

# An Exploratory Study the Expectations from Undergraduate Students' Perspectives for the Future Mobile Phone Innovations

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## ABSTRACT

*Mobile phones are now no longer a luxury in the world, which has become communications tool. Mobile phone holder is relatively much higher, particularly in undergraduate students in Taiwan. How do to seize more consumers' demands have become mobile phone suppliers' important factors to consider. This study investigated the undergraduate students' perspectives for future mobile phone innovations. This paper uses Qualitative and Quantitative method to gather information concerning the expectations of this group. The research finds that this group of customers has extremely high expectations for the innovations of mobile phones in three aspects, function, shape and efficiency. Undergraduate Students expect that future mobile phone should be versatility, entertainment and essentiality in the Function. Shape features should be light-weight, compactness and personalization, and variety. And the Efficiency of future mobile phone should be high-quality and durability, practicality, and value added. This information can also serve as a reference for product innovators in the design of blueprints.*

**Keywords:** mobile phone, expectation, innovation, function, shape, efficiency.

## INTRODUCTION

Mobile phones are one of the essential communications tools in modern life. The advancement of telecommunication technologies over the recent years has made it a new trend to combine telecoms and Internet video technologies. Mobile phone holder is relatively much higher, particularly in young people, so how do to seize more consumers' expectations and demands have become mobile phone suppliers' important factors to consider. New fashion mobile phone innovations are desired for young people. Taiwan has more than 23 million people. Data released by the National Communications Commission (NCC) suggests that, at the end of the fourth quarter of 2008 there were 25.41 million mobile phone subscribers (including 2G, PHS and 3G) in Taiwan. This total gives a mobile phone penetration rate of 110.3% (FINE, 2009). In the face of such a vast number of the mobile phone market, it is necessary to understand the factors people consider buying mobile phones and developments. The main purpose of this paper is to examine the expectations from undergraduate students' perspectives in Taiwan for the future mobile phones as new products. It aims to understand what the *function, shape* and *efficiency* of their ideal mobile phones so as to provide a reference for the business in the design of new handsets. This establishes a benchmark of set of goals, against which the performance can be measured, and gives employees a sense of belonging to a team.

## LITERATURE REVIEW

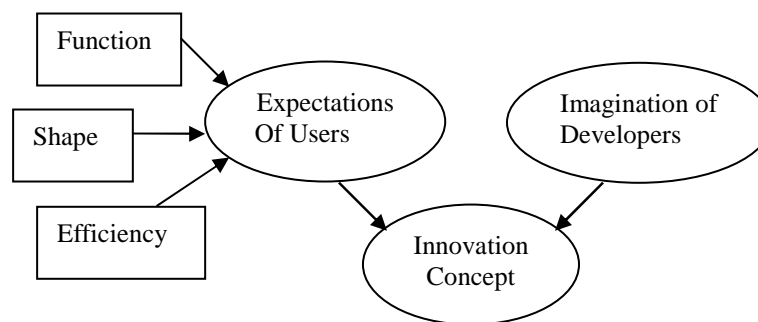
The output of the concepts of production innovations can be summarized into two aspects: customers' demands and creativity of developers and researchers. Companies have to combine these two elements in order to create competitive new products. This will also shorten the process of innovation and development and reduce the number of changes made to projects (Munro & Noori, 1988). The innovative concepts are the creative ideas generated by product developers for companies. Customers' demands are the styles and features anticipated by customers for a particular new product. For example, as far as the innovation of new mobile phones is concerned, what customers expect may be an easy-to-use and high power-storage model. The best new product perceived by developers may not

necessarily be the product most desired by customers. Therefore, the innovation of new products has to meet the psychological needs of customers in addition to technological innovations. Only by marrying these two elements can competitive products be created.

