

CHAPTER 2. LITERATURE REVIEW

This section will list and describe the literatures used in this research as the theoretical supports. These theories are resulted from the examination of various literatures in m-commerce. The literatures are including the theories on m-commerce, theories on technology adoption, and statistic theories to justify the proposed hypothesis.

2.1 M- COMMERCE

It is important to start this research by explaining more about m-commerce. Mobile commerce, or widely known as m-commerce, is a term that emerge not long after the penetration of mobile devices such as cellular phone and personal digital assistant (PDA) into the market. Although there are many definitions of m-commerce, for this research purpose the author prefer to define m-commerce as "any electronic transaction or information interaction conducted using a mobile device and mobile networks (wireless or switched public network) that leads to transfer of real or perceived value in exchange for information, services or goods." [9]. From this definition, it implies that m-commerce is not only consists of business oriented transaction or services.

The discussion on m-commerce becomes interesting because m-commerce offers advantages that traditional commerce, or even Internet commerce lacked of. Some literatures describe m-commerce as the extension of electronic commerce because their similarities, however, m-commerce offers another business opportunity with its own distinctive characteristics and functions [9]. The most obvious advantages are of course

its ubiquity. Through mobile devices, people enable themselves to be reached anytime anywhere since the mobile network is always available.

Through the advancement of network technology, m-commerce also provides service that can be personalized to fulfill the end user's needs. A location-sensitive service also becomes a key point in m-commerce. Knowing the location of the user, drives the service and application offering to a level that creates significant value to the user. User needs local information about their local environment. Location specific information is even more valuable in new environments especially when travelling. For instance a businessman arriving on a plane into Jakarta, he can expect to receive a message asking whether he needs a hotel room for the night.

The usage of m-commerce is inseparable with the penetration of mobile device and networking technologies it used. The paragraph below will explain about the enabling technologies that promote the use of m-commerce.

2.1.1 NETWORKING TECHNOLOGY

Networking technology is the backbone of m-commerce, without it real time system and all the advantages mentioned above would be just an imagination. The most popular technology is GSM (Global System for Mobile Communication), a standard that being used by 3 billion subscriber all over the world [2]. M-commerce also relies on the ability of networking technology to transfer data, some well-known technologies are; GPRS (General Packet Radio Service) or High-Speed Downlink Packet Access (HSDPA) which

in the theory can transmit a packet of data with same throughput rates as conventional modem.

Moreover, the latest advancement in telecommunication technology which enables high speed data transmission and communication is popularly called 3G (Third Generation). This generation's capability is represented much by Video call service, a new communication way which people can see real time video of the person they speak with.

2.1.2 SERVICE TECHNOLOGY

M-commerce also offers variety of services for the user to extend their mobile phone usage, not just traditional telephony like voice call or send a text, but also more advanced services like mobile banking or Internet browsing. Each provider offer different services, however these services can be classified into four categories, according to [10].

2.1.2.1 MOBILE COMMUNICATION

Mobile communication services are the most elementary and well-known type of services. The primary means of communication is of course by voice, and later simplified by text. The obvious example of this kind of service is Voice Call and SMS (Short Messaging Service).

2.1.2.2 MOBILE INFORMATION

The next service that essential to m-commerce is services that meant to provide information to the mobile phone subscriber. Currently there exists numbers of service that displays any type of information, like daily headline news, weather forecasts, or sport match results.

2.1.2.3 MOBILE TRANSACTION

Mobile transaction covers user activities that related to money exposure, according to [11], it includes m-shopping, m-finance and m-payment. M-shopping services offer customer to purchase anything anytime from supporting vendors. It is designed to provide convenient shopping experiences for mobile customers by enabling 'one-click purchasing', a jargon that reflects the simplicity of purchase through pushing buttons in mobile device. Cashless banking transactions such as "check account balance", "money transfers", and "credit card payment", can now be done through mobile devices, allowing the customer to bypass the tiring queue in real bank or ATM. M-banking is really popular to people with high mobility and high banking activities.

2.1.2.4 MOBILE ENTERTAINMENT

Entertainment is viewed as secondary purpose when people use their mobile devices, however, its existence will be the essential value-adding service that operators provide. This kind of service is recognized as a way to test new service technologies. Games, music, and graphic download are the most popular kind of service in this area.

M-commerce services can also be classified by its communication characteristic and its purpose of use. Below is the table of the classification.

