Smartphones habits, necessities, and big data challenges

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ABSTRACT

Smartphone usage reframes our daily life activities to support ease, convenience, multitasking, and always connect with others wherever we are. The excessive use of a smartphone can generate a large amount of data. Recently, the term of big data is popularly used to describe data that is high volume, high velocity, and high variety and the exponential expansion and accessibility of data, both structured and unstructured. A smartphone with Internet produces a huge amount of data that will enhance users' experience through volume, value, variety and velocity. This study was done through inductive approach by distributing questionnaires in Brunei Darussalam (Brunei) to understand the smartphone habits of users in Brunei. The analysis had identified the concerns that become the focal point of a study on the habitual using of smartphones in daily activities. The study was conducted in specific context, yet the methods and findings can be used into broader contents and contexts. The majority of respondents use smartphones to access Internet excessively. Since, they depend on smartphones then they deserve to get better value added and services. The paper proposes the findings relating to the big data concept.

1. Introduction

Smartphones are becoming central to our everyday lives. Their main purpose is to fulfil tasks both at home and at work. Skierkowski and Wood (2012) stated that mobile phones are also very important in our lives. Mobile phones – known as cell phones by people – have become the fastest communication device around the world. Their developed versions are nearly replacing computers and they are pocket size. These properties are the biggest proof of why they are so important in our lives. Since 1996, one of the fastest growing novel technologies in the mobile phone market is a smartphone. Since its introduction, the numbers of smartphones have reached an estimated 1 billion and expected to reach 2 billion in 2015 (Rushton, 2012).

There are wide ranges of smartphones available for purchase such as Apple, Samsung, HTC, Blackberry, Sony, Nokia and many more. Each of the different brands has much to offer to suit the customers' need and lifestyle. Furthermore, advanced mobile operating systems such as IOS, Android, and Windows as well as myriads of useful applications (Apps) have made the smartphone as must to have devices. The invention of the smartphone in general has brought many effects on our daily life, working tools, and learning process for students. One of the most important features required in smartphones is the Internet connection that enables them to have 24/7 connectivity through the mini browser or Apps for many purposes, which may include searching for information, connecting to a social network, or downloading music, video and related stuffs. All recent smartphones provide connection to the Internet along with cameras, video or audio players. On the other hand, supplier and business organizations can reach their customers through their smartphone easily and conveniently. Therefore, it is important to examine a future trend of the smartphone through the view of emerging big data technology.

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The idea of big data came from the rapid growth of the volume of information that cannot be fit into the computers used to process them (Schönberger & Cukier, 2013). Therefore, what innovators did was that they invented computers or systems that are able to efficiently process the vast amount of data. Big data are collected whether through online or offline. These data can be gained from any online sources such as social media (Facebook or Twitter posts, etc) which can be used for the organization's use to understand the patterns made by the users or machines like smart metres e.g. recording how much energy consumption of electricity, water and even gas (Watson, 2014). This information amplifies the fact that data could be analysed and used to reveal patterns within the processed data. In other words, it could greatly help the organization to understand the habits of a customer and use it to their advantage; on the other hand, users may benefit from the comprehensive and appropriate information for their own decision-making (Low & Anshari, 2013).

This study concerns about the sustainable service-oriented businesses in response of organizations, either profit or non-profit, to the mass adoption of smartphones and the advancement of Information and Communication Technology (ICT) especially big data technology. A sustainable organization seeks to create long-term values by embracing the opportunities and risks related to the protection, enhancement, and sustainability of the important resources, which are data and information. Our study is aimed to figure out the habits of people on smartphones and how an information service provider could enhance users' experiences in response to the users' habit on smartphones. Even though, the study is conducted in Brunei, the discussions may trigger other researchers to expand into different contexts and scenarios. We conducted surveys with people in Brunei to find out the users' behaviour, habit, and preference towards the smartphone and their online activities. Big data is used to analyse the phenomenon due to the changing of business environment mainly caused by the Internet of Things, cloud computing, and Web 2.0. In the next section, we present a literature review of related work. Section 3 contains the methodology of our research. We present our analysis and findings and discuss them in Sections 4 and 5; finally the conclusion is presented in Section 6.

