

TECHNICAL NOTE

CLOUD COMPUTING SYSTEM ON PROJECT MANAGEMENT TO SUSTAIN NATURAL ENVIRONMENT

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Abstract: The world ecological system is known to have a harmful affect due to the global warming phenomenon. Many companies currently were trying to give their best possible solution in preserving the environment. Cloud Computing is an Information Technology Infrastructure which is believed to have potential to become a new initiative to overcome the environmental condition. It is because this technology has ability to decrease the paper consumption in human daily activities as all the information was centrally stored in the server and it can be easily shared with other users who used the same application. In project management including e-tendering, the application of cloud computing is begin to be adopted whereby it provides a systematic approach for the participants and it is known as profitable paperless building project. Besides, there are also a lot of cloud computing which can be applied in project management such as Dropbox, Google Apps, Amazon Cloud Drive, Microsoft Office 365, Autodesk Buzzsaw and Box Enterprise. The purpose of this paper is to find out the benefits in using cloud computing system in project management as the system is not only offers its own beneficial in terms of technicality but it able to achieve the goal towards paperless. The methodology of the research is based on the intensive information gathered pertaining to the Cloud Computing which has been practiced in project management. In conclusion, it is crucial in bringing the solution towards the energy efficiency in order to protect our environment. Thus, cloud computing offers the best possible solution to sustain our natural environment as it provides the nature of paperless in daily human and business activities.

Keywords: *Paper consumption; cloud computing system; project management; sustainability, natural environment*

1.0 Introduction

The world is currently having a major environmental crisis which is global energy consumption, global warming and climate changes. The expansion of human actions is mainly contribute to this environmental challenge facing by the global as human loves to extract the natural resources, large-scale of deforestation, land degradation which all of this lead to the large amount of greenhouse gas emissions (Ministry of Environment, 2002).

According to Judson (2008), the major importance of environmental issue today is the paper consumption. It is because over 30 million acres of forest are destroyed annually and nearly half of trees from these affected forest also been cut which 50% used for the purpose of papermaking and paper production. Besides, paper has been described as the fifth largest energy consumer and among the greatest emitter of greenhouse gas.

However, in today's business activities, world people is increasing conscious that there are consuming and pressing on using bundle of papers. Besides, they are actually had a feeling of guilt on the rise used of paper in their daily routine and they are also concern towards its impact to the providence of trees and environment. Thus, a large extent of initiatives required to reduce paper consumption in everyday life process. Safe tree and reduce the consumption of paper is crucial for the purpose of environmental protection (Anand, 2013). As the paper is 95% produced by using the natural resources, the technology restriction and application is began to be adopted. A cloud computing is one of the initiatives which has been slowly gaining acceptance by organizations, especially in the office towards the paperless environment. Cloud computing is a web based application where all the application and operating system can be offloaded to service provided over the internet. For the office which has an intention towards paperless mission, this cloud computing providing a great solution to be implemented in their firms (Vuchnich, 2009).

Cloud computing is an IT infrastructure which conveniently installed on user's computer and the software is accessed through a web browser. Google Apps, Microsoft Online Service and Salesforce are among the current and leading cloud software in IT firms which able to prompt organization to embed online applications into existing operations (Moorhouse, 2011). According to Buyya *et al.* (2008), cloud computing facilitate users in keeping, achieve and exchange a lot of information between one another. It is useful for the organization which required in processing a big amount of data as it has its own beneficial features such as processing information related to clients.

Besides, cloud computing is normally used for business purpose and thus the users can easily collaborate with their colleagues in order to share all the information, either they are inside or outside of the office. This means that cloud computing is convenience and

accessible to use without having location limitations. In many cases, cloud computing is free to use such as Dropbox Google Docs, Microsoft Live SkyDrive where it allow the users to store their files up to a certain size. Other than that, the beneficial in using cloud computing is not only focus on the cost savings, but it also has its significant impact towards a healthy environment. It is because, cloud computing is one of the alternatives in reducing the paper usage as all the information is centrally located in the server. It is also able in reducing the old face-to-face meeting which required in bringing bundle of documents (Mayfield, 2011).

