Mobile Communication Devices and their Impact on Social Communication in Thailand

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ABSTRACT

This paper studies the impact of mobile communication devices on social communication. The paper focuses on the availability and use of mobile phone and tablet as tools to access the mass media, and how they impact contemporary culture in Thailand. The objective of this research is to provide quantitative tools to determine changing trend in mass communication moving from the traditional print media to electronic information transfer through mobile devices. The research intends to prove how this new means of information exchange impact both contemporary culture and social communication in Thailand. Structural data for telecommunication subscriptions and market trend was obtained through the ICT Ministry's data base. Primary data comes from a field survey. The survey is comprised of 60 randomly selected mobile device users. The methodology employed in this research consists of impact analysis modeling (IAM). Series of statistical tests were used to analyze the data. A confidence interval of 0.95 was used in all statistical tests. Laplace Trend Test (LTT). The findings show that there is an increasing trend among users to accessing the mass media through mobile devices. The Z-score LTT exceeds 1.65. The prospective impact of mobile devices on social communication was identified through Kahneman-Tversky Prospect Theory equation. Under the prospect theory, the impact of mobile communication devices on social communication exceeds 0.80. The intended contribution of this research is to introduce quantitative method in communication research through impact analysis. The impact of mobile communication device on social communication is used as a case study.

Key words:

Continuous probability, discrete probability, impact analysis, mass communication, randomness test, prospect theory, trend test

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1.0 INTRODUCTION

The *rationale* of this research is the need to verify the assertion that mobile device may be part of the mass media. The *question* addressed by this research is whether mobile device as a tool for communication impacts contemporary Thai society? If so, in what aspect has such am impact been found? This research proves that mobile device positively impacts contemporary culture in two

aspects; on the one hand, it contributes to the acquisition of knowledge through accessing information base via Internet connection and, on the other, mobile device allows more freedom of expression. The intended *contribution* of this research comes from its new findings

This research was accomplished through the use of two types of data. Primary data was obtained through field survey. The field survey was accomplished through written questionnaires. The secondary data came from the ICT Ministry's database. The database is comprised of subscription records of mobile and fixed line users from the year 2002 to 2013. The two types of subscription are summarized in Table 1.

Table 1. Mobile and Fixed Line Subscription from 2003 – 2014

No	Year	Mobile	Fixed Line	Gap	% ΔGap
1	2002	17,449,890.00	-	-	-
2	2003	21,616,910.00	6,997,401.00	14,619,509.00	
3	2004	26,965,548.00	6,979,484.00	19,986,064.00	37%
4	2005	30,460,238.00	7,293,467.00	23,166,771.00	16%
5	2006	40,125,470.00	7,219,893.00	32,905,577.00	42%
6	2007	52,973,994.00	7,563,352.00	45,410,642.00	38%
7	2008	61,837,164.00	7,394,349.00	54,442,815.00	20%
8	2009	65,952,313.00	7,204,936.00	58,747,377.00	8%
9	2010	71,726,300.00	6,924,844.00	64,801,456.00	10%
10	2011	77,449,466.00	6,661,174.00	70,788,292.00	9%
11	2012	85,012,411.00	6,377,256.00	78,635,155.00	11%
12	2013	93,848,536.00	6,056,207.00	87,792,329.00	12%

Source: http://www2.nbtc.go.th/TTID/

The first objective is to determine whether is a significant increasing trend for mobile subscription in the period from 2002 to 2013. There are three general methods of proving trends. The first method is the Reverse Arrangement Trend Test (RAT). The Reverse Arrangement test (RAT) is given by:

$$Z_{RAT} = \frac{R - \left(\frac{r(r-1)}{4}\right) + 0.50}{\sqrt{\frac{(2r+5)(r-1)r}{72}}} \tag{1}$$

where r = arrival time or $r = df = n-1$, R =reversal counts. The approach of Z_{RAT} is to use the first arrival of the event as the reference point. In subsequent observations, determine whether larger value occurs. If there is a larger event occurring, count such an event as 1. If there is a smaller event, count it as 0. Mark each count of value larger that the initial event as R_i. This method was not used because it is cumbersome to determine series of R counts.

The second method is called the Military Hand Book Trend Test (MHT). The MHT trend test method is given by:

$$\chi^2_{2r} = 2\sum_{i=1}^{r} \ln\left(\frac{T_{end}}{T_i}\right) \tag{2}$$

The MHT method is based on chi-square distribution. Use the chi-square table to determine the critical value as the standard value against which the observed trend is compared. The degree of freedom (*df*) is defined as $df = 2r$. Recall that r is the arrival time.

$$\chi^2_{2r} = 2\sum_{i=1}^{r} \ln\left(\frac{T_{end}}{T_i}\right) \quad (3)$$

The MHT method was not used in this research because it does not match the type of data distribution: $A^2 = 11.82$ and $A^{*2} = 12.85$. The data is normally distributed; therefore, MHT may not be used.

The third method is called the Laplace Trend test (LTT). The LTT method is based on normal distribution of the data. This research selects LTT as to test the trends of mobile subscription data for the period 2002-2013 because the Anderson-Darling test confirms that the data is normally distributed. The first test of the trend is to examine the year-to-year gap between mobile and fixed line subscription by using LTT. The Laplace trend test is given by:

$$Z_{Laplace} = \frac{\sqrt{12r}\left(\sum_{i=1}^{r}\left(T_i - \frac{T_{end}}{2}\right)\right)}{rT_{end}} \quad (4)$$

where r = degree of freedom or $df = n-1$, T_i = arrival time of event, i.e. $T_1, T_2, ...T_r$. The result of LLT shows that $Z_{LTT} = 13.76$ compared to the null hypothesis: $H_0 : Z_{obs} < 1.65$, there is a significant increase of the gap trend in the mobile device subscription relative to fixed line subscription. This finding is also confirmed by the significant decreasing trend in fixed line users by subscription count year-by-year from 2003 to 2013: $Z_{LTT} = 32.71$ and there is a corresponding increasing trend among mobile users in the same period: $Z_{LTT} = 2.58$. In both cases, the null hypothesis was $H_0 : Z_{obs} < 1.65$ using 0.95 confidence interval.