2. Literature analysis

Although a smartphone cannot replace all the desktop's or laptop's functionalities, it is handy and with the growing number of applications (Apps) developed for smartphones, they become very powerful devices. Unlike a desktop or laptop, smartphones can be carried around conveniently, either as devices for communication or devices for recording, playing or to some extent manipulating sounds, images and videos which are demanded by today's generation (Thompson, 2012).

According to Smith (2015), mostly, smartphones are used for calling, texting or basic Internet browsing. Research showed that 62% uses their mobile devices to search for information about health condition, 57% used it to do online banking, 44% used for information about a place to live, 30% to take class or get educational content, and 18% to submit a job application. The majority of smartphone owners use their phone to follow along news and share details of local happenings with others, whereas 68% frequently use their phone to follow breaking news events, and 67% used it to share pictures and videos.

With many Apps that can be conveniently utilized, the smartphone market is growing very fast. As such, the smartphone market is very profitable. Both old players and new players are competing to take advantage of the growing market by offering them innovative products. Amongst those players are Apple, Nokia, LG Electronics, HTC, Samsung, Acer, BlackBerry, Sony, Huawei and Google. Nowadays, the main player of SMD is Samsung, which accounts for 24.9% market share in Q2 2014, more than double Apple's, which is 11.7%. Other major players are Huawei (6.7%), Lenovo (5.2%), and LG (4.8%) (IDC: Smartphone Vendor Market Share, 2014).

Nowadays people are always in touch with their smartphone. For instance, Douglas (2011) described in South Korea, that more than 10 million smartphone users do mobile shopping in Tesco's South Korean network of shops. The commuters while waiting for the train from work, can simply do online shopping. The glass wall of subway stations plastered with pictures of Tesco's product, labelled with QR codes – black and white pattern; it's like a bar code. The user can scan it with their mobile devices and if their train comes before they finish shopping they can still shop inside the train.

They demand arrays of innovation in services and products accessible through smartphones that need responses from the service provider. For instance, users who drive vehicles demand for an attractive alert system in their smartphones for providing best route navigation and avoiding terrific traffic jam through accident live data updates at a specific location. This response is simply because users have been using smartphones for their daily life activities, including travelling. This requires sustainable innovation in both process and product developments to achieve sustainability in business. The demand for faster, cheaper, better services coupled with real time system management from customers has driven businesses to find integrated business strategies and solutions. In order to achieve this integration, information sharing is considered necessary to reduce inefficiency and waste of resources to foster sustainability (Mourshed, Matipa, Keane, & Kelliher, 2000). Information sharing can be facilitated through big data approach and methods.

2.1. Big data

Big data is a huge amount of data that able us to capture, link, collect, store and organize information. It is able to broaden its capabilities to transfer and share, predict, visualize, capture and search data. Big data is known as the fourth generation of computing (Watson, 2014). Because of the growth and evolution of Information and Communication Technology (ICT), big data extends its capacity in terms of volume, velocity and variety overtime (Anshari, Alas, & Guan, 2015).

In simple definition, big data is merely a huge amount of data, which is fast and diverse. In another perspective, big data is also known for the 3 Vs: *Volume*, *Velocity* and *Variety* (Laney, 2001). Big data is created very quickly in many different forms or volumes.

The purpose of volume in the data is that they are gathered by the organization, which is later used for further knowledge. The amount of knowledge that can be generated at each point of time depends on the structure of the knowledge (structured or unstructured source of knowledge), interactions and transaction within the system that make it possible to access and use the existing knowledge as indispensable inputs into the generation of new technological knowledge (Antonelli, 2014). Often used in organizations, big data allows more storage space compared to traditional data that is only limited at a certain range and has storage issues.

Big data is used to analyse significant information with doubled speed or velocity. Velocity deals with the time or speed in which the big data is being processed. Big data is a massive volume of structured and unstructured data that are obtained and processed through new techniques that can produce different result varieties. The data category variety is data from multiple data sources and data types, which include semi-structured and unstructured data. It also allows a diversity of all types of data formats such as pictures, audio and video, 3D models, and simulation and location data, for example, Google Map that is retrievable from smartphones.

