paper will conduct a study on the benefits that cloud computing has brought in knowledge management practices, this will entail looking at the extent of application of cloud computing in knowledge management currently and the special features in cloud computing that have made realization of these benefits possible. To establish long-term and sustainable competitive advantage in organizations, knowledge management has been viewed as critical in streamlining the operations within an organization. In fact, many tasks within the workplace requiring well-educated and qualified employees, knowledge has emerged as a critical factor of production. Among the major companies that have embraced the critical role of knowledge management include law companies,accounting, engineering, advertising agencies, and high-tech companies among others. However, the main challenge among these companies is how to implement knowledge management and support production without compromising the role of other factors of production within the companies.

## X. Conclusion

Based on the discussions above, it is clear that the advantages of cloud services to the UAVs supersede the disadvantages. It is also important to note that nearly all human innovations have both pros and cons. Just like the other innovations, cloud services may not be free from pitfalls but it still having a very impressive look to the modern business that are in the search for cost effective ways to improve working conditions of their employees and help in improving the visibility of the business to the outside world. With the present economic situations, it is clear that cloud services are here to stay, it is important that business owners should embrace this technology before they are forced into it by the situation. There are proves that the businesses who have begun employing the initiative of cloud services have seen decrease in expenses and increased profitability. This paper aimed at discussing on the pitfalls and upsides of cloud services to the UAVs and to the business intelligence, and provides an oversight to the companies which are thinking of employing this service. Apart from the discussed advantages and disadvantages, business management needs to consider other factors before choosing a cloud model. Thus, they should take into considerations the security requirements and the availability of cloud solutions.

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