TABLE 2.1 SERVICES CLASSIFICATION

Classification Theme	Category 1	Category 2
1. Based on the communication characteristic. [7]	<p>Synchronous Services</p> <p>This category of service consisted of services which provide two ways communications between users at the same time. For example: Voice call or Video call.</p>	<p>Asynchronous Services</p> <p>This category consisted of services that provide communication that is impersonal and single directed, for example: SMS or MMS.</p>
2. Based on the purpose of services. Widely used in consumer behaviour research to distinguish, shopping experiences and product judgment criteria [7]	<p>Hedonic Services</p> <p>Related to feelings and emotions such as fun, relaxation or pleasure. For example: Games, Music, Graphic</p>	<p>Utilitarian Services</p> <p>Concerned with quality of workmanship or delivery, fitness for purpose or the ability to perform a specific function, for example mobile banking.</p>

The advancement in networking and service technologies push other related technology to evolve. Many mobile device and computing vendors release products to cope with

network capability that available. In computing world, there has been a movement to have a unified format for data exchange to optimize transaction in m-commerce. XML (eXtensible Mark-up Language), WML (Wireless Mark-up Language), and WAP (Wireless Access Protocol) are the examples. This trend is also followed by software vendors that developed a mobile edition for their products, such as J2ME from Sun Microsystems or Mobile Internet Toolkit (.NET Mobile) from Microsoft, with these products, software developer is now have a greater access to build mobile-based software.

In the physical side, the latest mobile phones always come with features to enable advanced m-commerce service. The standard features are including video camera for video call and a GPRS / WAP-enabled operating system for mobile Internet browsing.

2.2 THEORIES ON TECHNOLOGY ADOPTION

In order to understand the usage and penetration of m-commerce in particular population of end users, it is useful to examine the theories on technology adoption. To align with the work of [12], this research use Cross Cultural IS research as a base to conduct the research, nevertheless this section also examines another existing theories that researchers use to conduct similar research that are relevant to be explained.

2.2.1 CROSS-CULTURAL IS RESEARCH

Cross cultural research domain offers an interesting environment for researchers to explore. It provides a meaningful way to understand the adoption and use of technology in a population of end users. Culture differentiates how the technologies are being used in the particular population. In the development of this research, the author also finds several studies that publish a similar process on examine cultural studies on many developed countries such as United States, Japan, France, and Korea. These studies try to find the effectiveness of mobile communication technology and eventually resulted in country specific solution.

It is interesting to relate cultural context to the adoption of m-commerce. The primary function of mobile devices is to allow communication between end users, from this fact it is clear that the pattern of usage become collective rather than individual. It is stated to be collective because mobile devices can not be used in isolation. In correlation with collective usage, cross cultural approach will be useful to justify this collective usage pattern and end-users attitudes toward mobile devices.

However, the numbers of research that use culture approach remains low, compare to researches that based on the technological infrastructure. The author assumes this is due to the fact that technological infrastructure proven to be more consistent for the end user. Furthermore, studies that examine the adoption of m-commerce in cultural context are relatively rare because this market is still immature.

Culture, nevertheless consists many dimensions [12], some of them are already widely used for research subject, and the rests are still open to be explored by researcher. The

discussion on culture is narrowed down by explaining the culture dimensions mentioned in the work of Hofstede [8]. Deeper explanation of Hofstede's work can be found in the later section of this paper.

2.2.2 TECHNOLOGY ACCEPTANCE MODEL

Another popular theory on adoption is Technology Acceptance Model (TAM). TAM explained that user perception on usefulness and ease of use are important factors to determine user attitude toward adoption of new technology [18]. TAM was based on the work of Ajzen and Fishbein in [13] called Theory of Reasoned Action (TRA). TRA is a mature theory in social psychology, it is greatly used to explain how people behave as they do in situations of 'reasoned action' by discovering causal relationship between beliefs, attitudes, intentions and behaviour [14]. TAM simplifies the TRA to model technology adoption in organisations [15]. Illustration of TAM can be viewed in diagram below:

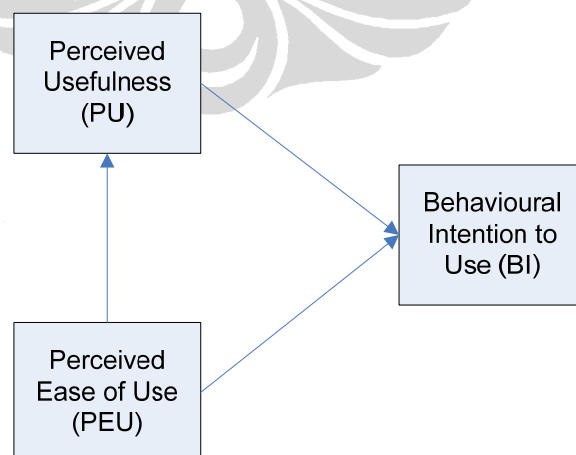


FIGURE 2.1 TECHNOLOGY ACCEPTANCE MODEL DIAGRAM [18]

- Perceived usefulness (PU)

Defined as ‘the extent to which a person believes that using the system will enhance his or her job performance’ [16].

- Perceived ease of use (PEU)

PEU is ‘the extent to which a person believes that using the system will be free of effort’ [17].

- Behavioural intention (BI)

Is predicted by Perceived ease of use (PEU), combined with perceived usefulness (PU).

TAM becomes popular since the concepts found to be universal to different computer systems and user populations. Like any other proposed model, TAM has been criticised for its inadequacies to describe personal and social influences to use a technology. Attempts to extend TAM have generally taken one of three approaches [18]:

1. Introducing factors from related models

TAM’s predictive power has been improved by the addition of factors suggested by other theories. For example, including social influence as proposed by TRA and supported by studies involving social influence [19] and the inclusion of prior factors, such as prior usage and experience [20].