Big data simply is about combining datasets, contrasting them in different ways, and doing it as quick as possible (Davis, 2013). However, big data is designed to extract *Value* from large volumes of a wide variety of data by enabling high-velocity capture, discovery and analysis (Villars et al., 2011). Value is given when the users have to trust the information being given so that they are able to make the right decision for their best interest. For instance, big data provides the value of saving time for users by giving information about the routes that pack with terrific traffic jam and suggests the best alternative route.

This big data will not process by itself. Although it was stated that the collected big data could be used to the company's advantage, it also has to be analysed in order to gain the needed info (Anshari, Alas, Guan, 2015). This type of analysis is known as 'Big Data Analysis'. Watson mentioned that there are three types of analytics: descriptive, predictive and prescriptive. Descriptive analytics has the purpose to summarize the data of what happened before such as Twitter and Facebook posts. Predictive analysis is processing statistical data to be used as a prediction of the future. Similarly, to predictive analysis, the prescriptive analysis can also be understood as a suggestion to take action or can also be used to identify necessary solutions. Therefore, the final product of analysis will have great value since the raw data is full of variety and volume; it could open doors of new possibilities and understanding.

2.2. Context study

The use of smartphone devices has significantly increased in Brunei currently. Relating to the study on the use of smartphones in daily activities can be a good postulate for an investigation. We eliminate the object's scope of study in Brunei for convenience sampling data. However, the data analysis and recommendations later could provide an alternative perspective in considering similar research in different contexts.

Southeast Asia ishome to one of the world's largest youth populations, where they tend to adopt new technologies more readily than older age groups. Smartphone adoption in Southeast Asia is set to enjoy significant growth over the next few years, with subscriptions set to grow approximately five fold by 2019. It is driven by more affordable prices, and especially by a high rate of a large and tech-savvy youth population. Brunei is a member of ASEAN and is located in Southeast Asia where the rate in parallel is highlighted in The Global Information Technology Report 2014, where there was an increase of about 10%. It affirmed that the rate of mobile phone users had exceeded 120 per 100 residents, and that the rate is increasing (Rohani, 2014). Furthermore, this should be seen as a preparation for Brunei's youth exposure, according to IPsmarx Technology Inc. (2015).

Brunei ranked 21st in its Government ICT promotion, and 17 in incorporating technologies in pursuit of its Vision. World Economic Forum (2014) released that Brunei was overall ranked 45 out of the 148 economies listed in the Networked Readiness Index (NRI), where in the previous year (2013) it was ranked 57 out of 144 economies. This put Brunei in the top 30th percentile in 2014, an improvement from 2013 where it was on the 60th percentile mark. This is similar to the usage of Internet individually, ranked 48, which put Brunei just above the top 30th percentile line. The "Households with Internet access" and "Impact of ICTs on access to basic services" were both ranked 30, putting Brunei clearly on the top 20th percentile for accessing the Internet. An interesting fact is that being one of the smallest nations globally, Brunei had ranked 19 for using the virtual social networks, placing Brunei clearly well within the top 15th percentile.

3. Methodology

The study was held in Brunei. The country is located on the northwest end of Borneo Island. Brunei shares a border with the Malaysian state of Sarawak and Sabah, and making up of four districts. The eastern part is the Temburong district and the western part comprises of Brunei-Muara, Tutong and Belait districts. Bandar Seri Begawan (BSB), the capital and the centre of government and business activities, is located in the Brunei-Muara district. The population of Brunei Darussalam is 348,200. Population growth averages about 2.2% per year. The population of Brunei Darussalam comprises 53% males and 47% females with 73.8% Malay, 14.8% Chinese, and 11.4% others. The survey was conducted on 589 respondents countrywide. They were considered and chosen for the survey, initially as convenient sampling that they are readily available and accessible to survey liaisons. The survey method for this study was designed to allow the same questions to be asked for a large number of people for responses to be gathered and compared with one another. In this case, it is used to quantify demographics, Internet usage & smartphones, activities, habit, applications, location and other defined variables which are generalized by the sample population. The questionnaire consists of 16 questions with multiple-choice answers to be chosen by the respondents and 1 question for them to write their comments or suggestions. They were conducted from February to March 2015. The respondent students manage to answer the questionnaire between 10 and 15 min. All the data analyses were conducted using Statistical Package for the Social Sciences (SPSS version 17.0 Inc.). No financial compensation was provided to participants. Data were analysed to find out the descriptive analysis of subject matters and correlation between variables.

