



Clustering Asian Countries on Fixed Broadband Subscribers: A Data Mining Approach

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ABSTRACT: *The breakthrough of internet technology increases the accessibility of online information. The research data was obtained through World Bank Organization, and ICT indicators Internet users, Fixed Broadband Subscribers, and Secure Internet Server as the data were carefully analyzed using cluster analysis. As the result of the study, advancement of internet technology in developing countries will slowly grow as infrastructure and affordability of fixed broadband are issues that hamper the adaptation. However, internet users and internet security will continue to grow and improved as more information are accessed online. Hence, it is theorized that a country that enjoys cloud computing in the recent year's amplified cloud users and secure internet server, however, it is accompanied with a decrease of fixed broadband subscribers.*

Keywords: *fixed broadband, Data mining, knowledge discovery database, Secureinternet server,*

I. INTRODUCTION

The internet is a superhighway to communication media with high-speed net access via broadband infrastructure. It allows communication media to circulate and share information across the earth with the belief that the information shared in this media is safe and secured. Broadband refers to telecommunication that provides multiple channels of information over a single communication medium, typically using some of frequency or wave division multiplexing ("Technical definition of broadband," n.d., para. 1). Fixed broadband technologies composed of DSL, cable modem, fiber-to-the-home with internet download speed of 256bit/s (OECD, 2015).

How is cloud computing related to the Internet? Cloud computing is a sharing data over a liberal net, wherein computers are interconnected where data are stored in the centralized storage to allow internet users to access the computer helps. According to the study of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP, 2016), has found that broadband capabilities and access are concentrated higher in East and North-East Asia. Where the total number of fixed broadband subscriptions in 2015 derives predominantly from East and North-East Asia (74.89%), followed by South and South-West Asia (9.77%), North and Central Asia (7.68%), South-East Asia (5.74%) and the Pacific (1.93%). In 2014 East and North-East Asia recorded 68.87%, followed by South East Asia (11.3%), South and South-West Asia (9.76%), North and Central Asia (8.1%) and the Pacific (2%).

In Asian countries, modernization of the Internet technology is extremely impressed by the growing number of users who access the Internet. In 2014, there are about three billion internet users globally, two-thirds of the user come from the developing countries (ITU-D, 2014). Asian countries level up its technology to ensure the satisfaction of its internet users. As Internet technology becomes vastly advanced, more and more internet users wanted to subscribe internet connection using broadband connectivity. From the 3rd to the 4th quarter of 2014, the number of fixed individual broadband subscriptions increased by 15 000. The rapid growth in fixed broadband capacity also continued in the 4th quarter of 2014 (The Internet Survey, 2015). Hence, internet security is at risk to the farming population of cyberspace users. Privacy and data theft will be the top security issues that organizations require to focus (Sharma, R., 2012). However, despite a significant number of cyberspace users the adoption of the fixed broadband in some Asian countries are slowly increasing. This study examines factors affecting the slow adaptation of internet technology fixed broadband in some Asian countries.

II. METHODOLOGY

Research Design

This study was anchored on the Data Mining and Knowledge Discovery Theory (Madisch, Hofmayer, Fickenscher, 2008; cited by Caluza, 2015). “Advances in data gathering, storage and distribution have created a need for computational tools and techniques to aid in data analysis.” Here we apply the term “KDD” to refer to the overall operation of discovering useful knowledge from information. Data mining is a particular step in this procedure—application of specific algorithms for extracting patterns (examples) from data (Fayyad, Piatetsky-Shapiro, & Smyth, 1996).

Research Method

The researcher collected the data from the cloud specifically, from World Bank Organization related to fixed broadband subscribers in Asian countries. The data was processed quantitatively using data mining techniques accurately cluster analysis using Mini Tab. The data obtained from 2003-2013 as it utilized the ICT indicators such as the Internet users, Fixed Broadband Subscribers, and Secure Internet Server from the ten Asian Countries these are Philippines, Cambodia, China, India, Indonesia, Malaysia, Singapore, Thailand, Hong Kong. The generated result was a dendrogram, amalgamation, and cluster centroids.