2. Introducing additional or alternative belief factors

Some of contextual factors such as age, gender and technological development are also frequently proposed to improve TAM. Urbaczewski et al. [12] propose the addition of culture as a variable that might determine the success or failure of an innovation.

And the last, new model usually tries to examine antecedents and moderators of perceived usefulness and perceived ease of use. For example, new model differentiate the actual system use component to measure number of calls, length of calls and the type of use (personal or work-related).

2.2.3 INNOVATION DIFFUSION

Diffusion model was developed by Everett Rogers in [21] to explain how an innovation diffuses through a society. This diffusion model has been frequently used to explain the acceptance or the rejection of innovation in an organisation or society. The theory describes the patterns of adoption, explain the mechanism, and assist in predicting whether and how a new invention will be successful in the market. The theory concerned with the manner in which a new technological idea, artefact or technique, or a new use of an old one, migrates from creation to use.

He defined innovation as “an idea, a practice, or object that is perceived as new by an individual or another unit of adoption”, while diffusion is “the process by which an

innovation is communicated through certain channels over time among the members of a social system” [21]. He narrowed the adoption process into five stages [22], namely:

1. Knowledge (exposure to its existence, and understanding of its functions)
2. Persuasion (the forming of a favourable attitude to it)
3. Decision (commitment to its adoption)
4. Implementation (putting it to use)
5. Confirmation (reinforcement based on positive outcomes from it)

Rogers also categorized people based on their openness toward new innovations noted in [18].

- **Innovators**

This is the category of people who have interest in technology and try to cope with new technology as soon as it appears. The innovator adopt new technology whatever the function is. In [18], innovators make 2.5% of the total population

- **Early Adopter**

This category is consisted of people who enjoy the technology advancement but they also have a specific interest to a technology that helps them solve their professional problem and tasks. Early adopter takes 13.5% of the population

- **Early Majority**

The early majority is a pragmatist category. People on this category fairly have interest in general technology. They are focusing on concrete day to day

professional problem instead of the technological tools that might be useful for them. Early majority took its name after its majority in the population (34%).

- Late Majority

Another large portion of population is the people who sceptical with the improvement in technology. They prefer to use conventional and conservatives way to solve problems. This category, like the early majority, takes another 34% of the population.

- Laggards

Laggards are the category of people who never adopt a technology at all. They make up approximately 16% of potential adopter in population.

Rogers also noted that earlier adopting individuals tend not to be different in age, but to have more years of education, higher social status and upward social mobility, be in larger organisations, have greater empathy, less dogmatism, a greater ability to deal with abstractions, greater rationality, greater intelligence, a greater ability to cope with uncertainty and risk, higher aspirations, more contact with other people, greater exposure to both mass media and interpersonal communications channels and engage in more active information seeking [22].

The diffusion of innovation process can be viewed on micro level since the targeted member of population is the end user or the individual. On the macro lever, innovation diffusion considers bigger economic development or technological advancement within the society [22]. This study found to be relevant with the penetration of technology in the twentieth century.

2.2.4 UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY

MODEL

As mentioned previously, there are several robust models to complement TAM model. One of popular model is UTAUT which developed by Venkatesh et al. in [17]. He reviewed eight models from mature social theory and unified all in one model, hence he named the model as Unified Theory of Acceptance. The eight models are:

Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), Motivational Model, Theory of Planned Behaviour (TPB), a combined theory of TPB and TAM, model of PC utilization, Roger's innovation diffusion theory, and social cognitive theory .

Diagram below illustrates how UTAUT combines all these theories and eventually produces the social entities and correlation between them.