2.0 Literature Review

2.1 Global Paper Consumption

In human's daily routine, paper has been large consumed for the purpose of business such as paying bills, printing services and etc. Large paper consumption will certainly harm the environment as the paper's impact to the environment will be continued even after the paper has been thrown away. Besides, a large paper consumption also commit to the emission of methane and greenhouse gas emissions which then contribute in global warming phenomenon (Preton, 2010).

The office paper consumption per employee has been estimated and it is approximately 10,000-20,000 sheets a year is used and the amount has the possibility to be increase to 40,000 sheets per year. There are 500 sheets per ream and the average employee consumes each year is around 30 reams. If the company used a ton of paper per year which about 400 ream, it takes 12-24 trees to be cut down per year. Thus, it shows that organization or offices are cutting down million acres of forests every year. In fact, the larger the organization, the larger is the paper consumption. Furthermore, for each ton of the paper emits by an office, it is equivalent of 6.3 tons of CO² which extremely harmful to the environment (Preton, 2010).

Nowadays, around 90 % of paper pulp is made from wood of tree fiber. Basically, it's either comes from natural forests or from tree plantations. It's been estimated near to 13 % of total wood use for paper manufacture representing 1% of the world's total economic output. It is also shown that the production of paper is the third most energy-intensive and the paper and pulp industry contribute to the fourth largest emissions of greenhouse gases. When the paper decayed or decomposed, it release gas that 25 times more toxic that CO² (Environmental Paper Network, 2007). Table 1 shows the global annual paper consumption per capita.

Table 1: Annual Paper Consumption Per Capita

Pound / Kilo Per Person	
North America	504.84/ 229
Western Europe	393.98/178.7
World Average	120.62/54.71
Latin America	94.84/43.02
Asia	90.34/41
Africa	16.56/7.51

(Sources: Environmental Paper Network)

Usually in a single year, a total amount of 300 million tons of paper produces in the world is equals to destroy about 30 million forest acres which equals to the size of Pennsylvania State. Accordingly Table 2 shows the paper consumption rate for each person in a country (Martin, 2011).

Table 2: Paper consumed per person each year by country

Paper consumption		
The number of 4-foot tree "consumed" per person each year		
	2010 or Latest	1× = 
1	Belgium	8.51
2	Finland	7.28
3	Austria	6.83
4	Germany	6.35
5	Japan	5.83
6	Sweden	5.67
7	United State	5.57
8	Danmark	5.54
9	Switzerland	5.37
10	Netherland	5.24
11	South Korea	5.18
12	Canada	4.89
13	Britain	4.48
14	France	4.18
15	Spain	3.74
16	Portugal	2.87
17	Ireland	2.21
18	China	1.81
19	Mexico	1.69
20	Brazil	1.29
21	Russia	1.21
22	Indonesia	0.67
23	India	0.23
24	Azerbaijan	0.16

(Sources: Bureau of International Recycling)

By not paying enough attention to the sustainable issues, lots of natural forests have been destroyed. While at the same time, other parts of forest also have been affected by different factors like building and roads construction. In Table 3 shows different fact relating to damages which occurs in the production of a single virgin fiber paper has been reported.

Table 3: Fact on Damages Occurs to Producing 1 Ton Virgin Fiber Paper.

	1 ton virgin fiber paper
Tree	24 trees
Energy	32 million BTUs
Wastewater	22,219 gallons
Solid waste	1,922 pounds

(Source: Kinsella, 2012)

2.2 Cloud Computing

Cloud has been referred as datacenter of hardware and software. This service can be the most powerful system available that has the ability to rent a server or a thousand servers to run a geophysical modelling application everywhere. Besides, it can store and securing huge amounts of data that only can be accessed by authorized applications and users. Cloud provider sets up a platform which has ability to scale automatically in order to change the workload that includes the OS, Apache, MySQL™ database, Perl, Python, and PHP. This system also has ability to use applications on the internet where it stores and protect data while providing a service such as email, sales force automation and tax preparation. Storage cloud can be used to hold application, business, and personal data where it has the ability using Web services to integrate photos, maps, and GPS information and creating a mash up in customer Web browsers (Sun Microsystems, Inc. 2009).