The significant growth of mobile service subscription underscores the perceived utility of the technology and its influence on contemporary Thai citizens. There are two types of mobile device users: pre-paid and post-paid. The mobile market composition and changes over the years is given in Table 2.

Table 2. Mobile Market in Thailand for 2002-2013

	Minute Usage		Revenue Per Month		Mobile Penetration		Market Growth	
Year	Post-Paid	Pre-Paid	Post-Paid	Pre-Paid	Post-Paid	Pre-Paid	Post-Paid	Pre-Paid
2002	447.00	127.00	1,057.00	209.00	6.67%	20.84%	-7.12	18.15
2003	468.00	111.00	1,191.00	258.00	5.58%	28.21%	-1.30	5.92
2004	462.00	105.00	1,140.00	286.00	6.53%	35.26%	2.84	4.94
2005	460.00	206.00	941.00	331.00	6.79%	40.00%	-0.53	4.23
2006	606.00	221.00	754.00	245.00	7.94%	53.25%	8.02	9.32
2007	648.00	277.00	746.00	254.00	8.30%	71.91%	-3.48	6.55
2008	539.00	217.00	643.00	214.00	9.75%	83.26%	6.02	3.15
2009	486.00	226.00	639.00	210.00	10.54%	88.26%	1.24	2.07
2010	477.00	233.00	648.00	210.00	10.78%	88.04%	2.01	3.03
2011	400.00	217.00	484.00	157.00	11.74%	95.78%	3.70	1.42
2012	375.00	220.00	454.00	161.00	14.71%	102.83%	6.60	3.07
2013	461.00	240.00	459.00	151.00	17.36%	123.22%	5.50	2.38

Source: http://www2.nbtc.go.th/TTID/mobile_market/minutes_of_use/.

Using the Laplace trend test, various components of the mobile market in Thailand shows significant increasing trend from 2002 to 2013. The test result is summarized in Table 3.

Table 3. Trend Test of Mobile Market in Thailand for 2002-2013.

	Minute Usage		Revenue Per Month		Mobile Penetration		Market Growth	
α Level	Post-Paid	Pre-Paid	Post-Paid	Pre-Paid	Post-Paid	Pre-Paid	Post-Paid	Pre-Paid
Z(obs)	6.94	4.18	33.58	5.42	6.26	6.23	6.16	5.99
Z(0.95)	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
Conclude	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.

Against this back ground information of the mobile market in Thailand, this research attempts to prove whether mobile device usage has any effects on contemporary culture of Thailand. If so, whether such effects (i) positively influence the increase of knowledge inventory by accessing information-base, (ii) brings positive change to contemporary Thai culture and (iii) increases the ability of people to express opinion through online posting via mobile device. These effects will be quantified into a perceived utility measurement under Kahneman-Tversky's Prospect Theory of utility. The Kahneman-Tversky equation for the prospect theory is given by:

$$U = \sum_{i=1}^{n} w(p_i)v(x_i) \qquad (5)$$

where w = weight assigned to each variable, p_i = probability for each event, v = function that produce each event, and x_i = event outcome.

2.0 LITERATURE REVIEW

The first form of mass communication was made possible by the printing press. (Splichal, 2006, p. 41, Ramey, 2007, pp. 1-2, Galician, 2004, p. 69). Large circulation of printed materials made it unfeasible to receive feedback from readers. Newspapers, for instance, became a one-way communication medium. (Newman, 1999, Nerone, 2006, and Pace, 1997). Thompson defined mass media as '[I]nformation distribution' - a "one to many" form of communication, whereby products are mass-produced and disseminated to a great quantity of audiences. (Thompson, 1995, 26-8). The purpose of mass media may be classified into three types: (i) advocacy, (ii) entertainment, and (iii) public service announcement.

Three theories explain the influence of mass media: limited-effects theory, class-dominant theory, and culturalist theory. Limited-effects theory the media exerts limited effect on people because people select to interact with the media based on pre-existing belief or knowledge. (Chaffee *et al.*, 1985, pp. 267-96). The class-dominant theory asserts that the media projects the views of the ruling minority in society. Bennet, 1982, pp. 30-55. Lastly, the culturalist theory argues that people create new their own meanings and, thus, their own new culture, as the result of interacting with the media. (Hutchby, 2006, p. 5; Hodge and Tripp, 1986, and Palmer, 1986). The first question presented in this research is *whether mobile device has any impact on the Thai society?*

Media is the tool used to communicate with the public. Mass media consists of seven channels: prints, audio recording, cinema, radio, television, Internet, and mobile phones. The second question present in this research is *whether the Thai public considers mobile phone as part of the mass media?*

Mobile phone usage is widespread in all parts of the world. (Oksman and Rautiainen, 2003, pp. 293-308). Mobile phone is part of our daily life. (Addo, A., 2013, p. 47). In some instances, mobile phone may be used as a tool to strengthen social ties. (Johnsen, 2003, p. 161-69). In Thailand, at the end of 2013, there were 93,848,536 mobile subscribers compared with 6,056,207

fixed line subscriptions. Thailand is a country with a population of 66,720,153 people. The person-to-mobile phone subscription ratio is 1.4 mobile subscriptions per person. In contrast, the ratio for the fixed line usage is 11.02 persons per fixed line. Mobile phone technology is accessible and affordable in Thailand. The pervasive use of mobile phone in Thailand motivates this research to raise the question of whether mobile has become the 7th media in Thailand. In an attempt to determine the influence or the mobile device, this research attempts to document three impacts of mobile phone in Thailand: acquisition of new knowledge, cultural change, and freedom of expression.