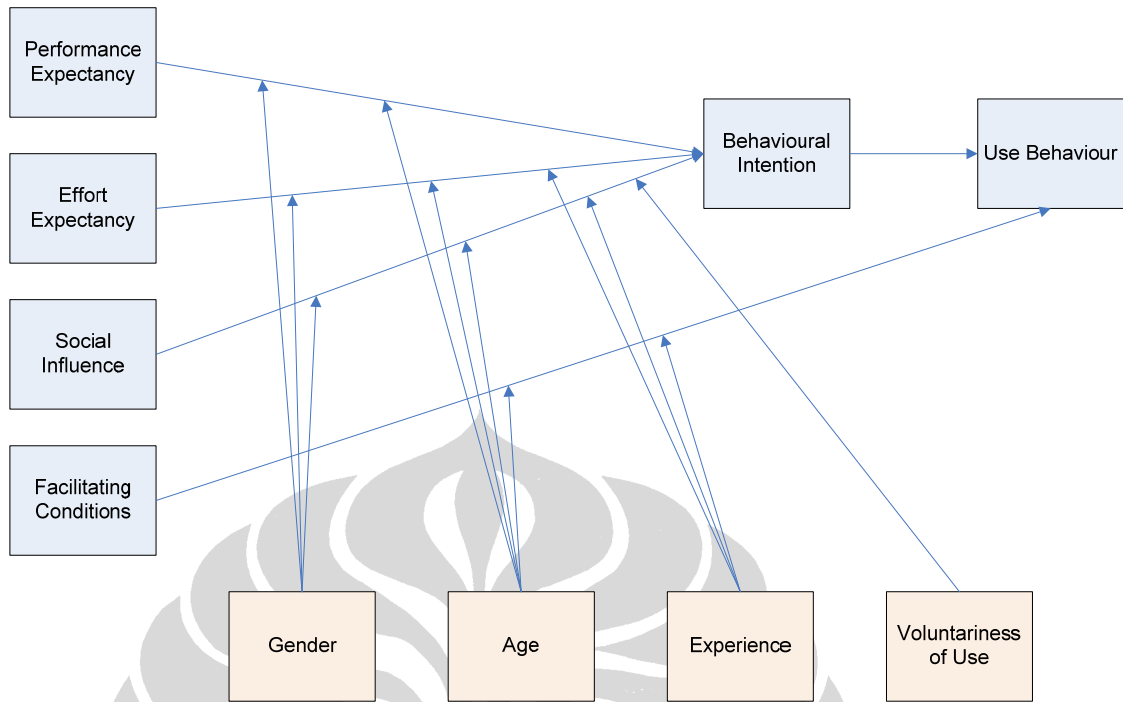


FIGURE 2.2 UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY MODEL [17]

UTAUT proposed four crucial elements that determine usage intention and behaviour, they are: performance expectancy, effort expectancy, social influence and facilitating conditions. UTAUT also introduce four mediating factors as the impact of four elements on usage intention and behaviour, these mediating factors are: Gender, age, experience, and voluntariness (i.e. the degree to which use of the innovation is perceived as being of free will) [18]. UTAUT is famous by its contribution to differentiate between mediating factors and determining factors.

2.3 HOFSTEDE FINDINGS

In order to complement the theory of cross cultural research, it is necessary to introduce Hofstede's Cultural Dimension. It is based on the research of Geert Hofstede conducted between 1967 and 1973 [23]. He studied how culture influence values in the workplace. His work was a large quantitative research which analysed a large database of IBM employee in 40 countries. Later, he extended his study on 50 countries in 3 regions. The replication and extension of his study on different international populations reached 74 countries and regions by 2001. The survey was extended not only on IBM employee but also included students, pilots and civil managers. Hofstede in his work defined culture as "the collective programming of the mind which distinguishes one group from another" [8].

The focus of his study was not to prove that culture is a product of mind, but rather he highlighting crucial patterns of feeling, thinking and acting which already established in late childhood [24]. This cultural context manifested in culture's choice of symbol, heroes, and values [24]. From his initial work, Hofstede identified four primary cultural dimensions to help him differentiating culture.

2.3.1 POWER DISTANCE INDEX (PDI)

Power distance measures the condition in one organization or institution where the members share and distribute different power. Power is related to someone's position in the society, economic stability and status he posses. Power index measure how the members accept and expect this inequality. The inequality represented here is of course

defined from the members with lower power, it also suggest that the level of inequality is endorsed by both followers and the leaders. This inequality of power happened in all culture, and therefore becomes a fundamental factor.

In countries that exhibit high PDI, Hofstede claims that the countries tend to have centralized political power and encounter tall hierarchies in organizations resulting in large salary and status differences. In this kind of culture, subordinate may view its supervisor to dictate and he expected to do as the supervisor told. In the family, parent will teach obedience and expect to be respected.

Contrast with countries with low PDI, there will be flatter hierarchies, where subordinates and supervisors are close and interchangeable. Equality is an issue that generally expected and desired. One interesting fact of countries with low PDI, they tend to have higher geographic latitude, smaller populations and higher Gross Domestic Products per capita than their opponents in high PDI countries [24].

Hofstede also claimed that this differences are already developed from hundreds year back. He does not believe that technologies like global telecommunication system will change traditional culture.

2.3.2 INDIVIDUALISM (IDV)

Individualism is the degree where individuals are integrated into groups or society. Collectivism is the term for culture with low individualism. In individualist side there is loose ties between individuals, everyone is expected to take care of one's self or the nuclear family but not everyone else. In collectivism side, individuals are integrated into

tight, cohesive in-group bound. Extended families like uncles or grandparents continue to protect these individuals for unquestioning loyalty in reply. However, the term collectivism is referring to groups but not state, therefore this dimension is also fundamental regarding all societies in the world.

Hofstede found that personal time, freedom and material rewards are external motivators that valuable. In individual to individual relation, people value honesty and self-respect, maintain firm privacy rights. Furthermore, countries with high index of individualism will put individual social-economic interest over groups and enforce freedom, self-government, and self-actualization ideologies.

In countries with low individualism index or the collectivist country will value intrinsic reward, like training, skills or physical condition. In relation with people, collectivist culture harmony prevails over honesty or truth also silence more than speech. Collectivist government may raid private life or dominate the economy.