III. RESULTS AND DISCUSSIONS

Number of clusters: 3				
	Number of observations	Within cluster sum of squares	Average distance from centroid	Maximum distance from centroid
Cluster1	7	6.507793190E+15	26250248.606	50327972.642
Cluster2	1	0.000	0.000	0.000
Cluster3	3	5.400344551E+14	11503458.981	17218556.128

Figure 1: Clustering by Observation of Asian Countries

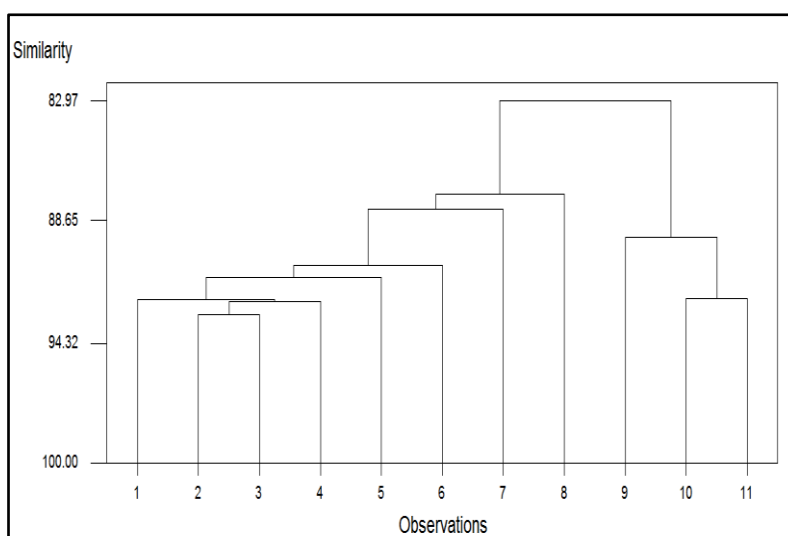


Figure 2: Clustering by Observation of Asian Countries

Cluster Analysis was used to determine the group of Asian countries that have a similar characteristic in terms of the three identified variables for the last ten years. In Fig. 1 Asian Countries are grouped into three clusters, which in Fig. 2 show the presence of the Asian countries that belong to a particular cluster. Based on the observation cluster 1 represents seven Asian countries that have close or similar variants, while cluster 3 accounts for the three countries that have the same variables.

Cluster Centroids				
Variable	Cluster1	Cluster2	Cluster3	Grand centr
IU-Phili	6.0614	25.0000	34.0784	15.4241
IU-Cambo	0.4110	1.2600	4.6800	1.6524
IU-China	14.2923	34.3000	42.1334	23.7042
IU-India	3.1866	7.5000	12.5834	6.1415
IU-Indon	4.8540	10.9200	13.8767	7.8662
IU-Malay	49.2701	56.3000	64.5900	54.0873
IU-Singa	63.3911	71.0000	72.0000	66.4307
IU-Thail	15.7847	22.4000	26.3566	19.2694
IU-Hong	61.0286	72.0000	73.1000	65.3182
FB-Phili	542329.1429	1722400.0000	7238907.0000	2475947.7273
FB-Cambo	8591.8571	35666.0000	28127.3333	16381.0000
FB-China	5.394752E+07	1.263370E+08	1.735263E+08	9.314079E+07
FB-India	2882724.5714	1.099000E+07	1.397992E+07	6646256.9091
FB-Indon	581888.5714	2280316.0000	2990393.0000	1393155.9091
FB-Malay	783171.7143	1835700.0000	2346866.6667	1305318.3636
FB-Singa	785314.2857	1268800.0000	1362666.6667	986727.2727
FB-Thail	1087978.1429	3251851.0000	4368000.0000	2179245.2727
FB-Hong	1728317.7143	2111109.0000	2232454.0000	1900608.6364
SEC-Phil	285.4286	622.0000	781.0000	451.1818
SEC-Camb	6.7143	24.0000	37.0000	16.5455
SEC-Chin	743.7143	2569.0000	4252.0000	1866.4545
SEC-Indi	943.5714	2601.0000	4282.0000	2004.7273
SEC-Indo	157.4286	480.0000	941.3333	400.5455
SEC-Mala	504.0000	1178.0000	1825.6667	925.7273
SEC-Sing	1404.7143	2689.0000	3271.0000	2030.4545
SEC-Thai	411.5714	912.0000	1223.6667	678.5455
SEC-Hong	1473.8571	3205.0000	4357.0000	2417.5455

Fig. 3: Identified variables, Internet Users, Fixed Broadband Subscriber, and Secure Internet Server

Fig.3. Indicates the original introduction of the Asian countries that offer the same status in term of internet users, fixed broadband, and secure web server for the last ten years. Counting at the presentation by a country that bears the largest number of Internet users using the cluster 3 information, Hong Kong has the heaviest number of internet users with 5,751,357 users as of 2014 or 80.2% of the population. The massive rollout of fixed broadband infrastructure has allowed Hong Kong to provide almost all households with access to high-speed broadband connectivity. Additionally, competing operators' investment has focused on fiber access networks due to inherent advantage of fiber access networks over competing platforms such as DSL or HFC, especially in the geographically small territory of Hong Kong (Phil Harpur, 2017). Hong Kong has formed into an advanced economy to enhance socio-economic development. Innovation has been used to improve the quality, openness, and reasonableness of business; taxpayer supported organizations, human services, education and utilities (Kwon, Paul, 2015).

