十二、研究計畫內容：

（二）研究計畫之背景及目的。請詳述本研究計畫之背景、目的、重要性及國內外有關本計畫之研究情況、重要參考文獻之評述等。本計畫如為整合型研究計畫之子計畫，請就以上各點分別述明與其他子計畫之相關性。

（三）研究方法、進行步驟及執行進度。請分年列述：1.本計畫採用之研究方法與原因。2.預計可能遭遇之困難及解決途徑。3.重要儀器之配合使用情形。4.如為整合型研究計畫，請就以上各點分別說明與其他子計畫之相關性。5.如為須赴國外或大陸地區研究，請詳述其必要性以及預期成果等。

（四）預期完成之工作項目及成果。請分年列述：1.預期完成之工作項目。2.對於學術研究、國家發展及其他應用方面預期之貢獻。3.對於參與之工作人員，預期可獲之訓練。4.本計畫如為整合型研究計畫之子計畫，請就以上各點分別說明與其他子計畫之相關性。

（二）研究計畫之背景及目的

本研究團隊因爲國際團隊，故以英文陳述如下。

1. SPECIFIC OBJECTIVE

Based on the empirical data of internet users' behavior of a series research from 1996 until the present, we attempt to:

1) Theorize a quantitative/hybrid model, which we call the General Adoption Model.
2) Test this model by examining longitudinal empirical data of the growth of internet users.
3) Analyze the meaning of this model.
4) Develop forecasts and applications of this model.
5) Explain an extended finding of the Cultivation Effect.

We use the term of 'General' to present and implicate that this model is able to applicable to all ordinary types of scenario such as general population, general adoptees, general social conditions etc.

2. LITERATURE REVIEW AND PROBLEM DEFINITIONS

There is a classic research tradition with heavy literature of the innovation diffusion or the S-type adoption model that explains how people adopt to new innovations, new technology, and so on.

This original fruitful idea could be traced back to Tarde[56] in 1903 while the widely cited early literature included Ryan et al.'s[52] work in the 1940's, Katz's[31] and Bohlen's[1] frameworks in the 1960s. There were two main streams of thought that had been developed after the forming of this research field. The first was Rogers et al.[50][51] who studied concepts of growth and defined an 'innovation diffusion model' in the 1970s. Hirschman[25] and other researchers contributed more details to develop the framework with more variations during the 1980s up to today[16][17][28][33][42][45][47]. Though they undertook many empirical studies, their conclusions were relatively qualitative.

The second stream was led by Bass[3][5][6] who initiated a new product growth model for consumer durables shortly after Rogers et al. in 1970's. His model looked more like a '^' (a hat or a peak) than an 'S' and was revised by Norton et al.[44] in the 1980's and Mahajan et al.[38] [41] in the 1990's. There were also a number of derivative modeling techniques under development up until the present time[53][55]. Their approach was more quantitatively to access 'a pattern or regularity that repeats over different circumstances and that can be described simply by mathematical, graphic, or symbolic methods.'

For Rogers et al, the basic assumption underlying this theory was that users' adoption of an innovation would pass through a 4-stage or 5-stage S-type curve. The 4-stage form consisted of awareness, trial, evaluation, then to adoption, while the 5-stage suggested there was an 'interest stage' between awareness and trial. On the other hand, for Bass, the process seemed to be reduced into two stages of innovation and imitation.

Extended applications in the information technology field also emerged, including: Gibson[24] and Nolan's[43] four stages of EDP growth in the 1970s, Nolan et al's IT adoption theory in the 1990s and other current investigations such as Abrahamson[1][2], Fichman[21], and still others[8][9][13][25][27][34].

From thousands of literature items, the example applications included corn seed, medicine, media effects, commodities,

computerized processes, and emerging information technology. Detailed reviews have been prepared by Rogers[49], Mahajan et al. [38], Fichman[22] and many others[60].