2.3.3 MASCULINITY (MAS)

Masculinity and its contrary side, femininity, refer to the degree where roles are distributed between genders. In masculine culture, traditional assignment to male for example assertiveness, competition, and toughness are being raised, the distinction still strongly maintained. Work goals will include challenge and recognition

While in feminine country, values like tenderness, orientation to home and children are being focused. The traditional distinction is collapsed and roles are often substituted

between genders. Work goal will be good living and employment security. Hofstede found that in different culture, different gender is dominated certain profession.

2.3.4 UNCERTAINTY AVOIDANCE INDEX (UAI)

Uncertainty avoidance measures the degree on how people in the culture tolerate uncertainty and ambiguity, and finally it refers to people's search for Truth. UAI shows in what extent a culture developed its members to face unclear and unformatted condition. Uncertain condition can be seen in new, surprising, or unknown situations that differ from usual situation. High UAI suggest that members of the culture are more avoids uncertain condition, they feel uncomfortable when deals with unstructured situations. Uncertainty avoidance produces rituals, values in correlation with punctuality, formality and tolerance.

High UAI countries try to avoid or minimize the occurrence of uncertain situation by enforce strict law and rules, and also security measures. In extreme, such novel opinions are treated more like a threat. These countries tend to belief an absolute Truth, and assimilated in their philosophical and religious views. Hofstede summarized that the members of high UAI countries are more emotional and motivated by inner nervous spirit.

In contrast, in low UAI countries, people are more tolerant to novel opinions that perhaps contradictive with their initial opinion. People in this culture allow many beliefs or philosophical view to life side by side. But people behave silently and less aggressive,

because these people are not as anxious as their counterpart in high UAI countries therefore people are not showing strong emotions.

Hofstede work can easily found in social studies on culture, because his definition of culture and measurement of cultural differences are considerably deep. However several criticism are addressed to his work, some of them put a question on the number of cultural dimensions that Hofstede used and found it as an oversimplification [25]. But, [26] concludes that the benefits outweighed the deficiencies of his research.

2.4 HARRIS' FINDINGS IN HONG KONG

The idea to relate culture influence in the adoption of technology has been inspiring many researchers to do research in this area. Culture and technology adoption alone are variables that always open to new discussion due to wide variables they contain. M-commerce as a product of technology is viewed as a medium to reveal the connection between culture and technology, because the communication is valued as cultural result, and the usage pattern of mobile devices is mostly inter-personal and collective. These facts show how cultural values are inseparable with m-commerce.

From many researches in this theme, the author is interested with the work of Harris et al. in [4] that discussed m-commerce adoption in Hong Kong and United Kingdom which possesses different cultural background. Sufficient literatures are comprehensively described in this research to build a clear cohesion between culture and m-commerce

adoption. The author interested to develop a similar research that is intended to complement the result of Harris et al. work. In return, the aligned result will be valuable to find a pattern of culture inception in m-commerce adoption.

In order to obtain a parallel result, most process in this research is developed to mimic the previous work of Harris et al, although, some adjustments are being made to transform the cross cultural framework into a research that examine single cultural profile. All research hypotheses are still maintained, so does some research variables. For example, this research targeted m-commerce user in the age range of 19 to 30 as the user profile. Next subsection will describe Harris et al. findings in their research

2.4.1 HONG KONG PROFILE

M-commerce infrastructure was already well-developed in Hong Kong. In 2005, Hong Kong had 91% penetration rate of m-commerce, as of 2007 the penetration increased to be 139.8% [39], or higher than its population. There were 6 operators licensed to serve a population of 6.8 million. This lead to dramatic prices falls which stimulated rapid growth; some analysts regard Hong Kong as the fiercest mobile market in the world [4]. Despite the 91% penetration rate noted above, Hong Kong's market only consists of only 5.87 million subscribers [4].

While in cultural side, Hong Kong exhibit high power distance culture, and collectivist culture, indicated by high power distance index and low individualism index from Hofstede dimensions. The full profile of Hong Kong's Hofstede dimensions is written in the table below.

TABLE 2.2 HOFSTEDE'S DIMENSIONS INDEX OF HONG KONG AND UNITED KINGDOM

Country	Power Distance (PDI)	Individualism (IDV)	Masculinity (MAS)	Uncertainty Avoidance (UAI)
HK	68	25	57	29
UK	35	89	66	35

2.4.1.1 USER BEHAVIOUR

In Hong Kong the usage of multiple mobile phones was not prevalent. It is supported by the fact that there is slightly different pricing structure between service providers. Hence the usage of more than one service provider is uncommon. In addition, the migration to other provider was also less likely to occur.

TABLE 2.3 HONG KONG USER BEHAVIOUR PROFILE

Question	Answers	Frequency	Percentage
Number of Mobile Phones held currently	1	103	79.2
	2	24	18.5
	3	3	2.3
	>=4	0	0
Number of service providers used currently	1	103	79.2
	2	24	18.5
	3	3	2.3
	>=4	0	0
Length of current mobile phone usage	< 1 year	52	40.0
	1-2 years	35	26.9
	2-3 years	13	10.0
	>3 years	30	23.1
Changed service provider in the past 12 months	Yes	33	25.4
	No	97	74.6

2.4.1.2 SERVICE ADOPTION RATE

The histogram below shows the distribution of services that were being used by a customer.