### Product Innovation from Perspectives of Users

There is a large amount of literature dealing with product innovations. Hayes, Wheelright, & Clark (1988) proposed the funnel model of the creative process. This model aims to examine the process of product innovation. The funnel model argues that the creation of new products by companies has to take into seven factors into consideration at the same time: customers, targets, innovation, planning, team, model and results. Among the seven factors, customers are an important one because customers' demands are the main source of creative projects. Cooper (1994) mentioned that there are seven stages in the development process of product innovation. The first stage is the output of the preliminary concept. Customers' needs are an important information source to sample great ideas. Khalil (2002) suggested that innovation is successful only when the innovative products are accepted by users and diffused by users. Therefore, the level of the adoption of creative products is highly relevant to the value placed by users on the product and the needs from users for the product. Rogers (1995) argued that when a new product is considered to be offering a better solution, higher compatibility, ease of use and a wider applicability, this product would be adopted at a faster pace.

Based on the above research finding, the generation of concepts is critical to the innovation stage of products. However, the output of new concepts relies very much on the desires and wants of users as an important information source. Therefore, it is necessary to discuss product innovation from the perspectives of users. This paper refers to the above analysis and divides the information sources regarding the concepts of product innovation into two types: the imagination of developers and the expectations of users. Figure 1 illustrates the conceptual structure. This paper suggests that as far as the innovation of most tech products are concerned, users care about three product characteristics the most. These three characteristics are product *function*, *shape* and *efficiency* (Pirkl & Babic, 1988 ; Akao, 1990). Therefore, innovators have to understand the expectations and demands from consumers for these three characteristics so as to create superior new products.



**Figure 1: Product Innovation Concept Model**

### New Style Mobile Phone Innovation

The sales of mobile phones are subject to the influence of many factors. The documents of consumers' behaviors research point out consumers' decisions affected by many factors including external environment factors and internal environment factors (Wang, Chu, & Chen, 2009). One of the factors is the differentiation of consumers' groups. Different consumers' groups have varying needs for the innovations of mobile phones, especially, in the "*function*", "*shape*", and "*efficiency*" of product. The company has to keep an open mind in their innovation strategies in order to stay ahead of the game (Koen & Duysters, 2007). Only by keeping up with the demands of consumers can they satisfy the needs of consumers (Arvind & Riley, 2003 ; Per, Gustafsson, & Archer, 2004). The mobile phone market for the young people in Taiwan is enormous. Carlos (2005) indicates that 60% of the youngsters in Taiwan have mobile phones. The older they become, the higher the percentage of them have mobile phones.

Undergraduate students are in the young group with huge demands in the future. The psychologies of youngsters and adults as consumers are different. Young people have their own consumption cultures (Dannie & Askegaard, 2006). Their needs for mobile phones change constantly along with new products; hence, their demands remain strong. The creation of a mobile phone catering to the young will be the most important competitive strategy in the market.

### **Gathering the Users' Ideas for New Product**

Users' expectations refer to the factors concerning users' anticipations and demands of new products (Davies & Holmes, 2002). Such information can be acquired via multi-process analysis method (MPAM). Jim, Kathlyn, Lawrence, & David (1988) indicated that the collection of customers' information may be through complaints from customers and requirements for orders. However, the most direct and effective method to understand the genuine needs, preferences and interests of users for an innovative product are through face-to-face interviews. Interview method is the most frequently used one by directly inquiring users to express their expectations and needs of new products (Kinicki, Lockwood, Hom, & Griffeth, 1990). Although the interview method can be directly applied to gather detailed information, however, the process is time-consuming and labor-intensive (Cox, Schlueter, More, & Sullivan, 1989). It is difficult in practice to collect a large amount of information. Therefore, interview method is not suitable for the collation of extensive information. How to improve such a shortcoming has become an important issue in information collection methods.