Table 1
Demography.

	Variable	Percentage
Gender	Male	46%
	Female	54%
District	Brunei-Muara	74%
	Tutong	10%
	Belait	14%
	Temburong	3%
Age	20 years or younger	42%
	From 21 up to 30 years	31%
	From 31 up to 40 years	14%
	from 41 up to 55 years	10%
	Above 55 years	19%
Income	$1000 or less	65%
	$1000 to $3000	22%
	$3000 above	11%
	Not answer	2%
Education	Secondary school	20%
	High school	23%
	Undergraduate	47%
	Postgraduate	9%
	Not answer	1%
Occupation	Student	60%
	Government officer	20%
	Private company	11%
	Business owner	2%
	Others	6%
Computer skills	Developer	8%
	Advance user	36%
	Moderate user	50%
	Beginner	6%

Data gathered from discussion were used to highlight some findings from the survey's results. The theory, concept, and findings will be used to understand the phenomenon and as a basis to construct recommendation. Next section, we discuss the findings from the survey; the findings will be used in the discussion.

4. Analysis

There were about 46% male students and 54% female participants who took part in this survey. About 74% respondents were from Brunei-Muara district, 10% from Tutong, 14% from Belait, and 3% of them from Temburong, which is the smallest district population in the country. Therefore, we believe that the respondents represent a fair share of the public. The time taken to complete the questionnaire on average was 10 min. Some respondents required as long as 15 min.

Table 1 shows details of demographic traits of the participants. There were about 42% of respondents who were under the age of 20, about 31% from 21 to 30 years of age, 14% of them were 31–40 years of age, and 29% of them above 41 years old. The income level of respondents: 65% of them have an income of less than $1000, about 22% of them have an income of $1000–$3000, and 11% of them were $3000 above. More than half of respondents were students (60%), about 20% of them were government officers, and 11% were private company's officers. In term of computer literacy, about half of them stated that they are moderate users, about 36% stated that they are advanced users, about 6% stated that they are beginners, and 8% of them can develop.

Internet habit and characteristics for respondents are shown in Table 2. About 38% of them stated that for less than 6 h they spend their time using the Internet, about 38% spend about 6–12 h, and 25% of them stated that they are always connected. It means that two-third of respondents access Internet more than 6 h daily. 75% of respondents use their smartphones to access the Internet, about 22% of them use their personal computers, and 3% of them use both. This marks one of the findings, where the majority of

Table 2
Internet usage.

Usage hours		New application	
Less than 6 h	38%	Consistently	16%
6–12 h	38%	Several times	44%
Always connected 24 h 7	25%	Once	23%
Mostly access Internet from		Never	16%
Smartphone	75%	Smartphones had before	
Personal computer	22%	1 to 2	59%
Both	3%	3 to 4	27%
		5 above	14%

the respondents access the Internet by using their smartphones, more than the use of their personal computer. Hence, it would be reasonable to use the smartphones as an advantage, instead of a disadvantage.

About 16% of them stated that they would look for new apps consistently, about 44% would do it several times, 23% said once, and the remaining 16% stated that they never do. In addition, about 59% of them have 1–2 smartphones, about 27% stated having 3–4 phones, and the remaining 14% claimed to have 5–6 phones. Fig. 2 shows the smartphone market share in Brunei; Samsung dominates the market with 41%, then followed by iPhone for 33%, Sony is about 10%, Nokia is 3%, 5% for HTC, and the remaining 8% are using other brands. We analysed further using CrossTab between the gender and preference of smartphones. Both male and female share the same percentage that the majority prefer Samsung over iPhone. The study reveals that respondents with an income level of $3000 above prefer iPhone (48%) and below $3000 prefer Samsung (41%–44%).See Fig. 1

