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Transforming Society through Cloud Computing: A Socio-Economic Analysis

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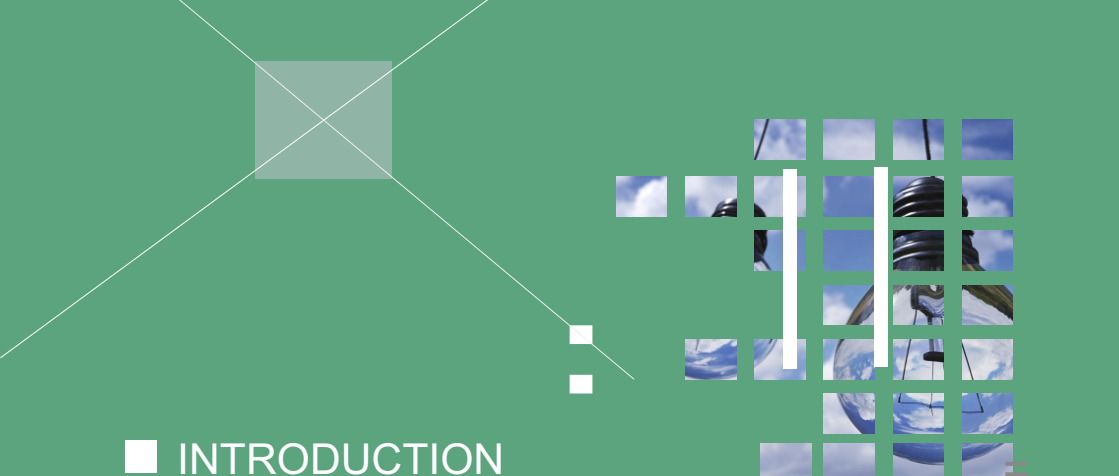
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■ INTRODUCTION

As one internet breakthrough that is capable to encompass and connect every aspect of social and economic life, cloud computing has become one of the promising tools to achieve positive transformation in society. Its capability to provide ease of access by bridging multiple system or computer program with unprecedented transfer rate is potential to bring efficiency in public sphere. However, not all public elements are more than willing to migrate its system to cloud computing. Some of them are still skeptical about potential benefit and loss of cloud computing adoption. One of the prime issue that become a hurdle is the legal data issues, for example. Therefore, Center for Digital Society (CfDS) through this publication series would give a comprehensive analysis on socio-economic benefit from cloud computing adoption, as well as the future of this technology in Indonesia. This publication is a concise and simplified version of our monograph, based on a research conducted by our researchers – led

by Dr. Dedy Permadi, Dr. Novi Kurnia, and Putri Paramita Agritansia, M.Acc.

Before pinpointing the potential massive benefit that public sector could reap from cloud computing adaptation, this release first and foremost will take a quick glance at the A to Z of cloud computing. The typology and basic benefit will become the first thing that will be discussed. To give a comprehensive understanding on defining cloud computing, this section will also explain about the possible challenges that might occur during the operation. After understanding the ground meaning of cloud computing, the writing will continue with comprehensive analysis on the impact of cloud computing in public sector, which covers the journalism and governance sectors. Furthermore, analysis of macro and micro economics will also be addressed in this edition. This will be concluded by pinpointing the challenges and prospects of cloud computing adoption in Indonesia.

Cloud Computing at A Glance

■ DEFINITION

Among many definitions on cloud computing, the one brought by C. Madhavaiah and Irfan Basir can be considered. They undertook a comparison of 36 definitions of cloud computing from the academic and practical perspectives in order to come up with an ideal definition of cloud computing.ⁱ According to them, cloud computing can be defined as information technology business model provided as services through internet. The services are provided both in software or hardware, depending on customers' (individual or group) needs and their geographical location.ⁱⁱ There are several characteristics attached to this service such as high quality and fast, dynamic, flexible (can be changed depending on the situations and needs), communal, as well as equipped with minimum service provider interaction in virtualization process and output.ⁱⁱⁱ

■ TYPOLOGY

As for its typology, cloud computing can be distinguished by two; according to its service and according to its deployment. According to its services, cloud computing can be divided into three types. The first one is software as a Service (SaaS) or cloud computing only as a software. This means that the customers will only be able to access the software application on every device that they possess. Customers do not possess any rights to control the infrastructure including network, server, and operating system with the exception of limited software configuration. The Second one is Platform as a Services (PaaS) or cloud computing as platform feature which enables user to gain access in programming libraries. This means customers have access to alter the software but gain no full control on its cloud computing infrastructure. The third one is Infrastructure as a Service (IaaS) or cloud computing as a system operation, meaning user or customer will have a full access on almost everything except its infrastructure and certain network.^{iv}