According to Chong *et al.* (2014), Cloud computing are accessible in all web browser and it does not require any additional tools. It can be accessed through the product website with a username and password when the product license is purchased. Other than web browser, most of cloud application is accessible through mobile phones, tablet and custom applications such as Autodesk Buzzsaw, Projectmates and Paskr.

Figure 1 shows the application of cloud computing. In cloud computing, it allows people to use software as and when it is required with the most efficient use of resources. Internet and central remote server is the most essential ingredient of this technology in order to maintain data and application. In Cloud computing, all the document stores can

be access everywhere through desktop, tablets, phones and laptops by having the access to the internet. The major advantage is collaborating on shared documents and any changes in the document can be made by individual. Besides, cloud computing allows much more efficient computing by centralizing storage, memory, processing and bandwidth (Quddusi, 2014).

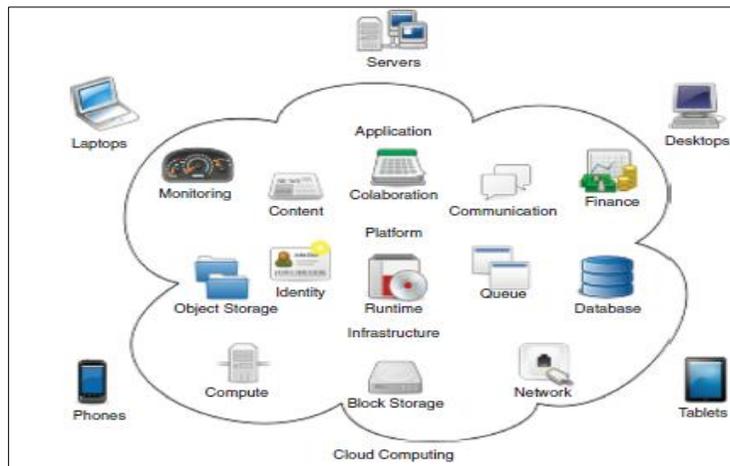


Figure 1: Cloud computing application (Quddusi, 2014)

In cloud computing, it consists of four major layers which are: (Cisco system, 2009)

i. Software as Service (SaaS)

In SaaS, the consumers purchase the ability to access and use the application which is hosted in the cloud. The application services are delivered over the network on a subscription and on demand basis. Besides, it also can be deployed with less effort. Google and Microsoft are among the provider for this service

ii. Platform as a Service (PaaS)

PaaS service allows the consumers to purchase in order to access to the platform, enabling them to deploy their own software and application in the cloud. Example of PaaS is Google Apps Engine, Amazon Web Services, and WebEx Connect

iii. Infrastructure as a Service (IaaS)

In IaaS, consumers have an ability to control and manage the systems in terms of operating systems, application, storage and connectivity network.

Besides, in cloud computing, the deployment model is different depending on requirements. There are four types of deployment models which support the needs of the services and cloud users which are: (Dialogic Corporation, 2010).

i. Private Cloud

Private cloud infrastructure is operated for a specific organization and it was operated either in-house or with a third party in the premises

ii. Community Cloud

In community cloud, the cloud infrastructure is shared among a number of organisations who are within the similar interest and requirements. The cost is shared among the organizations, and thus it helps to limit the establishment expenditure costs

iii. Public Cloud

Public cloud is available to the public for a commercial basis and it enables the consumer to deploy and develop services in the cloud with very little financial outlay.

iv. Hybrid Cloud

Hybrid cloud infrastructure comprises of several combination of cloud such as combination of private and public clouds. The purpose is to support the requirement in order to retain some data in the organisation. It has the ability through their interfaces in order to allow data and applications to be moved from one cloud to another.

2.3 Cloud Computing in Project Management

For a construction industry to be successful, project management plays a vital role as it involves policies, procedures, standards, guideline, technique and others. Project management is complex in many ways including the data distribution and thus many organisations frequently sophisticated towards information technology in construction industry as to maintaining the project management platform. The software application in project management such as Microsoft Project and Work Breakdown Structure (WBS) has been used by the construction industry players in managing the construction. However, the limitations of these software packages are they need to be installed and no interconnectivity between parties using the software. Thus, the introduction of cloud computing provides as an opening for a wide range of new functions and possibilities in project management (Chong *et al.*, 2014).