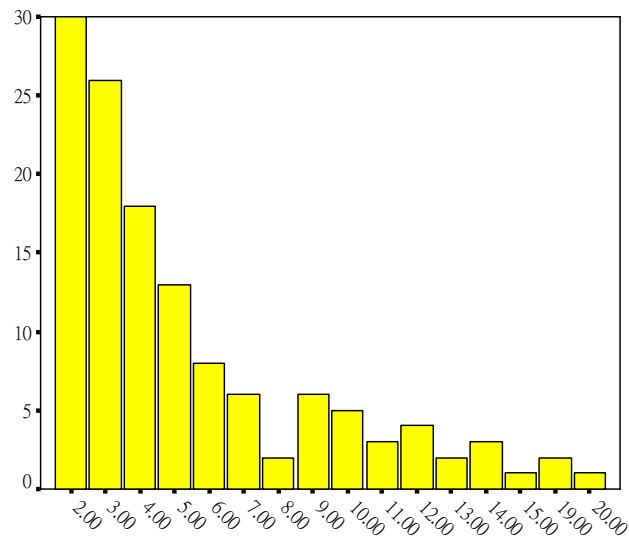


FIGURE 2.3 NUMBER OF MOBILE SERVICES ADOPTED IN HONG KONG

From the data above, it can be observed that the highest proportion of Hong Kong users (23%) only uses the two core communication services (Voice call and SMS), and around half of the population was recorded only to use the two core services plus two additional services.

2.4.1.3 HYPOTHESIS PROOF

Harris et al. found support for their hypotheses. The high use of synchronous services such as voice call in Hong Kong may be attributed to the higher level of collectivism in the culture, as hypothesised, but it may also be due to lower cost of calls in Hong Kong.

Analysis of the Hong Kong data in isolation shows that Hong Kong respondents consistently display more positive attitudes to hedonic services (apart from browsing the mobile internet) than they do to utilitarian services.

Harris et al. also find support for hypothesis that word of mouth recommendation is viewed as a more important influence on adoption in Hong Kong than any other factors, though this difference is not statistically significant. Price sensitivity in Hong Kong is proven by research finding which stated that discounts and free trial are the two most influencing factors for Hong Kong m-commerce user.

2.5 ATTITUDE TOWARDS TECHNOLOGY

To complement the theories on adoption, Kim et al. in their paper [7] have studied that the “Popularity”, or the effectiveness of a new technology, can be measured by asking the user to rank four attitudinal criteria toward the usage of that particular technology, they are;

- Frequency of use

It measures the quantity of time that user have spent in a period of time to use the technology.

- Perceived usefulness

It measures how the user feels that a particular technology is useful for their daily task.

- Perceived satisfaction

It measures how the user satisfied with the output that the technology brings, and how it is compared to the effort they have spent.

- Expensiveness

It measures how user will to spend such amount of resources (i.e. effort, money, and time) to use the technology until it produces the wanted outcome.

2.6 INFLUENCING FACTORS

There exist many influencing factors that push people to use m-commerce services. The number of factors is narrowed down only to those that will describe price sensitivity in the market and promotional factors related to the culture. Below is the list of factors that reflect price sensitivity in the market and its brief description (taken from the work of Schutte and Ciarlante in [34]).

- Discount

A term for reductions in a basic price of goods and services.

- Free Trial

Consumer is not charged to use a service or to consume goods in a period of time.

- Low Cost

Consumer is charged with price that is more affordable, or, consumer offered with lower pricing structure from their usual vendor.

While in promotional factors the author draw on the work of Usunier in [35], where the factors are:

- Incentive

Consumer gets money reward from the number of service they use or goods they consume. The reward can also be a point to afford similar service or goods.

- Family Recommendation

Is a push to use a product that have already used by consumer's family. The recommendation can be an advice, suggestion and testimonial for the product.

- Demonstration

Demonstration refers to a display or exhibition that demonstrates the product advantages in use.

- Lifestyle Enhanced

A product can be interesting to its user if it perceived to increase the user confident, i.e. products that is being a trend or luxurious.

2.7 STATISTICAL THEORY

As the discussion on the technology penetration includes the end user within population, it is practical to have an understanding on statistical analysis and theories. Statistical analysis is being used to conclude what actually happened in the population, statistical analysis relate the numerical result gained from the research with the adoption theory.

The author limits the discussion on the theories which relevant to justify the hypothesis. As stated previously, the proposed hypotheses try to find that one m-commerce service category will be more popular than the other. To justify this, the author needs to perform a statistical test to prove that the mean of one m-commerce service category is “statistically significant” than the other.