3.0 DATA

There are two types of data used in this research: primary and secondary data. The primary data was generated by field survey. The instrument used to collect the data is a written questionnaire consisted of five sections: (i) demographic information, (ii) perception of mobile device as a source of information, (iii) influence of mobile device on interpersonal relationship, (iv) access to mobile device technology, and (v) impact of mobile device on contemporary culture. The secondary data came from the ICT Ministry's website where mobile and fixed line subscriptions information are opened for public access at: www.www2.nbtc.go.th.

3.1 Research Instrument

The response format of the questionnaire is comprised of four answer choices arranged in successive integers from 0 (lowest) to 3 (highest). The rationale for equidistance scale of four choices is motivated by (a) flexibility of data set to be classified as dichotomous and polytomous in order to engage binomial and polynomial distribution testing, and (b) pointwise (per survey question) reliability of the instrument.

The scale flexibility is obtained through the used of zero as the lowest value. This use of zero allows the data to be dichotomized into categorical data set of zero and non-zero. This scale type allows binomial distribution and polynomial distribution testing. Binomial distribution testing consists of two elements: (1) predictive probability, and (2) significance test under the Z-equation. The binomial predictive probability is given by:

$$P(X) = \frac{n!}{(n-X)!n!} p^n q^{(X-n)} \tag{6}$$

where n = sample size, and X = targeted number to be forecasted. The variable p is the probability of success (Yes = 1) which is given by the Laplace Rule of Success:

$$p = \frac{s+1}{n+2} \tag{7}$$

where s = success, and n = number of total observations. The non-zero of the scale (0,1,2,3) is 3. Therefore, $p = (3+1)/(4+2) = 4/6 = 0.6667$ and the probability of zero is $q = 1 - p = 1 - 0.6667 = 0.3333$. The expected value is $E(X) = \overline{X} = 1.50$ and the expected variance is $E(\text{var}) = 1.66$ and $S = 1.29$.

The significance test for binomial distribution of discrete data is given by the Z-equation for binary data:

$$Z_{bin} = \frac{\frac{X}{n} - p}{\sqrt{\frac{pq}{n}}} \tag{8}$$

If the threshold is 1.50 and the value of *p* and *q* are known, the test statistics for the {0-3} scale can be determined thus:

$$Z_{bin} = \frac{\frac{X}{n} - p}{\sqrt{\frac{pq}{n}}} = \frac{\frac{1.50}{60} - 0.6667}{\sqrt{\frac{0.6667(0.3333)}{60}}} = \frac{0.025 - 0.6667}{\sqrt{\frac{0.2222}{60}}} = \frac{-0.6417}{\sqrt{0.3703}} = \frac{-0.6417}{0.6086} = -1.0545$$

From the Unit Normal Distribution Table, a score of $Z = -1.0545$ has a p-value of 0.1251 or 12.51% which is well within the 95% confidence interval. The Z_{bin} test confirms that the expected threshold value of the 0-3 scale is within 0.95 confidence interval.

3.2 Instrument Reliability

The 0-3 scale consists of four answer choices. Using the 0.95 confidence interval, the reliability of each question in the instrument is determined by the expected reliability equation

$$R = \sqrt{1 - \hat{e}} \tag{9}$$

where $\hat{e}$ (e-hat) is the expected error of an individual questionnaire which is given by:

$$\hat{e} = (df - 1)\alpha \tag{10}$$

The reliability of the *zero-embedded successive integers of four answer choice* may be determined: $\hat{e} = (df - 1)0.05 = (3-1)0.05 = 2(0.05)$ or $\hat{e} = 0.10$ because $df = n - 1$. With known $\hat{e}$, the reliability of the question may be calculated: $R = \sqrt{1 - \hat{e}} = \sqrt{1 - 0.10} = \sqrt{0.90} = 0.94867$ or approximately 0.95. The confidence interval used throughout this research is 0.95. The individual question reliability of a *zero-embedded successive integers of four answer choice* meets this 95% CI threshold.

3.3 Data Classification

There are three types of data where the dependent and independent variables may be classified: (i) quantitative, (ii) ordinal, and (iii) nominal data. The data used in this research is classified as quantitative data. Quantitative data are data which may be subject to mathematical operations. For purposes of proving the intensity of the relationship in bivariate data set: X (independent) and Y (dependent variable), the appropriate determinant is the Pearson Product Moment or Correlation Coefficient. The applicable test for significance is generally given by the t-test:

3.4 Independent Variable (X) and Independent Variable (Y)

The independent variables used in this research are comprised of three factors: (i) perception of mobile device as a source of information, (ii) influence of mobile device on interpersonal relationship, (iii) access to mobile device technology. These three factors are incorporated into the questions with the answer scale ranging from 0 (lowest) to 3 (highest).

The dependent variable Y is the impact of mobile device. The impact is comprised of the following components: (i) increase inventory of knowledge, (ii) positive change on contemporary culture, and (iii) increase personal freedom of expression. In this research, both X and Y are quantitative data.

3.5 Data Distribution Test

The data was first tested for distribution. Distribution test was achieved through the Anderson-Darling test. The Anderson-Darling test verifies whether the data is normally distributed. The AD test is given by:

$$A^2 = -n - S \tag{11}$$

where n = ample size. The required sample size for the AD test is $n > 5$, and S is the logarithm sum in the following form:

$$A^2 = \sum_{i=1}^{n} \frac{2i-1}{n} \left[\ln\left(\Phi(Y_i)\right) + \ln\left(1 - \Phi(Y_{n+1-i})\right) \right] \tag{12}$$

The test statistic for the AD test is given by:

$$A^{*2} = A^2 \left(1 + \frac{0.752}{n} + \frac{2.25}{n^2} \right) \tag{13}$$

The result of the AD test is summarized in Table 4.