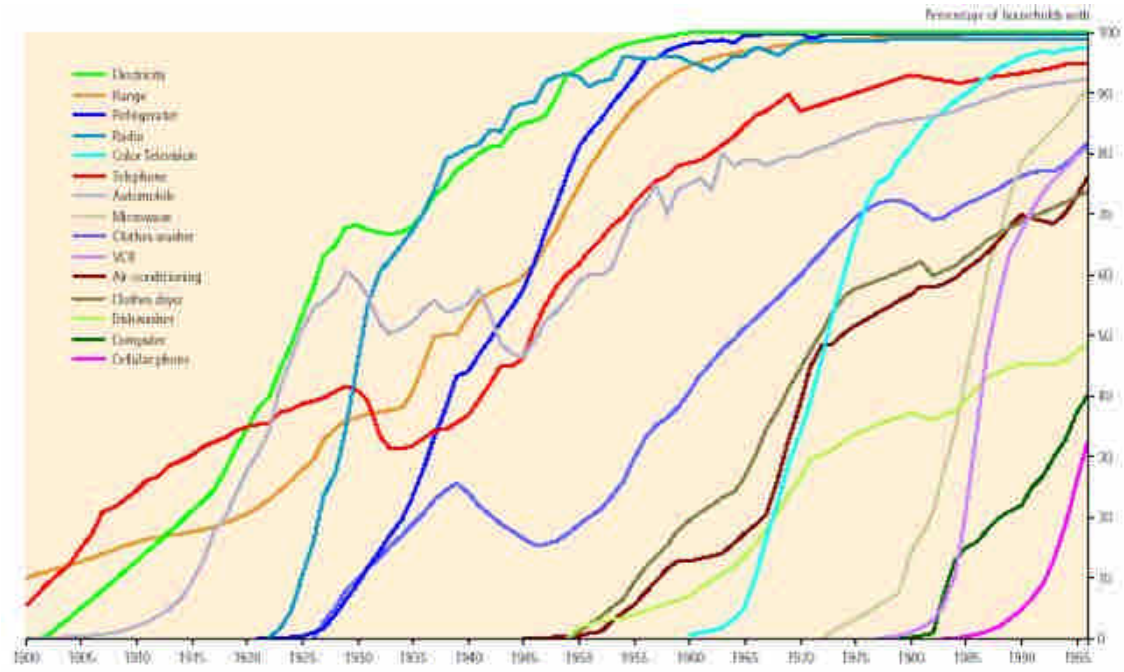
Apart from previous reviews, we want to examine the 'Adoption Model' (the term we use for 'innovation diffusion', since we find that the adoption behavior is not necessary for new adoptees) from a different point of view and pose a number of questions that still remain. Also we will choose the word 'users' instead of the term 'adopter' that many previous studies referred to. We will summarize some general problems and then take a close look at Rogers' and Bass' research efforts.

1.1. Qualitative Model or Quantitative Model?

All the former studies met a paradox in which the empirical studies could not conclude a quantitative result while the quantitative theorists could not find solid data to support their models with 'external validity'.

Most of the empirical studies would describe qualitative models such as those given in Figure 1. Their explanation of the S-type adoption is qualitatively true but the curves were not smooth enough to associate with stable statistical parameters so that forecasting was difficult. Though the researchers certainly had an idea of the stages of adoption process, they were not able to point out clear points for where the turning / inflection points might appear.

Figure 1**. Qualitative models of S-type adoption**



Source: Wikipedia[53]

The most popular quantitative approach was Bass[1]'s diffusion model and its variations, such as that of Mahajan et al.[41] They maintained that their models were able to produce a good-fit for existing data based on the coefficients of innovation and imitation; however, there was little real "future" data on which to test their models. Evidence in following discussion will show that the 'good-fit' was for the internal validity instead of external validity.

There could be two explanations for this phenomenon:

1) There is actually no behavior pattern behind the S-type curve; all the curves patterns are coincidence. Or,
2) There are indeed causal patterns behind the S-type curve; the curves are combinations of fundamental patterns and noises.

After having examined a great deal of data, we favor the second explanation. Reasons why the curves are combinations of fundamental patterns and noises might include the following:

Theory: previous and existing theories may not yet be complete.