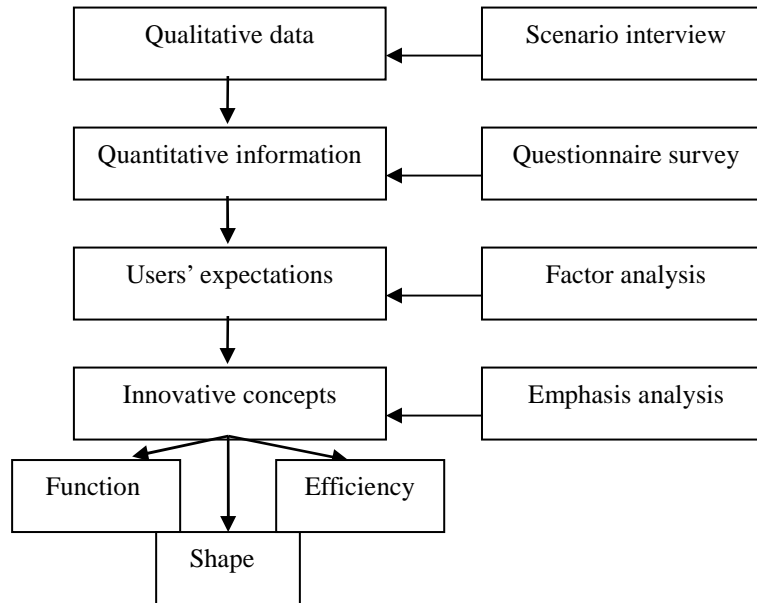
Questionnaire method is another data-collection method (Andronikidis, Vassiliadis, Fotiadis, & Priporas, 2008; King, 2008). It is frequently used in many domains for data collection. It can be applied to a wide range of topics (George, 2000; Hao & Robert, 2008; Liu, Hu, Ma, Cui, Pan, Chang, Zhao, & Chen, 2008). Questionnaires can be issued at large quantities to gather market information. However, it is difficult to delve into the individualistic or diversified minds of users with standard questions. This shortcoming of questionnaire method has to be amended with interview method. Ettlé & Elsenbach (2007) studied the characteristics of modified stage-gate regimes for new product developments by combining questionnaire and interview format protocols to present their finding. It is necessary to come up with a comprehensive data-collection process and use this process appropriate in order to collect the ideas of users for new products. This is essential to obtain accurate market information. This is where this paper would like to focus its efforts on.

## **RESEARCH METHOD**

### **Basic Concepts of MPAM Model**

Figure 2 outlines the structure of basic concepts of MPAM. This structure consists of the four steps for data gathering and four corresponding contents of data collection. They are comprised of sources of innovation information, research methods, analysis methods and output information, as shown in Table 1.

MPAM model proposed by this paper is a new methodology developed to address the aforesaid issues. It is a newly developed data-collection method by combining the benefits of interview method and questionnaire method. It carries the characteristics of qualitative research and quantitative analysis to gather the expectations and demands in the minds of users through multiple layers of analysis processes. The data acquisition process includes qualitative data, quantitative information, customers' expectations and innovative concepts. The analysis process consists of scenario interviews (Makela & Mattelmaki, 2002 ; Nielsen, 1993), questionnaire surveys (Mangione, 1995 ; Neuman, 1997), factor analysis (Joseph, Rolph, Ronald, & Willam, 1995) and emphasis analysis. It is suitable for the management of innovation projects because it can obtain market information rapidly and accurately.



**Figure 2: Theoretic Structure of MPAM Model**

**Table 1: Processes of implement MPAM Model**

Sources of Innovation Information	Research Methods	Analysis Methods	Output Information
1. Qualitative	Scenario interview	Scenarios, interviews, protocols	Descriptive protocol
2. Quantitative information	Questionnaire survey	Questionnaires, statistics and quantitative	Quantitative information
3. Users' expectations	Factor analysis	Factor analysis	Demand factor
4. Innovation concepts	Emphasis analysis	Statistics and analysis	Demand priorities

### Samples and Questionnaire

The population of this study is the undergraduate students in Taiwan. The subjects of scenario interviews are sampled from the population. The paper applies the MPAM by starting with scenario interviews with 16 undergraduate students. These students are placed in a relaxed and free environment to talk about what their expectations and demands for the future 4G mobile phones.