Table 4. Summary of Anderson-Darling Test for Data Distribution

	X_1	X_2	X_3	Y_i
A^2 (observed)	52.24	53.83	39.38	54.40
A^{*2} (standard)	52.93	54.54	39.90	55.11
Conclusion	Normal	Normal	Normal	Normal
Legend: X_1 = Perception of mobile device as part of mass media; X_2 = Effect of mobile phone on interpersonal relationships; X_3 = Access to mobile device technology; and Y_i = impact of mobile device on (i) knowledge acquisition; (ii) contemporary culture; and (iii) freedom of expression.				

A second examination of the data was the verification of randomness in the field survey. Randomness is defined as a stochastic process in which no significant trend may exist to allow predictable pattern. Most commonly used statistical test, such as the t-test requires that the data be random. For this reason, testing for randomness was accomplished in this research. The test for randomness was accomplished by the adjacent test. The adjacent test for $n > 25$ is given by:

$$L_{n>25} = 1 - \left[\frac{\sum_{i=1}^{n-1} \left(x_{i+1} - x_i \right)^2}{2 \sum_{i=1}^{n} \left(x_i - \bar{x} \right)^2} \right] \tag{14}$$

For $n > 25$, equation (13) approximately follows a normal distribution with mean zero: $\bar{x} = 0$ and the variance is given by:

$$S_x^2 = \sqrt{\frac{(n-2)}{(n-1)(n+1)}} \tag{15}$$

The result of the adjacent test is summarized in Table 5.

Table 5. Summary of Adjacent Test to Verify Random Process

$n = 60$	X_1	X_2	X_3	Y_i
L (observed)	0.074	0.072	0.073	0.074
L^* (standard)	$1.37 < L < 2.63$	$1.37 < L < 2.63$	$1.37 < L < 2.63$	$1.37 < L < 2.63$
Conclusion	Non-random	Non-random	Non-random	Non-random

Since the data is not random, Student t-test is not the appropriate tool to use for the test of significance. With questions in the dependent variables and 9 questions, the F-test for multiple regressions is used for significance test.

The last data treatment is to verify whether there is any extreme value in the data set that would create bias by using the Grubbs test. The Grubbs test allows the detection of outlier data points within a set. (Grubbs, 1969, p. 1-21, and Stefansky, 1972, pp. 469-479). The test is also known as the *maximum normed residual test* or extreme *studentized deviate test*. This test is used only in univariate data set. The assumption is that the data comes from a normally distributed population. The hypothesis statement follows: $H_0 : G_{obs} < G_{0.95,n}$ and $H_A : G_{obs} > G_{0.95,n}$. The test statistic is given by:

$$G = \frac{N-1}{\sqrt{N}} \sqrt{\frac{t^2_{\alpha/(2N),N-2}}{N-2+t^2_{\alpha/(2N),N-2}}} \tag{16}$$

The null hypothesis is rejected if $G_{obs} > \frac{N-1}{\sqrt{N}} \sqrt{\frac{t^2_{\alpha/(2N),N-2}}{N-2+t^2_{\alpha/(2N),N-2}}}$. The critical for G is provided by the G-table. The general argument is stated as:

$$G = \overset{\max}{i=1,\ldots n} \left| Y_i - \bar{Y} \right| \tag{17}$$

where Y_i = individual observations, $\bar{Y}$ = sample mean, and s = sample standard deviation.

The value of G is the largest value of the data point that deviates from the sample mean. The unit of measurement is a unit of standard deviation. The general statement is used for two-sided test. The one-sided Grubbs test for a low value is given by:

$$G = \frac{\bar{Y} - Y_{\min}}{s} \tag{18}$$

where $Y_{\min}$ = minimum value in the sample; $\bar{Y}$ = sample mean, and s = sample standard deviation. The one-sided Grubbs test for the high value is given by:

$$G = \frac{\bar{Y} - Y_{\max}}{s} \tag{19}$$

where $Y_{\min}$ = minimum value in the sample, $\bar{Y}$ = sample mean, and s = sample standard deviation. The results of the data analysis for the Grubbs test for the Y and X are summarized in Table 6.

Table 6. Summary of Grubbs Test to Verify Random Process

$n = 60$	X_1	X_2	X_3	Y_i
G (observed)	1.0 – 2.91	1.58 – 2.99	0.61 – **3.69**	1.48 – 1.73
G^*(standard)	3.19	3.19	3.19	3.19
Conclusion	No outliers	No outliers	Outlier on min	No outliers

This preliminary examination of the data confirms that X_i and Y_i in this survey, the public opinions were not randomized. This non-random process is came from a random process ma be explained by the fact that the population was homogeneous, i.e. everyone was mobile device or mobile phone user. Under the Grubbs test, there was no significant outliers found in the data from the field survey; thus, there was not extreme value to render the data biased. There was one survey returned with an outlier value of 0.50 in a [0-3] scale. This extreme value showed in $G(X_3)$ where the observed value is 3.69 compared to 3.19. In total there were 60 survey; each survey has 12 questions or a total of 720 questions were answer. Out of 720 counts, one count shows an extreme value. Therefore, it is dismissed as insignificant aberration.

There are 3 questions in the X variable that received a score of zero. These were Q4, Q6 and Q11. The survey contains 12 questions. The summary of this apparent extreme values are summarized in Table 7.

Table 7. Questions with Response Score of Zero

No.	**Description**	**Q4**	**Q6**	**Q11**
1	Score = 0	3	3	2
2	Score > 1	57	57	58
3	*s* counts	57	57	58
4	*s + 1*	58	58	59
5	*n + 2*	62	62	62
6	$p = (s+1)/n+2$	0.94	0.94	0.95
7	$q = 1 - p$	0.06	0.06	0.05

Code: Q(4): Mobile phones improves communication with others; Q(6): Mobile phone increases number of acquaintances; and Q11: mobile phone brings positive change to contemporary culture.