Data: the data may be biased due to the particular research methods and/or data gathering techniques.

Interaction of incomplete theory and biased data.

1.2. Complexity Theory or Simplicity Theory?

Much of the previous researcher considered Adoption as a dependent variable that was determined by a large number of diverse variables and pictured their theories in a complexity context. We agree that there are many relevant, subordinate, and/or intervening variables that may affect the adoption behavior; however, we intended to find out if there is a fundamental underlying variable.

For example, if a player wants to make a basket, there are many related variables such as the weight of the ball, the speed at

which he throws the ball, the height of the hoop, the range he jumps, his power, his scope, his nutrition, the mental concentration with which he plays, the influences of the opponent, the audience, the cheerleaders, etc. We can not predict whether the ball will make the basket by examining all the variables in a single, simple equation. We may get lost if we want to cope with many variables at the same time. On the contrary, we would want to determine what the `fundamental' variables are and which are the noises variables. For example, force (which is, in turn affected by mass and acceleration) might be identified as a fundamental variable. Such fundamental should be relatively simple and should lead us to go further.

To this end, we partition the variables from previous studies into three classes of factors: individual factors, adoptee/innovation factors, and social factors.

Individual factors include demographic and/or other behavioral variables such as innovativeness, perceived need, novelty seeking characteristics, creativeness, etc.

Most of previous literature uses the word 'innovation' to indicate the object introduced to the users and many researchers regard an 'innovation' as a product. However, we want to employ the word 'adoptee' instead, since the objects of adoption could be products, services, events, activities, ideas, and even people.

'Adoptee factors' are the characteristics of the adoptees themselves. For example, adoptees can be from a general/mass population or specialized/small group, individual or organizational, high-tech or relatively low-tech, etc. Though all previous studies focused their attention on 'new products', we posit that Adoption is a 'general behavior' for 'existing adoptees' as well.

Social factors consider issues including media coverage, channels of communication, characteristics of mass media, characteristics of interpersonal effects, change agents, opinion leaders, the social system, marketing strategies, pricing policies, advertising, etc.

As Albert Einstein has stated: 'Everything should be made as simple as possible, but no simpler.' This is our goal as well.

1.3. Research Methods / Data Gathering

Adoption research involves the study of human behavior and is heavily methodology dependent. It is very difficult to reach coherent findings between different research groups because of the following considerations.

1) Sampling

Many past empirical studies employed methods that might not reveal the whole picture.

1) Observed Variables / Measurement

What are the operational variables of Adoption and how to measure them? Rogers' method and its variations used the numbers of adopters and Bass' method and its variations used the sales (dollars/units) of the product.

In internet studies, many gathered data by 'counting heads' and failed to identify an 'Active User' from a 'Passive User', if the number of 'heads' were not equal to each other. During a survey, passive users might also have been randomly selected to become the 'noise'. We will discuss this further in our section on empirical testing and methodology.

2) Data Processing / Data Quality

Almost none of the published research reported its process of data gathering, screening, and managing of details. According to our long-term survey practice, we understood that there were various problems when the surveyor dealt with random digits dialing (RDD), samples size, sample replacement, refusals, etc., that would significantly influence the data quality.

3) Analysis

Some previous studies employed simple statistical methods and displayed the direct observed percentages, while some reports had a convergence problem between data and theory, even though they used sophisticated analysis tools. There was a common problem that the observed sample might not adopt the innovation at the same period of the survey.