Cloud computing offer the project management embracing to the new way in arranging documents with paperless because the cloud computing provides ranging from simple storage up to complex computing process with paperless (Loan 2013). According to Chong *et al.* (2014), cloud computing facilitates the users to upload and store document or files in the application. Then, all of the documents can be shared with other users of the application which allow systematic control and management of the project documents without the need to use of physical paper.

Besides, the application of cloud computing in project management also provide a possible solution where the project can be managed in a simple way which the users can connect with the team members even during off-site. Not only that, all the documents related to the project can be access to different country by simply share, all the necessary files through the clouds, without the need to print out any physical document (Warren, 2013).

Other than that, project management includes project and programme plans, reports and others management related information which need to be held with much updated and amended. Cloud computing enables the project management to be function as central repository in the organisation in upgrading all new programmes and also hold the information related centrally in order to be easily access by others stakeholders. With the cloud computing, the project managers can be more covert in monitoring the changes within the project. This is not only greatly reducing the paper usage but also reduced the timeframe involve in face to face discussion. It helps the users to keep on track of their work and progress of the projects as well as getting the most up-to-date information (Moorhouse, 2011).

2.4 Types of Cloud Computing Application in Project Management

The general cloud computing application of cloud computing which can be used in construction industry or project management is Google Apps, Microsoft Office 365, Dropbox, Amazon Cloud Drive and Box Enterprise. Even though it does not specifically designed for construction, but it can be adopted in any type of business. The most basic cloud computing application which frequently used in project management is Dropbox and Amazon Cloud Drive. Basically, the function is to store files, photos, documents in the cloud without the need of physical paper and storage. The file stored can be accessed anywhere and can be easily downloaded in desktop or mobile. Besides, it also helps to synchronize and manage all the related files by creating a folder and it can be easily access while automatically synced to the cloud.

Besides, the Dropbox and Amazon Cloud Drive also offers an advantages in terms of file sharing as the file stored in the cloud can be shared with by having an invitation with the users who are using the same application. The shared file able to be edited, updated and synced to the cloud users that has the ability to access to the file (Chong *et al.*, 2014).

Other than Dropbox and Amazon Cloud Drive, there are some others comprehensive cloud application in project management such as Google Apps and Microsoft Office 365 where it can be accessed from a website with a web browser. This cloud application is very useful for e-mail, calendars, website editing, online storage, messaging and video chat. With this application, it offers easy communication in delivering information because discussion can be conducted through video calls, online messaging or posted notes on calendars. It shows that, with this cloud computing application it beneficial in terms of cost as it able to reduce a large usage of resources especially in paper consumption. Besides, it is also facilitates the users with higher security (Chong *et al.*, 2014).

Autodesk Buzzsaw is also one of the cloud computing application in Project Management which able to help in reducing the paper consumption. The function of Autodesk Buzzsaw is to provide solution to increase efficiency in construction project. Construction is conventionally paper-based system in managing the building project. The drawings was copied and distributed to all the participants and lastly bring for archived. However, it has been recognizing that this manual work is unproductive and inaccessible, thus Autodesk Buzzsaw provides solution in project management. With Autodesk Buzzsaw it enormously reduced the paper consumption.

Cloud computing has successfully bring an office or organization for being paperless and the reduction in photocopying savings alone have made a profitable investment. Even though it is not 100% paperless but it is closer to that. Besides, with Autodesk Buzzsaw also, it able to reduce the need for courier service which required a lot of documents coordination. Therefore, in Autodesk Buzzsaw, the physical project document has been converted to the server with a high security (Jonsson & Worren, 2007).

According to Autodesk (2007), the latest version of document distribution required a lot of paper usage to send and received documents which sometimes it can be misplace. Besides, the communication between the parties involve from design stage to construction process required the information to be ready quickly. Thus, with Autodesk Buzzsaw, it facilitates the user with easy environment by centralized all the project information such as drawing in one server. It helps to keep everyone in the same page with less use of paper, fax and file cabinet to stores documents and other facility information. This process is efficient in terms of communication as today project is geographically dispersed. Basically, Autodesk Buzzsaw has been achieve in terms of

savings in project especially in printing cost because the successfully reduced the paper consumption.