The probability of zero score is about 5-6% while non-zero probability is about 94-95%. This occurrence is no cause for concern about data biasness or extreme values contamination.

4.0 METHODOLOGY

The quantitative method employed in this research is based on conventional statistical tests. These test include: (i) Anderson-Darling Test to verify data distribution, (ii) Adjacency Test to verify random process in data sets, (iii) Grubbs Test for Outliers, and (iv) Laplace Trend Test. Two modeling methods are employed in this research, namely simple and multiple regression models.

Simple and multiple regression models were used to verify the relationship between the dependent and independent variables. The simple linear regression is given by:

$$Y = \beta_0 + \beta_1 X + \varepsilon \qquad (20)$$

where β_0 is the Y-intercept, β_1 is the slope of the linear regression line, and ε is the forecast error. In the present case, simple linear regression was used to verify the relationship between the impact of mobile device (Y) and the public's perception of mobile device as a source of mass media (X). The decision for the hypothesis test is accept the null hypothesis if $H_0 : \beta_0 = 0$, otherwise reject if $H_A : \beta_0 \neq 0$ is true. If $H_A : \beta_0 \neq 0$ is true, the significance test follows the t_r test.

The multiple regressions were used to analyze multiple factors for the interaction between the impact of mobile device on contemporary culture (Y) and the explanatory factors: X1 = interpersonal relationship and X2 = access to mobile device technology. The multiple regression model is given by:

$$Y = \beta_0 + \beta_1 X + \beta_2 X_2 + \varepsilon \tag{21}$$

The decision rule governs the acceptance or rejection of the null hypothesis is given by $H_0 : \beta_0 + \beta_1 = 0$ and $H_0 : \beta_0 + \beta_1 = 0$. If $H_0 : \beta_0 + \beta_1 = 0$ is true and the null hypothesis is rejected, the test for significance follows:

$$F(k, N-k-1) = \frac{R^2 / k}{1 - R^2 / N - k - 1} \tag{22}$$

where the N = number of observations; $R^2 = r(r)$; k = number of predictors and $N-k-1$ is the degree of freedom for the F-test in multiple regression. In the present case $N = 60$ and $k = 2$; thus, $df = N - k - 1 = 60 - 2 - 1 = 57$. The F-critical value for $F(60,57)$ is 1.3952.

4.1 Sampling Method

The sampling method used in this research is *unequal probability sampling* of the Midzuno scheme (Midzuno, 1952, pp. 99-107). The Mizuno scheme for unequal probability sampling is given by:

$$P(s) = \begin{cases} \dfrac{\hat{X}}{X} \dfrac{1}{\binom{N}{n}} & \text{if } n(s) = n \\ 0 & \text{otherwise} \end{cases} \tag{23}$$

where $\hat{X}$ is the unbiased estimation of the population total X of the size variable x, i.e. $\hat{X} = \frac{N}{n} \sum_{i \in s} X_i$ under simple random sampling. It is under this approach that the sampling for this research was undertaken. A total of 60 counts were taken from the field survey.

4.2 Sample Size

A literature review of minimum sample size requirement for field survey is 30 counts. Agresti and Franklin suggest that the minimum sample size should be 30 counts. Agresti and Franklin (2012, p. 312). The rationale is that with 30 counts, the researcher could optimize the benefits offered by the Central Limit Theorem. In subsequent studies this call for $n = 30$ was confirmed in Louangrath's *n*-hat method (Louangrath and Rewtrakunpaiboon, 2013, pp. 127-139) and Louangrath's *n*-omega method (Louangrath, 2014). This research uses 60 counts of survey. This number of sample satisfies the requirement of minimum sample size under at least three methods: *n*-hat, *n*-omega, and nonfinite population methods.

Under the *n*-hat method, minimum sample size is determined by

$$\hat{n} = \sqrt{n_r^M} \tag{24}$$

where $n_r^M = n_r / 2$ and $n_r = n_i^{0.99} - n_j^{0.01}$. The following terms are defined: $n_i^{0.99} = n_i / 0.99$ and $n_j^{0.01} = n_i / 0.01$. The quotient of $\left(n_i^{0.99} / n_j^{0.01}\right) = n*$ and the initial sampling $n*$ is given by: $n* = (\sigma^2 n / S^2) / E^2$ where expected error is $\hat{E} = [n - n(1 - df(\alpha))]/n$ calculated from the initial or pilot sample. Under equation (23), the minimum sample size is a constant: $\hat{n} \approx 32$.

Under *n*-omega method, minimum sample size is determined by:

$$n_\omega = \sqrt{\frac{\left(\frac{|n_1 - n_2|}{2}\right)^{-0.01} - \left(\frac{|n_1 - n_2|}{2}\right)^{-0.99}}{2}} \tag{25}$$

where $n_1 = Z\sigma / E$, and $n_2 = Z^2\sigma^2 / E^2$; the value of *Z* and *E* are defined as $Z = 1.65$ and $E = 0.05$ for 0.95 confidence interval.

Under the *n*-omega method, the minimum sample size for 0.95 confidence interval is between 30 – 40 counts. In the present case, 60 counts of had been collected. This sample size satisfies the requisite under *n*-hat and *n*-mega methods; it is also consistent with Agresti's suggestion and other writers, such as Roscoe (Roscie, 1975, p. 163) and Abranovic (Abranovic, 1997, pp. 307-8).