On the other hand, the forms of cloud computing according to its deployment vary depending on the size of the customer operations. There are four variations of cloud computing according to its operational size from the smallest to the biggest, which are; (1) private, (2) community, (3) public, and (4) hybrid. Table I and II will give a better understanding on the typology of cloud computing, both in service and deployment

■ THE TYPOLOGY OF CLOUD COMPUTING BASED ON ITS SERVICE

Core Service



Software as a Service (SaaS)

A ready-to-use cloud computing software which has core applications to be used directly by users, and is accessible in many devices.

Platform as a Service (PaaS)

A platform given to the users to have limited access on running the cloud computing infrastructure using programming languages, and certain devices or tools provided by the cloud service providers.

Infrastructure as Service (IaaS)

A service which gives rooms for users to develop and control the operating system, storage system, and the applications of the cloud computing infrastructure under limited networks.

User's Rights



Software as a Service (SaaS)

Users do not have authority to develop or control the cloud computing infrastructure, including the network, servers, operating system, or even the capability of individual applications, with the exception of certain configurational settings attached to the provided application.

Platform as a Service (PaaS)

Users do not have full authority and access to develop or control the cloud computing infrastructure. However, users can develop and control the provided applications as well as the environment of the hosting applications

Infrastructure as Service (IaaS)

Users are not authorized to develop and control the infrastructure of the cloud computing system, but are allowed to have hands on the operating system, storage system, used applications, and to certain extent, some network components.

Modified from Mell & Grance, NIST (2011: 2-3)

■ THE TYPOLOGY OF CLOUD COMPUTING BASED ON ITS DEPLOYMENT

Private



Focus of Deployment

Serves the purpose of fulfilling the internal needs of organizations or companies with many customers.

Operator

Owned and operated by an organization, a company, or a combination of both.

Examples

SaaS: Internal Mail Server, Internal Web Application, and Database Server for internal purposes.

PaaS: Operating System + Web Server + Framework + Database for internal purposes.

IaaS: Virtual Machine that is provided in accordance with the demand/need of the company or organization

Benefit

Safely secures the data, because it is processed and managed internally.

Saves money, because it is only accessed from internal network.

Lacks

Requires huge investment to procure the infrastructure

Requires human resources with certain ability and competence to preserve the operations.

Communal



Focus of Deployment

Specially made for certain community coming from customers which have similar concerns, for example in missions, security standards, policy and compliance system.

Operator

Owned, managed, and operated by that community, a third party, or a combination of both.

Examples

Unavailable

Benefit

Unavailable

Lacks

Unavailable



Focus of Deployment

Tailored for the public with open infrastructure that is accessible by everyone.

Operator

Owned, managed, and operated by a business organization, academic organization, governmental institution, or a combination of those three.

Examples

Examples of free public cloud services: Google Mail, Facebook, Windows Live Mail, Twitter, and et cetera.

Examples of paid public cloud services: Office 365, Windows Azure, Adobe Creative Cloud, Salesforce, Amazon EC2, et cetera

Benefit

The public, as the user, does not have to invest a lot, since it is a ready-to-use platform.

Lacks

Heavily depends on the quality of internet service

Data security is not 100% guaranteed

Hybrid



Focus of Deployment

The infrastructure is a composition of two or more infrastructures (private, communal, or public). Despite the unique entity, it is still entitled to the common goals and needs of using and processing the technology and data.

Operator

Owned, managed, and operated by a business organization, community, academic organization, governmental institution, or a combination of those four.

Examples

Organization A subscribes to a public cloud service, Windows Azure, as a host for their applications. Due to the existing regulations, the data of Organization A cannot be stored in a third party. Hence, that organization must still be able to store their data in their own private cloud platform by using their internal connection.

Organization B already has Active Directory that runs on their Windows server (a private cloud). They also still subscribe to the Office 365 service (a public cloud), so it can be configured by the Active Directory as a login identity in Office 365.

Benefit

Safely secures the data, because it is processed and managed internally.

Flexibility in managing and developing the cloud platform depending on the needs.

Lacks

Users have to provide infrastructure for the applications that require certain integration from other cloud platforms.