2.5 Application of Cloud Computing in Electronic Tendering (e-tendering)

One of the main focuses of cloud computing system is to convert traditional method in managing document by paper into electronic versions. Cloud computing in procurement provides innovations in entire procurement process which enables a new level of communication and collaboration in construction from initial, bidding process and other related procurement management. Besides, the cloud computing in procurement also is easy and secure for global access and able to reduce the cost such as document processing cost and paper handling (Proactis, 2012).

The increase towards local and international competition in construction industry leads to the need of the Information Technology system. E-tendering is procurement mode which is an interesting development for current construction industry as it involve in using the internet and other electronic version to facilitate and manage the tendering process. It is a simple technical solution based for document management and brings many advantages such as real time data input and availability, centrally located applications, accessibility to definable user, increased uptime and others.

The e-tendering system involve in uploading tender document process into a secure website with secure login and authentication. It offers automation in tendering process such as prequalification or registration, public invitation, tender submission, tender closing, tender evaluation and tender award (Mastor &Azizan, 2012).

The traditional tendering process starts by using a print media such as newspaper to publish the tender advertisement and it followed by filling the requirement and lastly submitting before the closing date. It was mostly guided and includes handling paper to send and receive records. Thus, e-tendering has been evolved as an Internet based tendering system to replace this traditional method. It provides sophisticated internet system which is able for the contractors to download and manage the complete tender document with specification in electronic form. It shows that all of e-tendering process are not required any paper being produced or paperless and thus it gives a beneficial to the organisations in terms of lower cost (Mastor & Azizan, 2012).

The paper based tendering is known to have an issue in the procedures which the paper bids often to have a drawbacks, expensive to handle and often having complications in solving conflicts due to the absence of document and records. Thus, the E-tendering is functioning to improve the transparency level of the tender system, screening qualified tenders, cost and time saving, as well as reducing the dishonestly among the contractor. However, among all the factors, the most important factors that influences the implementation of e-tendering system in construction industry is to reduce the usage of physical item because of the nature of e-tendering is predominantly paperless work

system and offers environmental friendly use. This is also parallel with the government objectives and intention in the implementation of e-tendering systems (Suhaida *et al.*, 2013).

According to Mastor & Azizan (2012), e-tendering able to minimize the paper usage by over 90% as the tender is viewed and submitted online. Besides, every document related for tendering purpose can just be downloaded and viewed via the internet with no geographical boundaries and thus making it convenient in reducing lead time by 80%. Other than that, the documents related are securely stored online and back up without having any physical copies or storage space. In addition, through the automation process in e-tendering which all the documents are online access, it helps to eliminate the flow for managing documents, reduces the document compilations which required a large amount of paper and thus savings more resources and breeze in processing hundreds or thousands tenders.

3.0 Conclusion

Paper creates a large amount of waste to landfill and it is also one of the biggest consumers of raw components such as water, energy, and woodlands fibers. Humans are among the largest producer and consumer of paper every year. The global paper usage each year can be enough to build a 10 foot high wall with 6,815 kilometers long. Besides, with the rapid consumption of paper, the effect towards the environment has becoming severe and the global warming is one of the aspects. Currently, most of organisations are aware the importance of applying technologies in their work routine because it can be cost-effective system, increases their work efficiency to a high extent as well as able to reduce the use of natural resources. Thus, applying computer based and paperless systems seems to be an efficient pattern to achieve this purpose. By using Cloud Computing system, it offers a lot of advantages for both human and also nature. The construction industry has been responsive towards the information technology tools and systems which one of the goal is for the environmental beneficial such as enhancement of paperless. The Google Apps, Microsoft Office 365, Dropbox, Amazon Cloud Drive and Autodesk Buzzsaw is the cloud computing application which is useful in project management in reducing the investment cost for paper consumption as all the information is centrally located in one server. Besides, the applications of cloud computing in e-tendering system also bring other benefits towards the construction industry because the goal of e-tendering itself is not only focus on technical matter but it makes consideration as a whole including environment.