The design of questionnaires is based on the output of interview data. The analysis of protocol data generalizes many results regarding the mobile phone innovation ideas on the “function”, “shape” and “efficiency” aspects. Such information is summarized from the talks with interviewees. Questionnaire is designed for understanding the importance of each item in the “function”, “shape” and “efficiency” of mobile phone. After two pilot tests, some questions are modified. A 49-item survey instrument was developed following this extensive period of research in determining antecedents to assess the focus of this study.

### Data Collection and Research Methodology

The design of this study encompassed factor analysis and descriptive research. Incorporating factor analysis research design allowed the investigation of expectations of mobile phone innovation, while incorporating descriptive research allowed understanding the demographic profile of respondents, summary of key factors, and overall customer emphasis analysis. A total of 547 surveys were collected and were able to be applied for use in achieving the purposes of this study. This research study incorporated various statistical methods through SPSS in efforts to gather the necessary information. Based on the research designs, this study incorporated frequency tests and factor analysis to further extrapolate additional information in efforts to meet the overall objectives for this study.

## RESULTS

The research results of the MPAM process consists of the output of qualitative data, output of quantitative information, users' expectations and innovation concepts. The contents of qualitative data cover the data acquired by scenario analysis. Qualitative information covers the basic statistics and data obtained by questionnaire surveys. Users' expectations are the demand factors established through factor analysis. Innovation concepts are generated from the emphasis analysis of customers.

### Output of Qualitative Data

The output of qualitative data is generated accordingly. The process of scenario interviews is taped and records as the source of protocol analysis. There are three questions in the scenario interview. They are as follows:

- Please talk about what the ideal functions of your 4G mobiles can do.
- Please talk about what are the ideal shapes of your 4G mobile phones.
- Please talk about what are the ideal efficiencies of your 4G mobile phones.

The audio and video recording is then converted, transcribed, coded and analyzed. A total of 69 expectations and demands are established, as shown in Table 2. Among these items, 22 are about function requirements, 26 requirements for shapes and 21 for efficiencies. Such information is called "qualitative data", which will serve as a basis for questionnaire design.

**Table 2: Qualitative Data Generated from Scenario Interviews**

Interview questions	Expectations & demands	No. of Items
<b>Functions required for new products</b>	Basic communications functions, MP3, wireless TV, games, EasyCard, camera, digital dictionary, remote control, video recording, 3G, calendar and memo, Internet browsing, alarm, GPS, Bluetooth, dual screens, USB interface, memory card extension, external speaker, audio recording and calculator.	22
<b>Shapes required for new products</b>	Cute, cartoonist design, easy to carry around, personalized style, small, compact and lightweight, ergonomic, glasses-like design, round and smooth shape, antenna-free, keyboard of the right size, bright colors, foldable, sidekick, watch, single-key operation (joystick), fashionable black and silver colors, pink color, touch-screen, super slim, slide cover, big screen, lightweight, lidless, medium-size, multiple keys, wide shape.	26
<b>Efficiencies required for new products</b>	Large-capacity battery, strong reception, comprehensive features, easy to recharge, sturdy (not breaking down when fallen to the ground), water-proof, high-definition of pictures on the camera, large data storage capacity, good sound quality, clear pictures, flexibility to add features required by the owner, rich data, easy to use, premier screen lens, nano dust-free shell, sophisticated games, quick to start the phone, easy to press the keys, high stability, theft-proof, GPRS positioning system.	21

Source: This study. *N* = 16.

### Output of Quantitative Information

Quantitative information is derived through questionnaire surveys and statistical analysis. A total of 69 questionnaire questions are formulated. After two pilot tests, some questions are modified. Finally, the number of questions are condensed into 49-item in the formal survey. After the release and recovery of questionnaires and the elimination of invalid questionnaires, a total of 547 questionnaires are established, with a recovery rate of 84.1%.