Basic Benefits

Even though there are several types of cloud computing, the basic benefits are practically the same across all types and forms. There are at least six main benefits from cloud computing adoption:^v

Economical

Customers can choose what kind of services that they need, which in turn will affect their cost structure. They don't have to provide extra computer or other physical infrastructures such as server, physical storage, and software license because the service already provides everything with minimum cost. The cost of electricity and maintenance of server and other physical infrastructure will be greatly reduced because customers pay only what they use.

Fast and Reliable

Cloud computing provides high flexibility, scalability, fast-pace system and ease of access everywhere as long as there is internet connection nearby.



Global Scale

Cloud computing has unlimited capacity because it operates globally with strong storage and bandwidth servers placed in every continent.



Improved Productivity

Practicality and time saving are one of the features in cloud computing. Customers can use it directly with less set-up and maintenance which in turn can save human resources. These idle resources can be distributed to handle other stuffs which will eventually improve customer aggregate productivity.

Guaranteed Performance

Every cloud computing provider will guarantee their product performance. Guarantee is provided through technical maintenance and software services. In addition, performance will likely to keep increasing overtime because the provider will update their physical and software infrastructures regularly.

Data Resilience

Cloud computing service has advantage in data storage management because it can create data backup and recovery. Cloud computing can duplicate data and store it on their vast network. Therefore, data loss from power outage, hacker, and virus will less likely to occur.

■ Challenges of Cloud Computing

Even though the benefits seem apparent, cloud computing is not invincible from threats and public skepticism. According to ENISA, a European Union institution that runs analysis on modern computing, there are several reasons why some sectors like finance and banking are skeptical toward adopting cloud computing.^{vi} These reasons include less and unclear government regulations in cloud computing, weak organizational understanding, different visions from cloud provider, and security measure. Among these reasons, security become one of the prime challenge for cloud computing. Banking and financial sectors are afraid their data and privacy will still be breached because they are not in control of the location and safety of their data, as the customers 'hand over' their data to be stored in the cloud.



The Impacts: Social and Public Sector

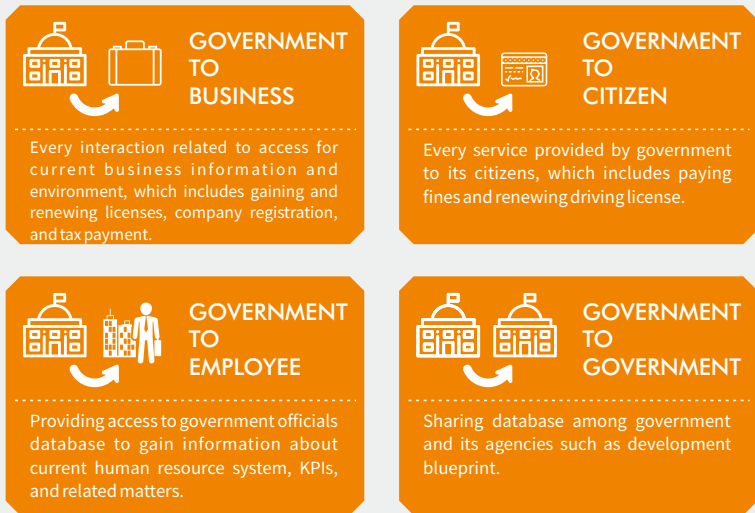
■ Citizen Journalism

On social context, with ease of access and great scalability, cloud computing will enrich and improve the other dimension of human interactions; the online world. Cloud computing will empower the humans' interaction online, including social media, and this will ultimately help them to shape changes in society. It will be almost impossible for social media and online world to move as fast as now without cloud computing. The cloud computing technology extensively smoothens the conduct of social media and internet applications in general, as data can run and flow in much bigger scales. One of the major example that could best capture this notion is on how cloud computing takes part on empowering citizen journalism, especially through social media channels. The case of citizen journalism in Sarinah bombing proves that cloud computing in the online and social media world helped enriching perspective on this specific case. What is unique in this case is that only couple minutes after the gun fights end, hundreds of citizens came to the site and reported it directly onto their social media. On Twitter for instances, these citizen journalists added the hashtags #JakartaBrave, #Prayfor Jakarta, and #KamiTidakTakut (We are not Afraid) on their reports.^{vii} The case emphasizes how massive the magnitude of citizens' participation is, enabled by cloud computing. We rarely see the times where Twitter's server gets down anymore, even in the middle of this huge flow of tweets and information shared by netizens during Sarinah bombing. This is only putting forward the idea of cloud computing intervention in the social sphere.