References

- Anand, S.V (2013). Global Environmental Issue. *Scientific Reports*, 2(2):632
- Autodesk (2007). *Autodesk Buzzsaw Empower your Team*. USA: Autodesk Inc.
- Bureau of International Recycling (2014). *The Paper Industry*. Retrieved July 01 2014 from: http://www.bir.org/industry/paper/?locale=en_US
- Buyya, R., Yeo, C.S. and Venugopal, S. (2008). Market-oriented Cloud computing: Vision, hype, and reality for delivering it services as computing utilities. *Proceedings of the 10th IEEE International Conference on High Performance Computing and Communications*, 1-9.
- Chong, H.Y., Wong, J.S., Wang, X. (2014). An explanatory case study on cloud computing application in the built environment. *Automation in Construction*, 44: 152-162.
- Cisco system (2009). *Cisco Cloud Computing-Data Center Strategy, Architecture, and Solution*. United States: Cisco System Inc.
- Dialogic Corporation (2010). *Introduction to Cloud Computing*. Canada: Dialog Corporation.
- Environmental Paper Network. (2007). *The State of the Paper Industry 2007*. Retrieved July 01 2014 from: <http://environmentalpaper.org/state-of-the-paper-industry-2007.php>.
- Jonsson., Worren,A.S (2007). *Profitable "Paperless" Building Project*. Usa: Autodesk Inc.
- Judson, D.S. (2008). The environmental catastrophe, 1-4.
- Kamarudin, S., Zakaria, R. (2013). *Potential Improvement for Effectiveness Implementation of e-tendering*. Universiti Teknologi Malaysia: Thesis
- Kinsella(2012). *Paperwork: Comparing Recycled to Virgin Paper*. North America: Environmental Paper Network
- Loan,L. (2013). *Cloud Computing, Cloud Storage and Project Management Software*. Retrieved June 30, 2014 from: <http://www.business2community.com/cloud-computing/cloud-computing-cloud-storage-and-project-management-software-0471705#18aOnf>
- Martin, S (2011). *Ecology Global Network: Paper chase*. Retrieved July 03, 2014 from: <http://www.ecology.com/2011/09/10/paper-chase/>
- Mastor, S.H., Azizan, A.Z. (2012). *E-Tender Application and its Implication to Malaysian Construction Industry*, 1-13.
- Mayfield, J.D (2011). *The paperless office: Learning to work in the cloud*. Retrieved July 03, 2014 from: <http://realtormag.realtor.org/for-brokers/feature/article/2011/01/paperless-office-learning-work-cloud>
- Ministry of environment (2002). *Environmental Measures Implemented in FY2002 based on the Basic Environment Plan*. Retrieved June 30, 2014 from: <https://www.env.go.jp/en/wpaper/2002/08.pdf>
- Moorhouse (2011). *Cloud computing and Project Management*. Retrieved June 30, 2014 from: <http://www.moorhouseconsulting.com/news-and-views/publications-and-articles/cloud-computing-and-project-management>
- Preton (2010). *Environmental issue associated with toner and ink usage*. Israil: Preton Ltd.
- Proactis (2012). *Cloud e-procurement: Unlock the Cloud for Spend Control and eProcurement Innovation*. PROACTIS Group.
- Quddusi, S.U.H (2014). *Total Quality Management*, 26(2), 102-108.
- Sun Microsystems, Inc. (2009). *Introduction to Cloud Computing Architecture*. United States: Sun Microsystem Inc.
- Vuchnich, A (2009). *Cloud Computing and the Paperless Office for CPAs*. Retrieved July 03, 2014 from: <http://www.accountingweb.com/blogs/vuchnich/cloud-computing-and-paperless-office-cpas>

Warren, P. (2014). *What does Cloud Computing mean for Project Managers*. Retrieved June 30, 2014 from: <http://www.projectinsight.net/blogs/project-management-software-discussions/what-does-cloud-computing-mean-for-project-managers-guest-post>