1.4. Rogers' Model and Its Variations

1.4.1. Theory and Approach

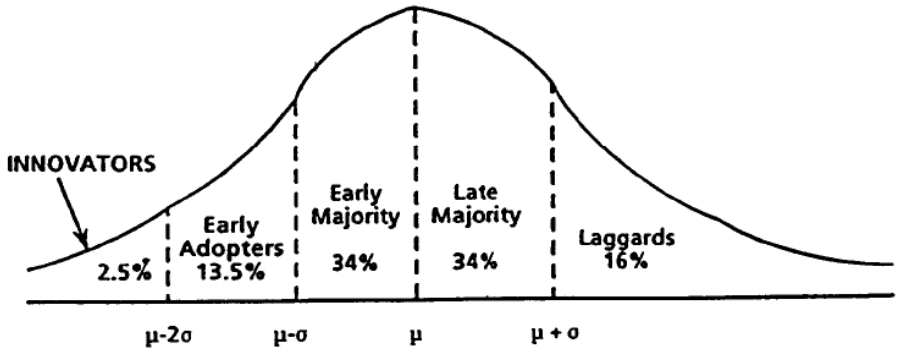
Rogers et al.[49] approached the problem mainly from a theoretical point of view;; however, most of their results were relatively qualitative.

They defined the elements of innovation diffusion as: the innovation and communication channels (over time, and among members of a social system). They theorized five categories of adopters' characteristics: innovators- venturesome, early adopters-respectable, early majority-deliberate, late majority-skeptical, and laggards-traditional.

1.4.2. Modeling and Forecast

Rogers et al.'s basic idea behind the modeling of adoption was the Normal Density Function (NDF), as in Figure 2, where they estimated the percentages of the five-class adopters: innovators - 2.5%, early adopters - 13.5%, early majority - 34%, late majority - 34%, and laggards - 16%. The concept was qualitatively right; however, there were few studies that could definitively prove these numbers.

Figure 2**. The Basics of Rogers' Model**



Source: Rogers [49]

1.4.3. Rational Behavior?

Rogers' philosophy was based on the assumption that human nature and people's behavior are rational, so that an individual, whether fast or slow, will follow very logical and systematic steps to become aware of the outside change, to show their interest, to take a trial, to make an evaluation, and then to decide on the adoption. It was an ideally pedagogic training exercise for how to make an adoption, but it might not describe what actually happens in practice.

We have spent more than twenty years studying and monitoring the discussions between interviewers and respondents. Based on this experience, we have concluded that there are many people who are hesitant to make decisions or at least to make decisions in a rational way. Thus, `rational theories' might not be an appropriate fit for ordinary people. A further discussion on this empirical problem is provided by Wu et al.[63]

We believe that human nature and people's behavior are emotional and collective. Some people simply have the nature of making quicker decision to adopt at a certain cost, while some people are naturally inclined to do nothing until the adoption `happens to them'. People also have the tendency to accelerate their adoption behavior after many others, whose characteristics are similar to them, have made the adoption.

1.4.4. Static Population Structure?

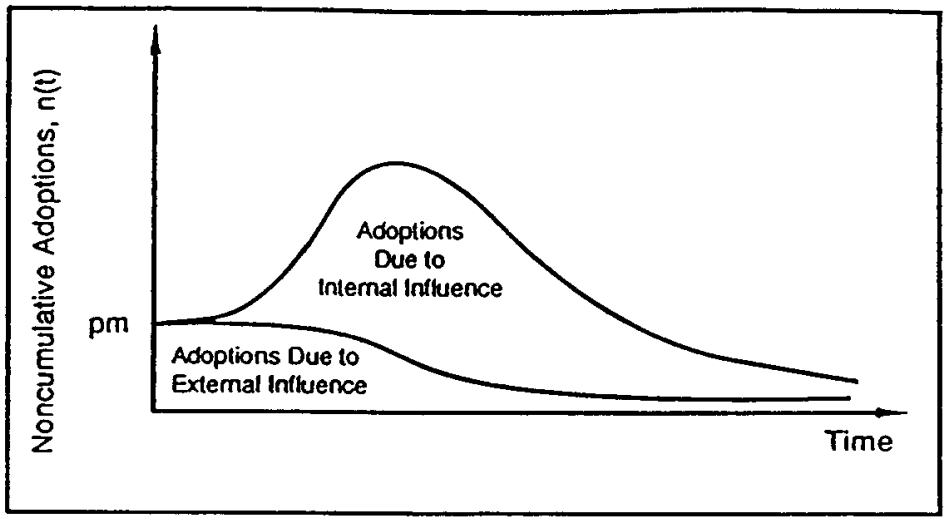
Rogers noticed that adoption behavior is highly related to the passage of time, but this idea was not reflected in his model. The graphic of the static NDF seems to be roughly correct for the structure of users / adopters under a certain given time. However, we believe that there is time-dynamic adoption behavior. For instance, there are new born and deceased users during the process of adoption and, we have to incorporate this dynamic change into the cumulative data set.