A reliability test is performed on all the questions: handset "function" (.86), handset "shape" (.84) and handset "efficiency" (.89). The Cronbach's of all the questions is .94, implying that the overall reliability of the questionnaire is rather high and compliant with the statistical requirements.

Basic questions include the subject's sex, age, handset of mobile phone, ideal price, and favorite phone brands. The respondents' basic statistics are shown in the table 3. The result of basic data analysis shows that about 57.2% of

the respondents are male and 42.8% are female. Those aged between 20 and 21 are the biggest group, accounting for 42.0% of the total. 75.5% of the respondents have only 1 handset. The ideal price range of the handset is below NT\$10,000, followed by NT\$3,001~5,000 (36.9%) and NT\$5,001~10,000 (31.3%). As far as brands are concerned, Nokia accounts the highest percentage of 19.6%. Other quantitative information is data analysis and emphasis analysis, as explained below.

**Table 3: Characteristics of the Respondents**

Basic features	Category	Sampling number	Rate
Gender	Male	313	57.2%
	Female	234	42.8%
Age	Below 20	101	18.5%
	20-21	230	42.0%
	22-23	156	28.5%
	24-25	51	9.4%
	Above 26	9	1.6%
Handset of phones	0	3	0.5
	1	413	75.5
	2	107	19.6
	3	15	2.7
	4	2	0.4
	5	5	0.9
	other	2	0.4
Ideal price	Below 3000	114	20.8
	3001-5000	202	36.9
	5001-10000	171	31.3
	Above 10000	60	11.0
Favorite brands	ASUS	38	6.9
	BenQ	47	8.6
	InnoStream	23	4.2
	LG	14	2.6
	Motorola	71	13.0
	Nokia	107	19.6
	OKWAP	41	7.5
	Panasonic	47	8.6
	Samsung	21	3.8
	Sharp	17	3.1
	SonyEricsson	70	12.8
other	51	9.3	

### Users' Expectations

Users' expectations showed the factors of questionnaire extracted via factor analysis concerning the functions, shapes and efficiencies of the 4G mobile phones. Factor analysis used the principal component analysis and Varimax method. Factors with eigenvalue of greater than 1.0, factor loading of bigger than 0.3 and the variance between factors of greater than 0.3 are extracted (Hair, Anderson, Tatham, & Black, 1995). According to factor analysis, KBO and Bartlrtrt of individual variables for the functions, shapes and efficiencies are 0.897, 0.884, and 0.915, respectively. They are all greater than 0.7 and  $p < 0.001$ . Therefore, there is no major variance in the correlation between variables.

#### (1) "Function" Factor

There are 16 questions covering functions in the questionnaire. A total of three factors are extracted via principal component analysis. These three factors are "versatility", "entertainment" and "essentiality", as shown in Table 4. These three common factors explain accumulated 51.77% variances. The eigenvalues of the three common factors are 3.492, 2.749, and 2.044, respectively.

**Table 4: Factor Analysis (Prescribed Determinants of Phone Function) Varimax Rotated Loading**

Factor and Variables	Factor 1	Factor 2	Factor 3
<b>F1 – Versatility</b> <ul style="list-style-type: none"> <li>•should have GPS functions(e.g. maps)</li> <li>•should be computerized</li> <li>•should serve as Easy Card</li> <li>•should provide Internet browsing</li> <li>•should provide operational features(e.g. remote control)</li> <li>•should have USB interface</li> <li>•should have audio recording functions</li> </ul>	0.696 0.682 0.660 0.615 0.590 0.574 0.542		
<b>F2 – Entertainment</b> <ul style="list-style-type: none"> <li>•should have entertainment features(e.g. gaming)</li> <li>•should have video features (e.g. 3G and movies)</li> <li>•should have MP3 functions (e.g. music and stereo)</li> <li>•should have photo-taking functions</li> <li>•should have dual screens</li> <li>•should have Bluetooth functions</li> </ul>		0.697 0.660 0.653 0.635 0.483 0.463	
<b>F3 – Essentiality</b> <ul style="list-style-type: none"> <li>•should have basic communications functions</li> <li>•should have alarming functions</li> <li>•should have memory-card extension functions</li> </ul>			0.729 0.718 0.641
			Total Variance Explained
% of Variance explained	21.82%	17.18%	12.77% 51.77%
Cronbach's Alpha	0.805	0.774	0.596
Eigenvalue	3.492	2.749	2.044