Fig. 3 portrays a list of online activities in Brunei. The most popular Apps amongst people in Brunei are instant messengers like WhatsApp and Line, agreed by a total 97% of respondents, then followed by social networks for 81%, and music and video/movie streaming came next with 76% of respondents. Online learning is a popular activity since half of the respondents are students for about 59%, followed by -news or e-book for 50%. The study also reveals that online games are still high amongst participants. There were 42% of them who use smartphones for online games. Online games also use a vast amount of big data as they record and store data of players logging in, hours of play, registrations, or how many have not logged in for days. While, e-commerce activities are not intensively utilized for online activities in Brunei.

The survey would like to reveal a correlation of their personal feeling optimism and type of smartphone's brands. We did a Chi-square test to find correlation between these two variables (smartphone brand and personal feeling optimism). If the result of the Chi-square test shows that variable feeling optimism is independent from variable brand of smartphone, then we cannot conclude any relation between the two variables. Otherwise, we can conclude the relationship. To make sure that variable feeling optimism has a relationship (not independent) with smartphone brand, we need to put the degree of independence as small as possible; say less than 5%. The number of 5% is called the error or mistake that may happen by chance. If probability is lower than 0.05, the two variables have a relationship; otherwise we cannot conclude any relationship between the two variables. We found that there is correlation between smartphone brand and personal optimistic feeling since the Chi square test was 0.028 (below 0.05) that indicates the relationship between two variables.

However, the study also reveals further an interesting fact that those respondents with an iPhone (47%) have a greater optimistic feeling compared with those who own a Samsung (36%), while both iPhone and Samsung owners share the same traits that they were a moderately kind of easy-going person, meaning that the majority of respondents are neither an easy going person nor serious type person. They stand at the moderate level, which can be interpreted that 10% of respondents are hardworking students or workers, half of them are moderate level students or workers, and the remaining group are an easy-going type of person.

The study also measures the relationship between numbers of Internet access and instant messenger (IM). There is a strong relationship between the number of hours spent for Internet access and instant messenger activities (Fig. 4). It is indicated from the Chi Square test that shows 0.025 (below 0.05). It explains the relationship between Internet access and excessive access of IM since the rates of IM at home, transportation, restaurant, classroom/workplace, and restroom are high as well.

We are also interested to find out the correlation between the level of education and optimistic feeling. There are 65% of respondents with a postgraduate level feeling optimistic out of work or study. While, those who are in undergraduate and high school educations, 45% are feeling optimistic and half of them are not sure. We found also that the higher their education level, the less easy going the person.
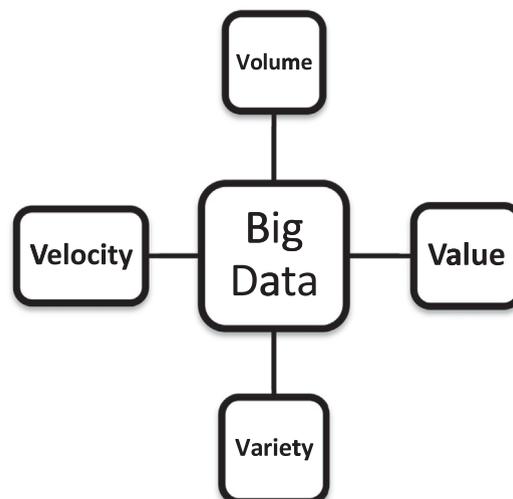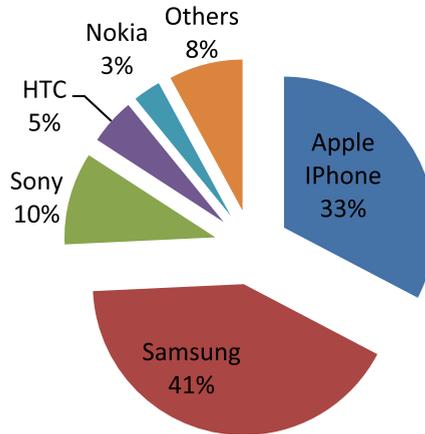

Fig. 1. Model of big data.