What does it imply that the mean is statistically significant than the other? Suppose that there exist three situations shown from diagram below [27]. It is easily noticed that the difference between means in each situation is all the same. The first example shows moderate variability of cases in each population. The second example shows high variability, and the third is population with low variability. It is obvious that the most distinct difference is appearing most at the third example, because there is relatively little overlap between the curves. In other two examples, the different between the means is barely unnoticed because there is a big area where the curves overlap, here it is said that the two samples are not statistically significant.

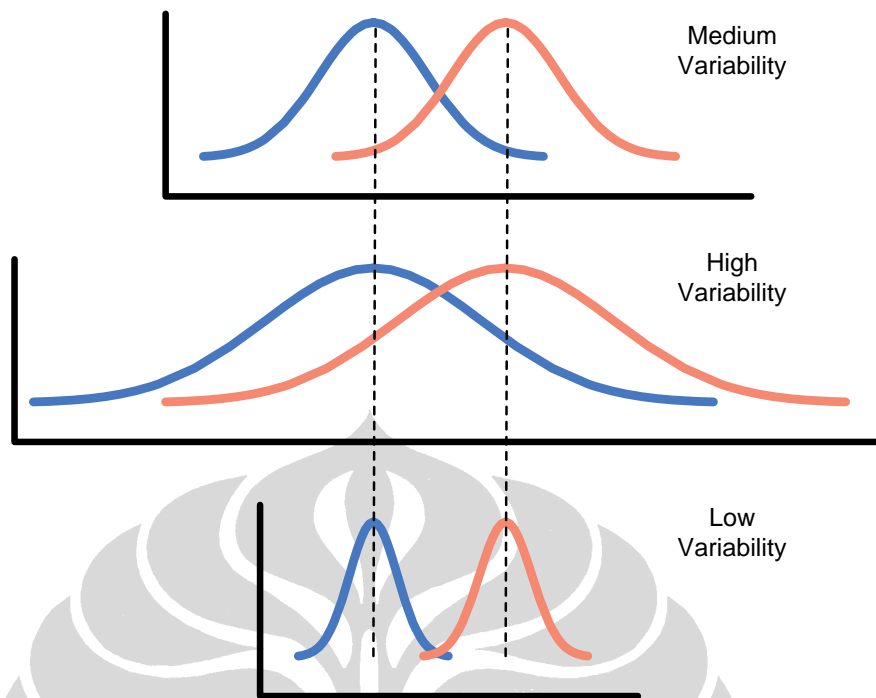


FIGURE 2.4 NORMAL DISTRIBUTION AND ITS VARIABILITY (TAKEN FROM [27])

These examples resulted in an important conclusion; it is important to judge the differences between means relative to their variability (the spread of cases) in the population. To check whether difference between the two means (relative to their variances) is significant, two statistical tests explained below are popular to be used.

2.7.1 T-TEST

T-test is widely used to compare means between populations [28]. The means can be resulted from any nominal measurement of a variable in that the population. T-test is used to prove that the variable mean is statistically significant from the other mean. The

null hypothesis (H₀) that t-test use is that the mean of both observed population are the same.

T-test is based on the following assumption [29]:

1. The data are drawn from normal distributed cases.
2. Standard normal distribution is built from a population with a mean of zero and a variance of one.
3. The samples may be independent (samples that taken from two unrelated populations) or dependent, depends on the hypothesis proposed.
4. The equality of variances
5. Because the test needs to compare a population with another population, it is important to have both populations in similar variance. Variance denotes how possible values taken from samples are dispersed from the expected value (mean). Variance said to be high if the average distance of possible values and the mean is high.

There are three kinds of t-test to suit different case of observations [28], this classification is based on how many sample(s) that is observed. These classification also based on the sample dependency with other sample (independent/ dependent)

1. One sample t-test

This test is used to test a mean from a population to a certain standard.

2. Independent two samples t-test

To test means from two randomly selected populations, for example cats and dogs

3. Dependent (Paired) two samples t-test

This test used to test a dependent sample, for example body weight before and after a treatment, or another example to measure body height from wife and husband.

Notice that in order to have an accurate t-test, the three assumptions mentioned earlier have to be met. There is a possibility that research study does not meet these criteria. Frequently, the first assumption about normal distribution is not satisfied. Histogram usually gives clear illustration whether the sample normal or not. Moreover, there are numbers of statistical test to justify whether a population is in normal distribution or not. Some of the popular tests are Kolmogorov-Smirnov test (for population with number of samples greater than 2000), and Shapiro-Wilk test (for samples between 3 and 2000) [28]. The discussion of these normality tests is out of the scope of this research. However, to overcome this situation there are two possible alternatives, explained below.

1. Transformation

When research meets a condition where the survey is not in normal distribution, the data need to be transformed into close-to-normal data by applying arithmetic operation to the data. The goal of this arithmetic operation is transforming sample values into less-variants values, thus removing the outlier. Indeed, not normal data often resulted from errors in data input. Below is the list of arithmetic operation that can be used for some cases [30].

- Calculating the square root (Sqrt) of each data to normalize weakly skewed datasets.
- Calculating the logarithm (Log10/Ln) of each data to normalize more strongly skewed datasets ("log-normal" distribution). Any type of log will do this.
- Calculating the reciprocal (1/var) of each data may produce a normal distribution from an exponential dataset.