Note: Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA): 0.90  
 Bartlett's Test of Sphericity"  $\chi^2 = 2644.591$ , significance at  $p=0.000$ .

(2) "Shape" Factor

There are 13 questions covering shapes in the questionnaire. A total of two factors are extracted via principal component analysis. These three factors are "light-weight, compactness and personalization" and "variety", as shown in Table 5. These two common factors explain accumulated 43.69% variances. The eigenvalues of the two common factors are 2.866, and 2.813, respectively.

**Table 5: Factor Analysis (Prescribed Determinants of Phone Shape) Varimax Rotated Loading**

Factor and Variables	Factor 1	Factor 2	Factor 3
<b>F1 – Light-weight, compactness and personalization</b> <ul style="list-style-type: none"> <li>•should be easy to carry around (e.g. compact and lightweight)</li> <li>•should be ergonomic (e.g. easy to grab)</li> <li>•size of the keyboard should be medium</li> <li>•should allow personalized colors (e.g. various colors)</li> <li>•should offer the designs bespoke to the preferences of individuals (e.g. any irregular shapes)</li> <li>•should be super slim</li> </ul>	0.760  0.723 0.684 0.528  0.523 0.508		
<b>F2 – Variety</b> <ul style="list-style-type: none"> <li>•key strokes should be few (e.g. touch screen, single-key and joystick)</li> <li>•should be of medium size</li> <li>•should look chic and trendy</li> <li>•should come in various designs (e.g. sliding lid, lidless and foldable)</li> <li>•should have big screens</li> </ul>		0.723  0.680 0.570 0.537 0.514	

•should have outer screens (e.g. shells) •should not have antenna		0.512 0.463	
			Total Variance Explained
% of Variance explained Cronbanch's Alpha Eigenvalue	22.05% 0.767 2.866	21.64% 0.739 2.813	43.69%

Note: Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA): 0.884  
Bartlett's Test of Sphericity"  $\chi^2 = 1692.794$ , significance at p=.000

### (3) "Efficiency" Factor

There are 20 questions covering efficiencies in the questionnaire. A total of three factors are extracted via principal component analysis. These three factors are "high-quality and durability", "practicality" and "value added", as shown in Table 6. These three common factors explain accumulated 50.51% variances. The eigenvalues of the three common factors are 3.639, 3.345, and 3.075, respectively.

**Table 6: Factor Analysis (Prescribed Determinants of Phone Efficiencies) Varimax Rotated Loading**

Factor and Variables	Factor 1	Factor 2	Factor 3
<b>F1 – High-quality and Durability</b>			
•the definition of the screen should be high	0.719		
•the image quality of photos taken should be high	0.708		
•should be equipped with a large data storage capacity	0.705		
•the voice quality should be good	0.675		
•should be water-proof	0.624		
•should be sturdy to withstand drops	0.581		
•the functions on the keyboard should be robust (e.g. fast keys)	0.345		
<b>F2 – Practicality</b>			
•should be highly reliable (e.g. low breakdown rates)		0.704	
•should have large-capacity batteries (powerful storage)		0.703	
•the reception should be good		0.687	
•the keyboard should be easy to maneuver (e.g. not-too-tight and not-too-loose keys).		0.636	
•the recharge should be quick and easy		0.599	
•should be easy to use		0.490	
•should be quick to start		0.476	
<b>F3 – Value added</b>			
•games should be sophisticated.			0.703
•the shell of mobile phones should be nano dust-free materials.			0.686
•should be able to accommodate additions by users			0.638
•should be GPRS functions (e.g. anti-stolen, localization)			0.620
•the database should be rich and extensive (e.g. large dictionaries, daily life tips).			0.596
•the screen should be of good quality.			0.444
			Total Variance Explained
% of Variance explained Cronbanch's Alpha Eigenvalue	18.19% 0.831 3.639	16.72% 0.804 3.345	15.37% 50.51% 0.756 3.075