Fig. 2. Smartphone brand in Brunei.

Fig. 5 shows how often the Bruneians use their smartphone and where. The majority of respondents (98%) often to always use it in-home, 83% (often to always) in a restaurant, 69% often to always use in transport, 80% (often to always) in a classroom or workplace, and 36% even use in a restroom. An interesting fact shows that more than half of the respondents use their smartphone in home, restaurants, classroom/work, and in transport.

In relation to smartphone activities and gender, almost all Bruneians drive a car to work or university, and Fig. 4 shows that respondents who use smartphones in driving are in high percentage. This indicates that they use it while driving a car. The survey found that females (72%) are more likely to use a smartphone compared to males (64%). It also found that females (27% always use; 58% often) tend to use more smartphones in a classroom or workplace than males (always use 21%; 53% often).

5. Discussion

In this section, we discuss the findings and the future direction of the smartphone and its user habits with the big data approach. The explosion of big data emerges from a variety of data sources including from excessive using of smartphone which can extend the functionalities of smartphones to become a 'smarter mobile phone'. Big data analyses multiple data to recognize any patterns or trends, especially to a user's behaviours and habit which are generated from their online activities through smartphone.

Big data can be used to detect future problems such as business trends, product preference, and best route for travellers. This is due to its capabilities to gather data at a massive speed and able to distinguish the value of the data. For instance, with the aid of data generated from smartphones like social networks or IM, business organizations have more control and understanding of their loyal customers' behaviour based on their clicks, comments, sharing contents, purchase, budget, etc. (Anshari, Almunawar, Low, Wint, &
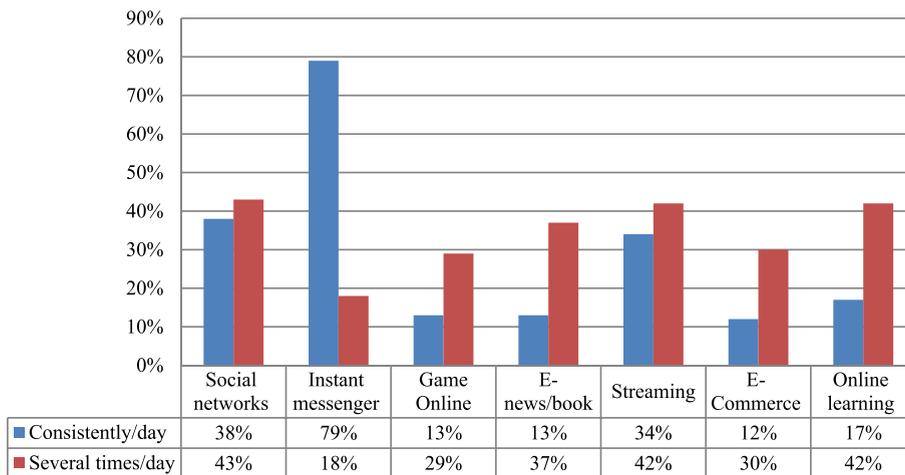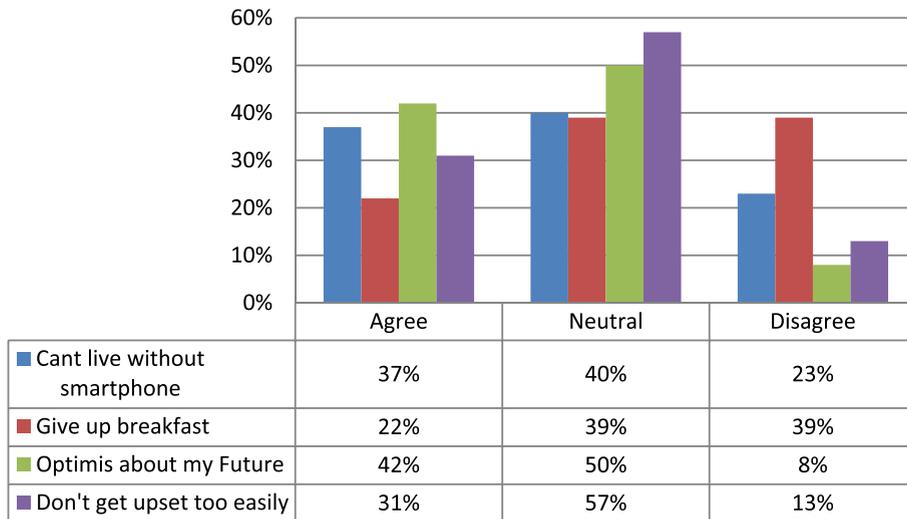