1.5. Bass' Model and Its Variations

1.5.1. Theory and Approach

Bass' framework was simpler than Rogers', and he defined two groups of users / adopters: innovators and imitators. The adoption of innovators is typically due to external influence, while the adoption of imitators is primarily due to internal influence as depicted in Figure 3.

Figure 3**. The Basics of Bass' Model**



Source: Mahajan et al. [38]

1.5.2. Modeling and Forecast

Bass assumed that the Probability of Adopting at time t given that an Adoption has not yet 'Occurred' will increase with the Number of Previous Adopters. The laggard adopters will experience Learning and Imitation before making an adoption. He defined:

Conditional Probability of Adoption at time t = p+qF(t), where

The Hazard Function is given by:
f(t)/(1-F(t)) = p+qF(t),
where, in turn, p = coefficient of innovation and q = coefficient of imitation

Further, he models

Sales at time t = S(t) = m(1-F(t))(p+qF(t)) = pm+(q-p)Y(t)-(q/m)Y(t)^2, where

M = Ultimate Market Potential,

Y(t) = mF(t) = Cumulative Number of Adopters at t, and

m-Y(t) = Number who have not yet adopted (remaining market potential).

Bass' model indicated an important concept: Everything has limits — Sales will decline as the market saturates. So he developed the following augmentation:

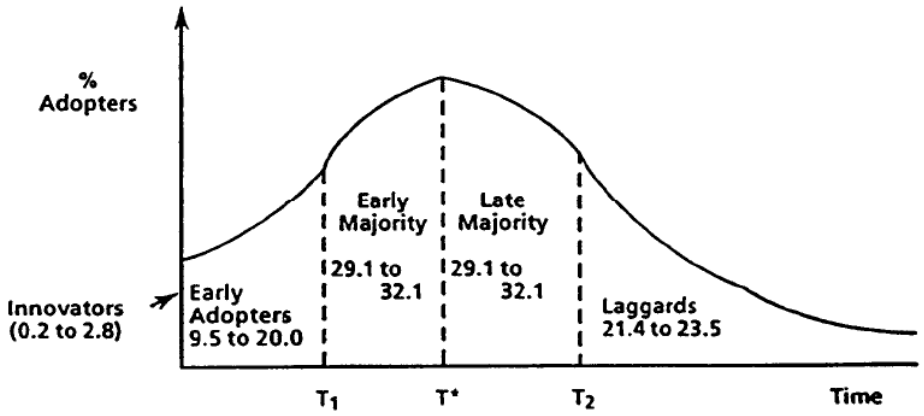
Solution to the Differential Equation for Sales = S(t) = dY(t)/dt:
dY(t)/dt = pm+(q-p)Y(t)-(q/m)Y(t)-(q/m)[Y(t)]2

= m(p+q)2/p EXP(-(p+q)t)/(1+(q/p)EXP(-(p+q)t))2

Time of Peak = (1/(p+q))Ln(q/p)

The Bass model's forecast is depicted in Figure 4.

Figure 4**. Bass Model's Forecast**



Source: Mahajan et al. [38]

1.5.3. Adoption Is Sales (Dollars/Units)?

Most of Bass' analysis was based on product sales, either in sales value (dollars) or sales units, and considered the sales is the operational variable for adoption.

Though the sales units may be a better indicator of adoption than sales value (since prices go up and down), the quantity of product units may not reflect the real adoption quantity. First, the amount of sales units includes individual purchases and cooperate purchases that can not be explained together. Second, it will not reveal the Passive users' behavior.

For example, A grandmother became an internet user after all her children and grandchildren were users. She began to use email to contact her friends. However, she was not going to purchase a dedicated PC for herself. Thus, in this case, the passive user's behavior will not be reflected by the sales units of PCs, nevertheless.