Note: Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA):0.915  
Bartlett's Test of Sphericity"  $\chi^2 = 3876.190$ , significance at p=.000

## Innovation Concepts

Innovation concepts are derived from the expectations and demands from users for mobile phones. This paper finds from the survey that the importance of valued factors among the expectations and demands from university students in Taiwan for mobile phones are “efficiency” > “shape” > “function”, shown in Table 7. Therefore, the innovation of the 4G mobile phones should pay particular attention to the improvement and innovation of handset efficiency. Especially, users place most emphasis on the communication efficiency of high-quality, followed by large power storage capacities, durability and value added.

To sum up, the innovation concepts of mobile phones in the future should be high-quality reception, compact and lightweight design, large power storage capacity, easy and quick to recharge and high reliability. These are the expectations and demands from university students in general. The more direct evidence provided by users from their own perspectives is the best information source of innovation concepts.

**Table 7: Determinant Responses (with respect to mobile phones’ Function, Shape, and Efficiency)**

Expectations	Factor Constituents	Perceived Value	Average Value
Function	Factor 1: Versatility	2.642	2.971
	Factor 2: Entertainment	2.857	
	Factor 3: Essentiality	3.416	
Shape	Factor 1: Lightweight, compactness and personalization	3.155	3.040
	Factor 2: Variety	2.925	
Efficiency	Factor 1: High quality and durability	3.353	3.219
	Factor 2: Practicality	3.447	
	Factor 3: Value added	2.857	

## CONCLUSION

This paper refers to the survey contents in existing literature to set up its study of the innovation design of the 4G mobile phones. Based on the empirical results, this paper establishes the following conclusions:

The research finds that the Taiwanese university students have many valuable ideas and viable innovative thoughts concerning the innovation of the 4G mobile phones. This finding is in line with Per, Gustafsson, & Archer (2004) and Arvind & Riley (2003). To summarize these opinions, the most important three values at the core: *functions, shapes and efficiencies*. These innovation demands provide a specific direction to the developers of products.

The university students in Taiwan pay more attention to the innovation of functions and efficiencies as far as their demands for new generation mobile phones are concerned. They are less fussy about the innovation of shapes. The young people hope that the mobile phones of tomorrow come with enhanced communications and alarming functions. As far as efficiencies are concerned, the new mobile phones have to stay by for a longer period of time. In other words, one recharge lasts longer. The recharge should be quick and convenient. The quality of communications has to be good and highly reliable. There should not be any dropped calls. The research finding sheds light to the direction of the innovation of handsets.

The factor analysis yields various factors. On the function front, there are three factors: versatility, entertainment and essentiality. There are two factors concerning shapes and they are “lightweight, compactness and personalization” and “variety”. Finally, in terms of efficiencies, there are three factors: “high-quality and durability”, “practicality”, and “value added”.

This paper is the first one to emphasize the benefits of MPAM and illustrates how to use MPAM with the study on the innovations of mobile phones as an example. This paper finds from the illustration process that it is feasible to gather information with MPAM. Through individual interviews, researchers are able to establish a wide understanding of the internal needs of users. These needs are unique and not generic. The application of MPAM to gather information is feasible in the management of product innovations in companies. MPAM can be applied in a wide

range of subjects. In addition to the investigation of innovation concepts of new products, it can also be applied to the investigation of management innovations. It is a premier research method.

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