	Social networks	Instant messenger	Game Online	E-news/book	Streaming	E-Commerce	Online learning
■ Consistently/day	38%	79%	13%	13%	34%	12%	17%
■ Several times/day	43%	18%	29%	37%	42%	30%	42%

Fig. 3. Online activities.

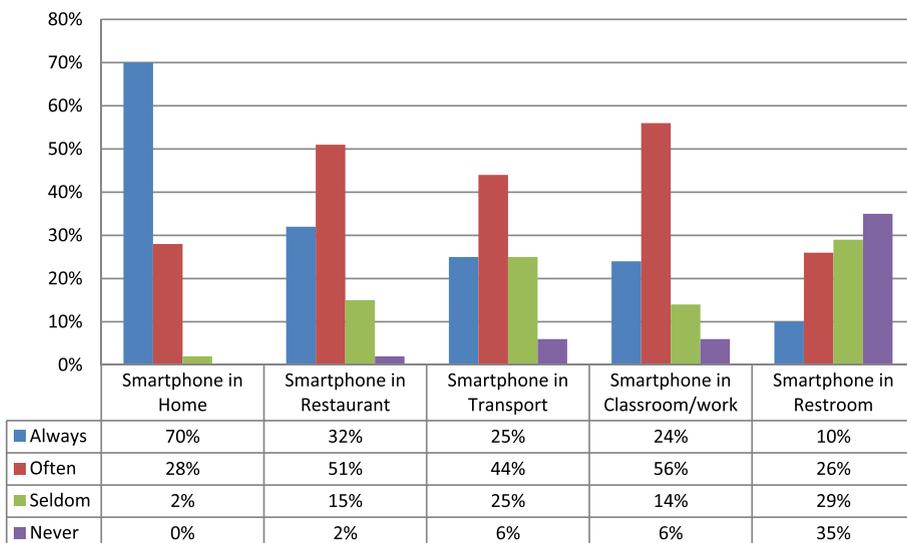|	Agree	Neutral	Disagree
■ Cant live without smartphone	37%	40%	23%
■ Give up breakfast	22%	39%	39%
■ Optimis about my Future	42%	50%	8%
■ Don't get upset too easily	31%	57%	13%

Fig. 4. Smartphone habits and personal feeling.

Younis, 2013). With the ability that they possess, the business organization is able to know what their customer's taste and personality are, and can predict what their next purchase might be; they can consider this and advertise or offer discounts of products that would fulfil the customer's desire (Anshari, Almunawar, Low, & Al-Mudimigh, 2012). In return, their business would expand by attracting more customers from reading the positive reviews by those loyal customers.

How is value being created from big data? Fig. 6 shows the framework of big data in smartphone services. Big data can capture patterns, trends, habit, and behaviour of smartphone users. Those understandings are gathered structured data sources and unstructured data sources relating to the smartphone owner. Structured data sources can be from social networks and IM activities of smartphone users. While, unstructured sources can be gathered from CCTV or vehicle registration numbers. From those data sources, big data analytic works to form patterns, trends or forecasting. The analytic results can be presented to users through push message, alert, notification or suggestion based on their pattern.

To simplify the argument, we give a simple example of a smartphone on wheels and how big data generates value for the users. For instance, there are few benefits of the smartphone on wheels. According to Latham (2000) the benefits of using mobile phones in the car is the ability to call ahead, if people are late, thereby can reduce the pressure on the driver to speed through traffic. The ability to call in advance on the destination from work to home, if there is a need of anything, can reduce the number of car trips, help the environment and reduce traffic congestion, and able us to report emergencies, such as car accidents, assaults, and robberies. In fact, the survey shows that about 69% of respondents used their smartphone while driving.