1.5.4. Products' Characteristics Do Not Matter?

Bass' cases included both popular products such as TVs, freezers, etc., and specific products such as projectors, mainframe computers, etc. It seems that product characteristics are not explicitly taken into account in the model.

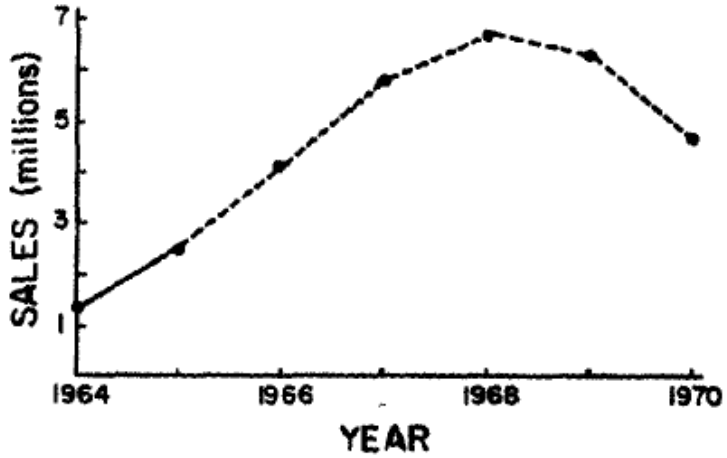
1.5.5. Parameters and Its Manipulation/ External Validity?

The Bass model's p and q factors (coefficients of innovators and imitators) could be somewhat arbitrary and produce different results with same data.

For example, consider one of Bass's original and most successful cases: the growth of color TV.

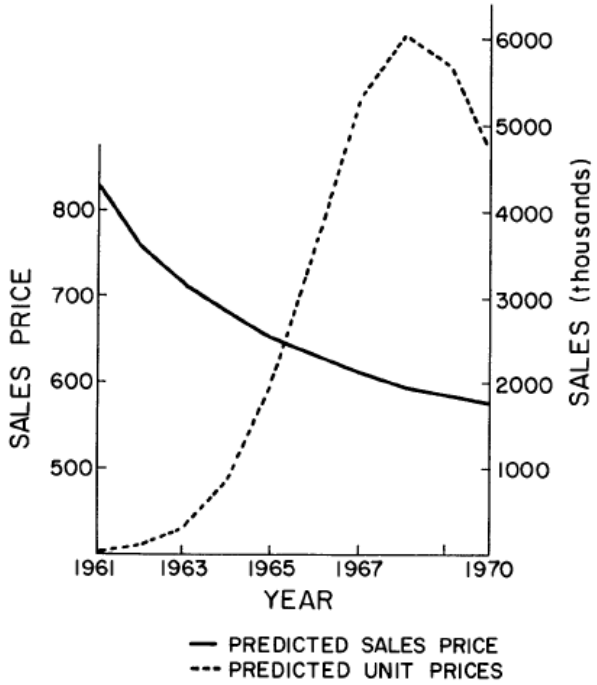
Bass has employed the same data three times to test his model and to project forecasts: in 1969 (Figure 5), 1980(Figure 6), and 1999 (Figure 7).