2. Non-parametric test

T-test is categorized as a parametric test since it deals with normal distribution data. However, non-parametric test can be used if there is a vague condition where the normality of the population is in question [31]. Non parametric do not rely on the assumption of distribution probability in the population. Non-parametric test are widely used in a study which resulted in ranked values, like movie rating or IQ score. Non-parametric test is necessary when the data have no clear numerical interpretation.

Non-parametric test frequently noted as distribution-free test, it based on fewer assumptions, therefore non parametric test has wider applications than its counterpart in parametric test. It also noted to be more robust than parametric test. Fewer assumptions make non-parametric test to be easier to use. Some statisticians prefer to use it since non parametric test minimize errors and misunderstanding [31].

In non-parametric side, Wilcoxon Signed-rank test is a substitute for paired sample t-test [32]. In line with paired t-test principle, Wilcoxon signed rank test judges whether two observations on a sample produce statistically significant outcomes. Again, Wilcoxon Signed-rank test does not rely on the assumption that the data are drawn from normal population like t-test does, but the distribution are determined from the data itself. Below are the assumptions on performing Wilcoxon Signed-rank test [33].

- The measurement scale of the samples is at least interval
- The samples are mutually independent
- The distribution of both populations are symmetric
- The samples all have the same median.

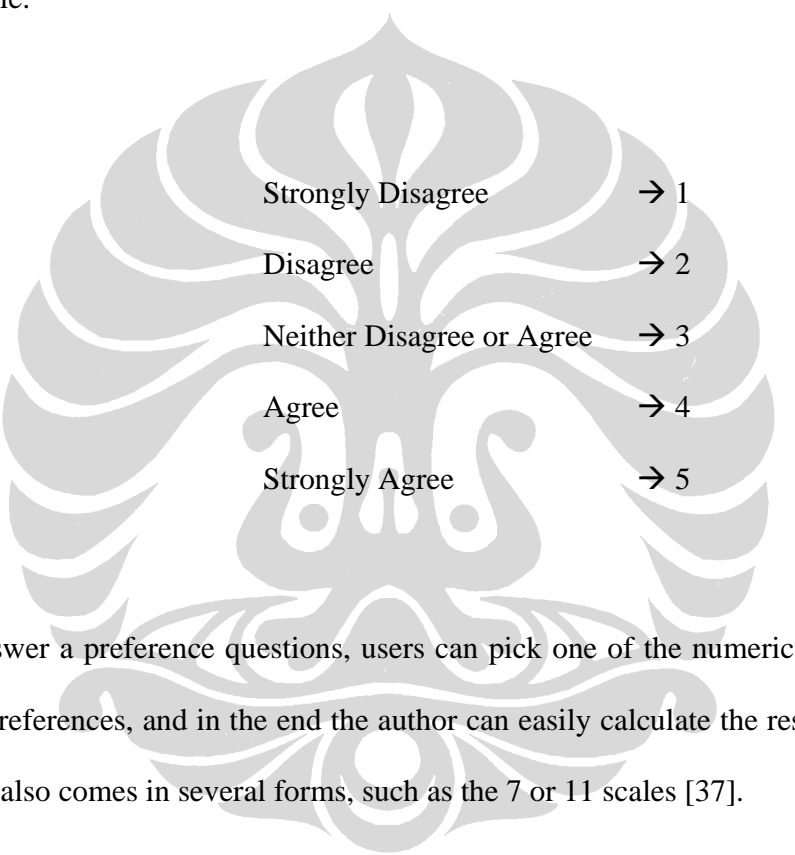
Usage of both tests (T-test and Wilcoxon Signed-rank test) should be based on careful analysis of their advantages and disadvantage. The table below will briefly describe the two sides of both tests.

TABLE 2.4 STATISTIC TESTS, ITS ADVANTAGES AND DISADVANTAGES

Statistic Test	Advantages	Disadvantages
1. T-Test	Produce more accurate result for specific cases which is an observation of a variable in one or two populations.	Need to transform data into normal distributed sample. This transformation require fair amount of intervention, thus decreasing the originality of data.
2. Wilcoxon Signed-rank test	Relies on fewer assumptions. The most important, it does not take population distribution into account. Fewer assumptions also make the calculation simpler.	Used only for ranked data. Only matched with the condition of paired sample observations.

2.7.2 LIKERT SCALE

The adoption of m-commerce often deals with user preferences. Likert scale is a technique of scaling subject preferences, by associate numerical value to a set of attitude statements [37]. In this research five statement items to response the questions are being used, the number 1 to 5 are assigned to each statement correspondently. Below is the example:



Strongly Disagree	→ 1
Disagree	→ 2
Neither Disagree or Agree	→ 3
Agree	→ 4
Strongly Agree	→ 5

To answer a preference questions, users can pick one of the numerical value that match their preferences, and in the end the author can easily calculate the response. In addition, Likert also comes in several forms, such as the 7 or 11 scales [37].