The *n*-hat and *n*-omega method is consistent with the conventional minimum sample size determination in nonfinite population cases. (Montgomery, Runger and Hubele, 2001, p. 172). The non-finite population sample size is given by:

$$n = \frac{Z^2\sigma^2}{E^2} \tag{26}$$

The minimum sample size under equation (26) is 161 counts. In the present case, the population is nonfinite because the population of mobile devise is dynamic. In any given day, there may be additional subscribers and some subscribers may also drop out from the population. Under this circumstance, the population proportion method proposed by Yamane is inappropriate. (Yamane, 1967, p. 886). The Yamane method is given by:

$$n_Y = \frac{N}{1 + Ne^2} \tag{27}$$

where N = population, and $e = \alpha$ or the error level. This method for calculating minimum sample size was not used because (i) the population size is not known and (ii) the method assumes that the population is normally distributed; such an assumption is improper without conducting an initial population study to verify population distribution type. Minimum sample size determination by various methods is summarized in Table 8.

Table 8. Minimum Sample Size Determination by Various Methods

Method	Population	Initial Sample	Bootstrap	Sample Size
$\hat{n} = \sqrt{n_r^M}$	Non-finite	Yes	Yes	30
$n_\omega = \sqrt{\omega / 2}$	Non-finite	Yes	Yes	30
$n = Z^2\sigma^2 / E^2$	Non-finite	Yes	Yes	161

$n_Y = N/(1+Ne^2)$	Finite	No	No	400

5.0 FINDINGS AND DISCUSSION

The general finding shows that the public does not see mobile device as part of the mass media. This finding comes from the simple regression analysis between the impact of mobile device on contemporary culture (Y) and the public perception of mobile device as part of the mass media.

An additional finding verifies that mobile positively impact contemporary culture. This impact was brought about by the change in interpersonal relationship and the availability of mobile device technology. This relationship was revealed through multiple regression analysis between the impact of mobile device on contemporary culture (Y) and two explanatory factors: (i) interpersonal relations (X1) and (ii) accessibility to mobile device technology (X2). The finding of simple regression for each Y element and X element is summarized in Table 7.

Table 9. Impact of Mobile Phone on Contemporary Thai Society

Dependent Variable (Y)		***Indication of T-test Significance Level: CI = 0.95***								
Questions	**Y_i**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**
Q10	*Knowledge*	-	-	-	-	2.5	-	-	4.1	
Q11	*Culture*	-	-	1.9	-	3.3	-	-	2.6	2.6
Q12	*Freedom*	-	-	2.5	-	2.2	2.4	-	2.9	
		Independent variable (X)								

Code key:

- **Q1:** Mobile device will soon replace printed materials
- **Q2:** Mobile device is part of mass media
- **Q3:** Communication via mobile device is better than face-to-face
- **Q4:** Mobile phone improves communication
- **Q5:** Mobile phone is important to daily life
- **Q6:** Mobile device increase number of acquaintances
- **Q7:** All my acquaintances have mobile phones
- **Q8:** Mobile phone must have many functions
- **Q9:** Use mobile device to access the Internet

Dependent variables: Q1, Q2, Q4 and Q7 have no significant bearing on the impact of mobile device usage, i.e. acquisition of knowledge, impact in culture and increase personal freedom of expression. The general perception towards mobile device as a potential replacement or rival to printed media (Q1) is perceptively insignificant. Secondly, the public does not see that mobile device is part of the mass media. Thirdly, there is no significant finding that mobile phone improves communication skills. Finally, the access to mobile technology, i.e. mobile phone, is considered a common place and does not have any significant impact on knowledge acquisition, change contemporary culture of increase personal freedom of expression. Although these three independent variables: Q1, Q2, Q4 and Q7 do not show significant impact on the dependent variables: Q10, Q11 and Q12, this finding also provides important lesson about the public perception on mobile phone in Thailand.

5.1 Simple Regression Analysis

There are eight questions in the survey acting as independent variable (X). These eight questions are grouped into three groups: (i) perception of mobile device as an element of the mass media, (ii) mobile device as a tool to improve interpersonal relationships, and (iii) access to mobile device technology. These independent variables are regress on one category of Y called impact. The

impact of the use of mobile device is comprised of (a) increase knowledge acquisition, (b) positively impacting contemporary culture and (c) increase in person freedom of expression.

5.1.1 Mobile Device Impact on Knowledge Acquisition

There is a general perception that the use of mobile device contributes to the acquisition of new knowledge. This perception is explained by two factors: (i) the belief that mobile device is important in a person's daily life, and (ii) the mobile device must have many features. The two simple regression equations produced through this single factor analysis are: $Y_{(5)} = 1.33 + 0.40X$ with a t-score of 2.47 and $Y_{(8)} = -0.009 + 0.84X$. People considered mobile device important in their daily life and they believe that mobile phone should have many features.

5.1.2 Mobile Device Impact on Contemporary Culture

There are four instances where single regression modeling shows that mobile device has an impact on contemporary culture. This impact comes from the belief that communication through mobile phone is better than through face-to-face communication. This relationship between culture and communication effectiveness is captured in the following linear regression equation: $Y_{(3)} = 1.57 + 0.22X$ with the t-score of 1.85.

The second cultural impact by mobile device is seen through the perception of the importance of mobile phone in the person's daily life. The simple regression equation expressing this relationship is given by: $Y_{(5)} = 0.37 + 0.56X$ with the significance level of $t = 3.30$.

The third impact of mobile phone on contemporary culture is seen through the user's desire for many features in the mobile phone. The relationships between these two variables are expressed in the following linear regression equation: $Y_{(8)} = 0.09 + 0.61X$ where the significance test shows a t-score of $t = 2.56$. In all impact factor analysis, users consistently place significance importance on the features offered by the device.

The fourth impact under simple regression analysis is explained by the use of mobile device to access the Internet. The simple regression model is given by: $Y_9 = 0.43 + 0.52X$ with the significance level of $t = 2.63$. Mobile device has a positive impact on contemporary culture; this impact was explained by the use of mobile device for Internet access.