Public Sector

Besides transforming human interactions, cloud computing also helps government to address public services, particularly on the emphasis of shared service. Shared service, enabled by cloud computing, is a way to organize administrative functions by optimizing budget activity, service flexibility, and other services that can be utilized by everyone.^{viii} The use of cloud computing urges government to opt for transparency which can promote integrity. Cloud-based shared service eases the conduct of e-government that demands access to public information to be further used and accessed by others. Through shared service and cloud computing, everyone can easily interact with stakeholders in the government. There are at least four processes that government could obtain in implementing e-government;^{ix}



With cloud computing, e-government is able to provide the best service for its stakeholders; the people and the business sector. Cloud computing eliminates the existing barriers separating government and other stakeholders, so that better flow of works and collaborations can be coordinated to deliver enhanced public service for everyone.

The Impacts: Economic Sector

■ Microeconomy

Cloud computing is indeed beneficial when it comes to economic sector, both in macro and micro economic level. On micro level, cloud computing adoption can help saving cost, especially the one related with information technology infrastructure. According to Cisco, adopting cloud computing will affect cost structure and dramatically reduced software and hardware cost, both in procurement and maintenance.^x According to Gomoloski, company will only use 10%-30% of their ICT technology. Furthermore, Marson completes Gomolski's finding that from this 10%-30%, only 6% that uses its maximum capacity.^{xi} This means companies have to pay 100% of their ICT cost even though in fact they will practically use 30%. Since the nature of cloud of computing is pay-as you go, company can save their cost because they will only pay let say 30% of the initial ICT cost. Several studies from Marson and Carr also show that business sector could save cost from ICT procurement by 40%-50%.

■ Macroeconomy

On macroeconomic level, adopting cloud computing in several businesses will create ripple effect that also affects other business sector. The notion came from both backward linkage index and forward linkage index. Backward linkage index calculates how big one sector development can pull other sector due to the increase of input.^{xiii} From table III, we can find that the computer programming industry and computation service, which is the core of cloud computing, reach the value of 0,484505. This means that is in the 28th position from 112 sectors. In the sense of forward linkage index, the calculation is almost the same with backward linkage but with more emphasis on the increase of aggregate production among the industry. In table IV, it can be seen that the same computational industry's value is 0,87381, which is the third biggest among all industries. The high value of the forward linkage index of this sector relative to other sectors show that the increase in that sector will push for bigger activities on other sectors. Both calculations show that computational industry will create ripple effects for all sectors which in turn increase aggregate production.

Calculation Results of Backward Linkage Index

RANK 01	Sector's Code: D35 Sector's Name: Electricity, gas, steam and air conditioning supply	Backward Linkage Index 0,759699941
RANK 02	Sector's Code: C28 Sector's Name: Manufacture of machinery and equipment n.e.c.	Backward Linkage Index 0,727136711
RANK 03	Sector's Code: C26 Sector's Name: Manufacture of computer, electronic and optical products	Backward Linkage Index 0,722081469
RANK 04	Sector's Code: C22 Sector's Name: Manufacture of rubber and plastic products	Backward Linkage Index 0,721138737
RANK 05	Sector's Code: C18 Sector's Name: Printing and reproduction of recorded media	Backward Linkage Index 0,708634821
RANK 26	Sector's Code: C29 Sector's Name: Manufacture of motor vehicles, trailers and semi-trailers	Backward Linkage Index 0,50021592
RANK 27	Sector's Code: R_S Sector's Name: Other service activities	Backward Linkage Index 0,49827356
RANK 28	Sector's Code: J62_J63 Sector's Name: Computer programming, consultancy and related activities; information service activities	Backward Linkage Index 0,484504873
RANK 29	Sector's Code: H53 Sector's Name: Postal and courier activities	Backward Linkage Index 0,471576373
RANK 30	Sector's Code: M69_M70 Sector's Name: Legal and accounting activities; activities of head offices; management consultancy activities	Backward Linkage Index 0,442601671

Source: Calculation from the World Input Output Database 2014 (2016)

Calculation Results of Forward Linkage Index

RANK 01 Sector's Code: C18
Sector's Name: Printing and reproduction of recorded media
Forward Linkage Index: 0,974117921

RANK 02 Sector's Code: A02
Sector's Name: Forestry and logging
Forward Linkage Index: 0,926601278

RANK 03 Sector's Code: J62_J63
Sector's Name: Computer programming, consultancy and related activities; information service activities
Forward Linkage Index: 0,873870796