Figure 5**. Forecast of Color TV (units) 1960-1970, Published in 1969**



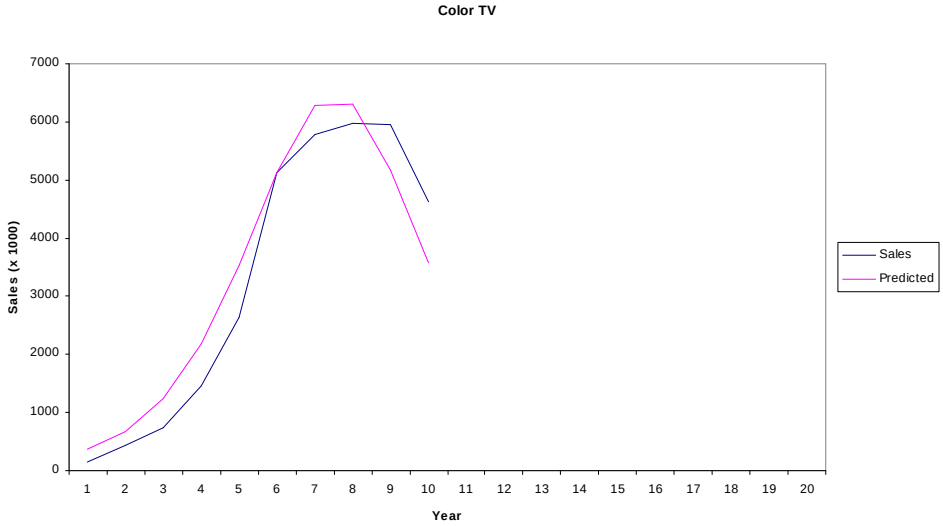
Source: Bass[6]

Figure 6. **Forecast of Color TV (units/ value) 1960-1970, Published in 1980**



Source: Bass[5]

Figure 7. **Forecast of Color TV (units) 1960-1970, Published in 1999**



Source: Bass[4]

The last post-forecast (from the 1999 paper) was very good. Further, Mahajan et al.[40] concluded that the Bass model has a good fit. However, the differences between the three Bass publications reached around one million units, showing that the results could be varied significantly by different choices of p and q. Of course, it is often very difficult to collect future empirical data to prove a theory's external validity.

1.5.6. Single Peak?

One of Bass' most important findings was the 'single peak' growth curve (see Figure 7 above). Such a curve did a very good job of describing the growth between 1964 and 1970 and successfully depicted the peak. Nevertheless, if we make additional observations, given in Table 1, we find it is not the end of the story. The growth will climb to a higher, second peak.

This fact implies that the previous single S-type models might not completely explain the adoption behavior; on the other hand, our new theory will forecast such 'twin peaks'.

Table 1. Color Television Sales (millions units) Growth

Year	Bass' Forecast	Fact
1964	1.35	1.5
1965	2.5	2.6
1966	4.1	5.1
1967	5.8	5.8
1968	6.7	6.0
1969	6.3	6.0
1970	4.7	4.6
1971	decreasing	6.3
1972	decreasing	7.9
1973	decreasing	10.1
1974	decreasing	8.4
1975	decreasing	8.5

Source: Bass[6], U.S. Census Bureau[57]

1.5.7. Bass' Bad Cases / Twin Peaks?

Bass presented eleven cases for his classic 1969 paper. He used multiple regression analysis to test his model. The R^2 values of nine of the products were above 0.690; the only two exceptions were black and white televisions (0.077) and home freezers (0.473). He republished the cases in 1980 and eliminated the latter two products.

With a closer look, we suggest that these cases might not be too ill-behaved.

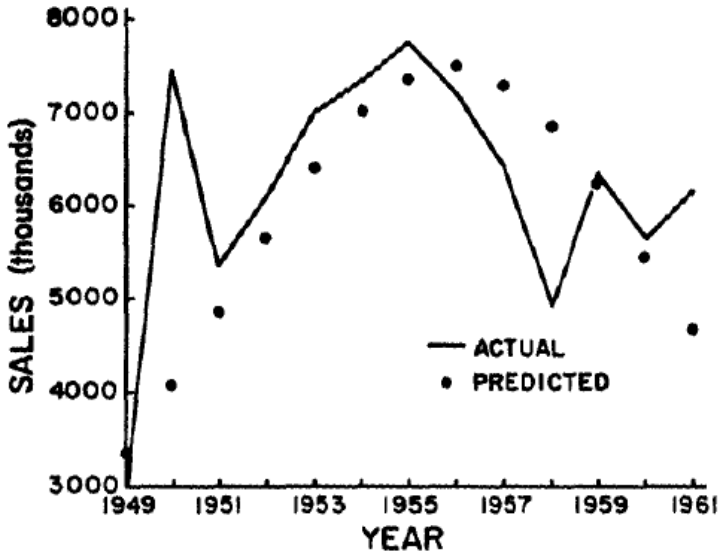
One could reason that the latter two products were more for mass population clientele than were the other products: recover players (0.953), electric bed coverings (0.934), water softeners (0.920), room air conditioners (0.900), power lawnmowers (0.898), clothes dryers (0.858), electric refrigerators (0.762), steam irons (0.730), and automatic coffee makers (0.690).