5.1.3 Mobile Device Impact on Personal Freedom of Expression

The fourth category of impact is the expression of personal freedom through the use of mobile device. There are four specific findings under this category of impact. The impact was shown through four explanatory factors under simple regression analysis. These factors are Q3, Q5, Q6, and Q8. The first simple linear regression model is given by: $Y_3 = 1.67 + 0.30X$ with the significance level of $t = 2.52$. This model explains that without mobile phone, the Thai public has perceptible freedom of expression at 1.67; however, with the availability of mobile device, this freedom is effect by 0.30 time each unit of measurement for mobile device. The public perception is that mobile device has a positive impact on personal freedom of expression.

The second finding comes from Q5 (importance of mobile phone in daily life). The simple linear regression equation captured the relationship between Q5 and freedom of expression (Y) is given by: $Y_5 = 0.96 + 0.42X$ with the significance level of $t = 2.23$. There is a latent meaning in this finding: freedom of expression is important to the daily life of the Thai public. This finding is a novel finding because this research in the impact of mobile device has produced a measurement of how the Thai public perceives personal freedom. The importance of freedom of expression is expressed through the use of mobile device.

The third finding for simple regression of the impact of mobile device on the freedom of expression comes from Q6 (increase number of acquaintances through the use of mobile phone). The simple regression model is given by: $Y_6 = 1.44 + 0.30X$ with the significance level of $t = 2.35$.

It means that with the use of mobile phone, there is a positive impact on the increase of the number of acquaintances by a factor of 0.30 times. There explained factor is "freedom of expression;" therefore, this finding suggests that mobile device allows the public to be more self-expressive through the increase in personal network. The intensity of this increase in personal network is by a factor of 0.30 times a bare condition without mobile device.

The fourth finding is the positive impact on the freedom of expression comes from Q8 (multi-features and function of the mobile device). These functions allow the users to communicate and access the Internet. The simple regression model which captures this relationship is given by: $Y_8 = 0.02 + 0.71X$. The significance level is $t = 2.86$. Without multiple functions, i.e. $X_{(Q8)} = 0$, the expression of personal freedom is 0.02 in value with a t-critical value of $t = 0.03$ (statistically insignificant). The features defined in the survey include: chat, Internet access, and email. These three elements allow the public to engage in self expression. Their presence contributes to an increase of freedom of expression by a factor of 0.71 times.

5.2 Multiple Regression Analysis

In multiple linear regression model in the form of $Y = \beta_0 + \beta_1 X + \beta_2 X_2 + \varepsilon$, data analysis shows that the impact of mobile device on contemporary culture (Y) is explained by interpersonal relationship (X1) and access to technology (X2) is given as: $Y = -0.57 + 0.37X_1 + 0.68X_2$. The test of significance shows that $t_{X_2} = 2.46$ and $t_{X_2} = 2.82$ compared to the standard value of 1.64. Thus, the null hypothesis that $H_0 : \beta_0 + \beta_1 = 0$ is rejected because $\beta_0 + \beta_1 = 2.46 + 2.82 = 5.28$ or that $\beta_0 + \beta_1 \neq 0$. The relationship between X and Y under multiple regression analysis is summarized in Table 9 according to the level of statistical significance.

Table 10. Factor Combinations in Multiple Regression Model

Dependent Variable (Y)		***Indication of T-test Significance Level: CI = 0.95***								
Questions	**Y_i**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**
Q10 = k	*Knowledge*					k			k	
Q11 = c	*Culture*			c1 c3		c1 c2			c2	c3
Q12 = f	*Freedom*			f			f		f	
		Independent variable (X)								

5.2.1 Mobile Device Impact on Knowledge Acquisition

The combination of Q5 (importance of mobile phone in daily life) and Q8 (multiple features in mobile phone) do not contribute to significant impact in knowledge acquisition. This factor combination produces the following multiple linear regression equation: $Y_{(10,5,7)} = -0.29 + 0.22X_1 + 0.74X_2$. The significance level for $X_1 = Q5 = 1.37$ and $X_2 = Q8 = 3.46$. This factor combination failed significance test. This finding shows that when each factor is treated alone in simple regression model, each passes the t-test, but when combined one of the factors (Q5) failed. It means that knowledge acquisition via mobile device depends more on features or functions offered by the device than personal perception of how important is the device.

5.2.2 Mobile Device Impact on Contemporary Culture

In simple regression analysis, there are four factors that show significant explanatory power to mobile device's impact on culture. These factors were: Q3, Q5, Q8 and Q9. In combination, the following multiple regression model was obtained:

$Y_{(3,5,8,9)} = -0.51 + 0.15X_1 + 0.42X_2 + 0.23X_3 0.16X_4$. Among the four factors combined, only X_2 still passes significance test with $t_{Q5} = 2.21$. The remaining factors show t-value less than 1.64.

Through two-factors combination, the models passed t-test. These combinations include: (Q3, Q5), (Q5, Q8) and (Q3, Q9). The first combination (Q5, Q8) is given as: $Y_{(3,5)} = Y = -0.51 + 0.47X_1 + 0.4X_2$ where the t-vale for Q5 is 2.60 and for Q8 is 1.65. This means that the positive impact that mobile device has on contemporary culture comes from the perceived importance of the mobile device in one's daily life (Q5) and the features offered by the mobile device.

The second combination of the multiple regression consists of Q3 (Communication via mobile device is better than face-to-face) and Q9 (Use mobile device to access the Internet). The multiple regression equation produced by this combination is $Y_{(3,9)} = Y = -0.29 + 0.19X_1 + 0.49X_2$. The levels of significance for the two independent variables are 1.69 and 2.50 respectively. This means that there is a significant perception among the public that mobile device has a positive impact on contemporary culture because communicating through mobile device is better than face-to-face communication and Internet access.