	Smartphone in Home	Smartphone in Restaurant	Smartphone in Transport	Smartphone in Classroom/work	Smartphone in Restroom
■ Always	70%	32%	25%	24%	10%
■ Often	28%	51%	44%	56%	26%
■ Seldom	2%	15%	25%	14%	29%
■ Never	0%	2%	6%	6%	35%

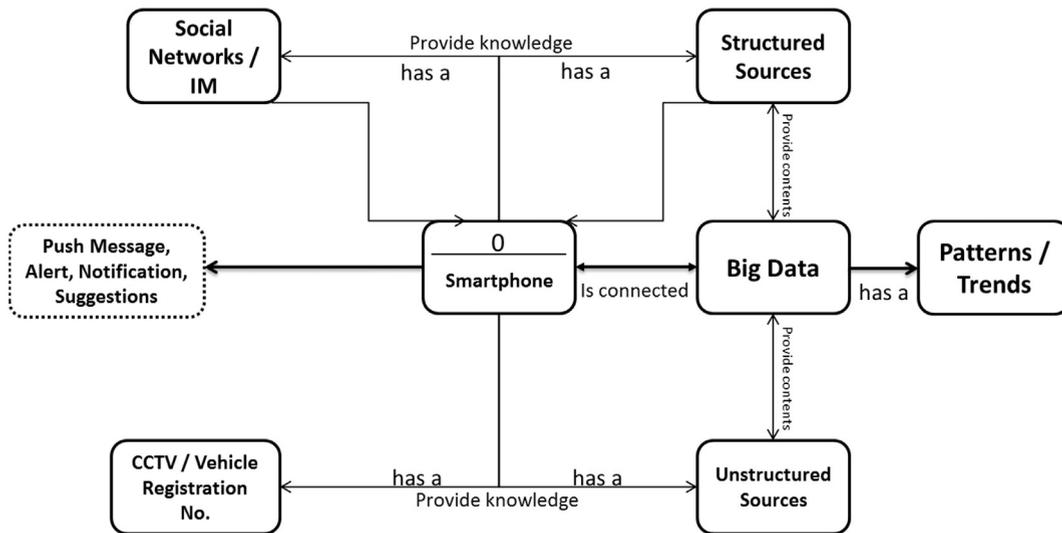**Fig. 5.** Smartphone habits and personal feeling.

Fig. 6. Big data in smartphone.

Big data in transport can alert users with smartphones to find the best route in reaching the destination without being trapped in jams due to accidents. Big data is able to compile, integrate, and analyse and broadcast to the users who retrieve that information. If there is an accident in a specific location, then the source of data that accident has happened can be generated from various means either structured data or unstructured data. The data of an accident is recorded by the nearest CCTV with the details of the location then it is sent to the traffic controller system. Police who are investigating also make an update about the event from their mobile device to the central traffic controller system. People who pass by the location also broadcast the event by updating their status in social media (Facebook, Instagram, Tweeter, etc.) and IM (WhatsApp, Line, etc.). Then, big data analytic tool gathers all the data from those sources (CCTV, police report, social media, IM, etc.), and an alert message will be pushed to each smartphone of the users who are going to pass the congested place. The 'smart message' can only be sent to owners' smartphones based on the vehicle registration number that is captured and thosegoing to the direction where the accident happens. Therefore, big data promises a 'smarter phone' service that intelligently advises the best value, velocity, volume and variety for users in users' smartphone.

6. Conclusion

The research reveals the smartphone usage and habits in Brunei. We are able to achieve our main objective, which is to prove that the majority of the respondents access the Internet by using their smartphones, more than the use of their personal computer. The respondents with an iPhone have a greater optimistic feeling compared with those who own a Samsung, while both iPhone and Samsung owners share the same traits that they were a moderately kind of easy-going person. The survey reveals a correlation between their personal feeling optimism and type of smartphone's brand. We also propose the framework on how big data can create value added to smartphone and its functionalities. The explosion of big data emerges from a variety of data sources including from excessive using of a smartphone can extend the functionalities of a smartphone to become a 'smarter mobile phone'.

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