RANK 04 Sector's Code: C25
Sector's Name: Manufacture of fabricated metal products, except machinery and equipment
Forward Linkage Index: 0,855141414

RANK 05 Sector's Code: C23
Sector's Name: Manufacture of other non-metallic mineral products
Forward Linkage Index: 0,846078405

RANK 06 Sector's Code: N
Sector's Name: Administrative and support service activities
Forward Linkage Index: 0,822626439

RANK 07 Sector's Code: J58
Sector's Name: Publishing activities
Forward Linkage Index: 0,785193746

RANK 08 Sector's Code: K65
Sector's Name: Insurance, reinsurance and pension funding, except compulsory social security
Forward Linkage Index: 0,725238495

RANK 09 Sector's Code: J59_J60
Sector's Name: Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities
Forward Linkage Index: 0,718406626

RANK 10 Sector's Code: D35
Sector's Name: Electricity, gas, steam and air conditioning supply
Forward Linkage Index: 0,692440576

Source: Calculation from the World Input Output Database 2014 (2016)

Prospects and Challenges in Indonesia

Despite its groundbreaking benefits in business, government, and society as a whole, cloud computing service still faces challenges especially in Indonesia. One of the prime challenge that is facing cloud computing adoption is government regulations on electronic transactions. According to government regulations number 82 year 2012 article 17 sentence 2, electronic system service providers have to put their data and recovery center in Indonesia.^{xiv} Since the nature of cloud computing is the global-scale operation, they spread data centers all over the world. This makes a lot of cloud computing providers difficult to comply with this regulation.

Beside regulations, infrastructure also becomes one challenge for cloud computing adoption. In the sense of infrastructure, Indonesia Cloud Readiness Index (CRI) is in the 11th position from 14 countries.^{xv} The index is created by Asia Cloud Computing Association (ACCA) and based on 11 parameters, which are broadband quality, power grid, environment policy and sustainability, online security, privacy, public policy and its implementation, intellectual property rights, advance business environment, as well as free information flow. Indonesia only increases one position from last year and acquires a total score of 50,6 with the lowest one being in the international connectivity parameter.

Even though Indonesia's regulations and infrastructure are not yet ready for a complete cloud computing migration, it is imperative to understand that these challenges are only affecting foreign cloud providers. For local cloud providers, this is a golden opportunity to seize the untapped market and to aggressively campaign about the benefit of cloud computing. The local providers are in advantage because they can tap about 57,6 million small and medium enterprise units in the country which accounted for the country's 60,34% of gross domestic product.^{xvi} According to Reza Haryo, Senior Market Analyst of IDC Indonesia, in 2020 cloud computing consumption in small and medium enterprise will reach the level of 20,87% which are valued at more than 14 million US dollar.^{xvii}

The prospect of cloud computing in Indonesia is among the brightest in developing market. Even though the growth is hindered by regulations and infrastructure, every year the cloud market will increase at the range of 22-36%.^{xviii} A more comprehensive regulations and clear infrastructure building is among the priority list should Indonesia want to unleash its full potential through cloud computing.

Policy Recommendations

01

The government is expected to have more commitment to intensify the technological and communication infrastructure development, emphasizing on the betterment of internet access and use.



02

The government is expected to start gathering data and information to draft and pass a more substantial and specific regulation on cloud computing adoption in the country which goes beyond the discourse of geographical location of the data centers.



03

The government is expected to increase awareness and impulse campaigns in the use of cloud computing. The campaign should also underline the fact that cloud computing is not only for 'back-up' purpose, but also for main storage purpose as well.



04

The government is expected to enhance the knowledge and capacity of the people on cloud computing, so that the use can be maximizing the benefits.



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ABOUT CFDS

Center for Digital Society (CfDS) is the research center established by the Faculty of Social and Political Sciences, Universitas Gadjah Mada. The institution is created under the concern over the contemporary dynamics of socio-political condition of the world that is accentuated by the impeccable influence of information technology. The phenomenon triggers the new patterns and complexities in the society, and thus requires new approaches in managing such complexities.

CfDS pledged to delve more on the study of contemporary digital society, including related issues surrounding the topic; such as the issues of smart city and urban development. The emphasis is then put on the utilization of technology to shape the society in becoming digitalized, as well as to bring solvency to social issues.

Vision

Solving Social Problem and Accelerating Prosperity through Indonesia Digital Society

Activities

1. Research and Development
2. Dissemination and Publication
3. Education and Policy Advocacy

Research Scopes

1. Digital Commerce
2. Digital Citizenship
3. Digital Lifestyle



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