5.2.3 Mobile Device Impact on Personal Freedom of Expression

One of the impact measurements in this study is the impact of mobile device on the expression of personal freedom. Simple regression analysis shows that factors: Q3, Q5, Q6 and Q8 have significant contribution to the increase of expression of personal freedom. The combination of these factors in multiple regression produces the following equation: $Y_{(3,5,6,8)} = -0.48 + 0.22X_1 + 0.15X_2 + 0.22X_3 + 0.50X_4$. In this multiple regression model, factor Q5 fails to produce significant t-score. Only Q3, Q6 and Q8 produces t-score higher than 1.64. The t-score for these three factors are 1.88, 1.74 and 1.96 respectively. Factor Q5 was removed and a new regression equation was obtained: $Y_{(3,6,8)} = -0.33 + 0.22X_1 + 0.25X_2 + 0.57X_3$. The F-test statistic for multiple regression is given in Table 9. This result leads to the conclusion that the increase in the expression of personal freedom through mobile device usage came from (i) the belief that communication via mobile device is better than face-to-face, (ii) the use of mobile device increases number of acquaintances, and (iii) in order to achieve (i) and (ii) the mobile device must have many features.

Table 11. F-Test Statistics for Multiple Regression: $n = 60$

Multiple Reg.	R^2	K	R^2 / K	$1 - R^2$	$N - K - 1$	$\frac{1 - R^2}{N - K - 1}$	$F(obs)$
Y(5,8)	0.25	2	0.13	0.75	57	0.01	9.50
Y(3,5)	0.20	2	0.10	0.80	57	0.01	7.13
Y(5,8)	0.20	2	0.10	0.80	57	0.01	7.13
Y(3,9)	0.15	2	0.08	0.85	57	0.01	5.03
Y(3,6,8)	0.24	3	0.08	0.76	56	0.01	5.89

The critical F-value for two factors is $F(2,57) = 19.48$ and for three factors is $F(3,56) = 8.57$. The findings of observed F-values in table 9 could not reject the null hypothesis. However, the individual t-score for each factor in the model would have passed the t-critical value.

6.0 CONTRIBUTION OF THE RESEARCH

This research has made several contributions to the field of mass communication and the measurement of such impact on contemporary society. Firstly, the research questions the notion that mobile device is part of the mass media; at least, this is not true in Thailand. This belief is

evidenced through the use of mobile device as a medium for marketing campaigns, i.e. advertisement via mobile phone SMS (mobile marketing). However, a sample of public opinion in this survey shows that the Thai public still does not perceive that mobile device is part of the mass media. This finding implies that as long as this perception does not change, mobile marketing in Thailand is a futile effort.

Secondly, the quantitative method in this research allows us to measure the utility of mobile device as an impact indicator on contemporary society. This impact-utility is made possible through the use of the prospect theory. Under the Kahneman-Tversky's theory of prospective utility, this research shows that mobile device or mobile phone technology has positively impacted the Thai society: 0.43 in knowledge acquisition, 0.34 in contemporary culture, and 0.37 in freedom of expression. This finding is summarized in table 12.

Table 12. Utility Measurement under Kahneman-Tversky Prospect theory

$U = \sum_{i=1}^{n} w(p_i)v(x_i)$	Knowledge	Culture	Freedom
Q10	0.43	-	-
Q11	-	0.34	-
Q12	-	-	0.37

Note: $w = 0.30$ equal weight among three factors: knowledge, culture and freedom of expression; $p_i = s+1/N+2$; $v = \beta_0 + \beta_1 X_i$ where v is the simple regression model and X_i is the score for individual survey-question: x_i.

This research is a contribution in the current literature in quantitative methods in communication research. This research employs primary and secondary data to accomplish its objective. Primary data is used as part of background information and the primary data is used for proving specific research question. The use of secondary data as an introduction to the subject matters helps put the literature review in perspective.

7.0 CONCLUSION

The public in this survey does not see mobile device as part of the mass media. Mobile device impacts the Thai society. This research measures these impacts in three aspects, namely (i) knowledge acquisition, (ii) positive contribution to contemporary culture, and (iii) freedom of expression through the use of mobile device. This research is an exploratory research. As such, this research may serve as a catalyst for future studies on this subject.

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APPENDIX 1
L Statistic

The critical value of L at various significance levels. Lower bound = a and upper bound = b. Source: Hart, B.I. (1942). "Significance Level for the Mean Square Successive Difference to the Variance." *Annals of Mathematical Statistics*, **13**: 445-7.

	Significance Level: α			
Two-sided	0.10		0.02	
One-sided	0.05		0.01	
n	*a*	*b*	*a*	*b*
4	0.78	3.22	0.63	3.37
5	0.82	3.18	0.54	3.46
6	0.89	3.11	0.56	3.44
7	0.94	3.06	0.61	3.39
8	0.98	3.02	0.66	3.34
9	1.02	2.98	0.71	3.29
10	1.06	2.94	0.75	3.25
11	1.10	2.90	0.79	3.21
12	1.13	2.87	0.83	3.17
15	1.21	2.79	0.92	3.08
20	1.30	2.70	1.04	2.98
25	1.37	2.63	1.13	2.87

APPENDIX 2
Grubbs Test

Grubbs test for single outlier using mean and SD. Test value = $\left|X - \overline{X}\right| / s$. Grubbs, Frank E. (1950). *Sample criteria for testing outlying observations*. Annals of Mathematical Statistics, Vol. 21, pp. 27-58.

	Significance Level	
Df = n -1	**5%**	**1%**
2	1.15	1.15
3	1.48	1.50
4	1.71	1.76
5	1.89	1.97
6	2.02	2.14
7	2.13	2.27
8	2.20	2.39
9	2.29	2.48
10	2.36	2.56
11	2.41	2.64
12	2.46	2.70
13	2.51	2.76
14	2.55	2.81
15	2.59	2.85
16	2.62	2.89
17	2.65	2.93
18	2.68	2.97
19	2.71	3.00
20	2.73	3.03
30	2.92	3.26
40	3.05	3.39
50	3.14	3.49
100	3.38	3.75