However, Cambodia has 4,100,000 Internet users as of June 2016 with 25.5% penetration rate. Fixed broadband penetration is increasing moderately from 0.2% in 2012 to 0.4% in 2014 and 0.6% in 2016. It is predicted to grow from 1.2 % in 2016 to reach between 2.2% and 2.7% by 2021 (Internet World Stat, N.A). For many years Cambodia strenuously focuses on mobile service while the internet acceptance rate was disturbingly low. One of the major factors that inhibit the rollout of both dial-up and DSL Internet services was a limited fixed-line infrastructure (Phil Harpur, 2016). In recent survey Cambodia, shows an increase of internet users by 43% over the course of 2016 and to reach 45% penetration in January 2017 (Kemp, Simon, 2017).

Moreover, in cluster 3, China holds the largest amount of fixed broadband subscription. China leads the fixed broadband market regarding both overall subscribers and market penetration 53% (Sarah Smith 2017). With 731,434,547 Internet users as of Dec 2016, 52.7% penetration rate (Internet World Stat, n.a). Broadband has become a key revenue generator of the telecom operators. China Telecom, China Unicom is the largest suppliers of the fixed broadband. Fixed broadband level in China will continue to develop gradually due to the increasing wealth of end users and digital media giants seeking new audiences (Sarah Smith 2017). China keeps on building world-class telecommunication infrastructure, and the investments show no sign of dwindling. As information activity develops, operators are keeping pace by expanding both local and global networks through submarine and terrestrial cable links. The nation additionally has a great vision of the space program and has built up a nearby industry to create, manufacture and send interchanges satellites (Evans Peter, 2014).

Additionally, in cluster 3, Hong Kong among the country that has Secure Internet Server. By definition, secure internet server is a technology that uses data encryption on the web (World Bank, 2008). Hong Kong is the first Asian country that adopts The Personal Data (Privacy) Ordinance (the PDPO) came into force in 1996 (Lovells, Hogan, N.A). In Hong Kong privacy, data protection and cybersecurity under legal framework which is the Personal Data (Privacy) Ordinance (PDPO) (Raul, Allan Charles, 2014). The Ordinance applies to personal data defined as all information relating directly or indirectly to individual and from which it is practicable to ascertain the identity of the person (Lucchetti, Stefania, 2009).

Lack of progress in fixed broadband among low-income countries is a manifestation of the growing digital divide. The total number of broadband subscriptions is an important indicator of the market size, and commercial opportunities (COMCEC Coordination Office, 2017). International Telecommunication Union report in 2014 fixed-broadband penetration will continue to grow slowly at 4.4% globally in 2014, mostly due to a slowdown in developing countries, where fixed-broadband infiltration development rate is relied on to drop from 18% in 2011 to 6% in 2014. In developed countries, fixed-broadband penetration will develop at around 3.5% in 2014 compared with 4.8% in 2011 (ITU, 2014). Additionally, high pricing is a significant deterrent for fixed broadband adoption. Affordability of access is one of the key factors driving the adoption of fixed broadband by consumers and businesses in the region (United Nation ESCAP, 2016). Huge discrepancies in affordability of fixed broadband services, an average of 74.5 dollars compared 22.5 dollars in developed countries. It tells a huge disadvantage to the developing world (Broadband Commission, 2015).

Interpretation:

1. The cluster centroids show cluster three has the most number of internet users, and cluster one is the least among the three clusters.
2. Moreover, relative to the fixed broadband subscribers, cluster one has the most fixed broadband subscribers among the three clusters.
3. Lastly, cluster three has the most secured internet servers, and cluster one is the least among the three clusters.

Theory

It is theorized that a country that enjoys cloud computing in the recent year's amplified cloud users and secure internet server, however, it is accompanied with a decrease of fixed broadband subscribers.

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