The source of the low multiple regression efficient for the latter two products was that the curves based on their data had two peaks (Figure 8, Figure 9).

Furthermore, we examined other cases in Figure 1 and we could find a number of cases that, had significant 'twin peaks'.

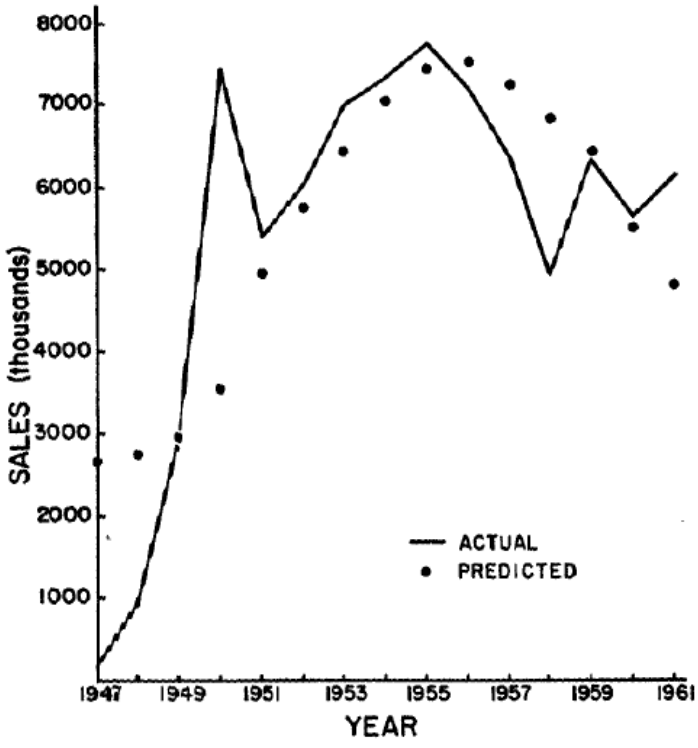
Those hints may support our new theory about 'twin peaks' once again.

Figure 8**. The Growth of B/W TVs**



Source: Bass[6]

Figure 9. **The Growth of Home Freezers**



Source: Bass[6]

1.6. Research Limitations and Opportunities

A major difficulty in Adoption research is the nature of human behavior. It is impossible to test Adoption behavior in lab.

Fortunately, the growth of the internet has provided us with an excellent opportunity to examine our research objective over the last decade. One characteristic of the internet is that it is not limited to a certain group or to a special social context.

3. THEORY DEVELOPMENT ON GENERAL ADOPTION MODEL

Adoption is the fundamental behavior for people's taking, selecting, and decision making.

The Adoption Behavior could be defined and measured by the following conceptual (and maybe mathematical) General Adoption Model and its three derived mathematical sub-models.

We refer to this model as the 'General Adoption Model' to indicate that this model may be the law to explain people's Adoption Behavior with core factors we are able to observe.

1.7. First: Adoption Motivation Model

People are divided into 2 groups by Adoption Motivation (AM) that is a born attribute of human nature.

The peoples of the first group are with active AM who make adoption individually, i.e. they choose.

The peoples of the second group are with passive AM who make adoption collectively, i.e. they wait the adoptees happen to them.

The strength of AM of each group contributes to an independent normal distribution.

Thus, the simplest AM model is the following that Xi denotes the time-to-adoption for person i, i = 12,…,n. Xi's are i.i.d. Nor(μ;σ^2), where μ and σ^2 are typically unknown.

$$X_i \sim \begin{cases} \mathrm{Nor}(\mu_1, \sigma_1^2), & \text{with probability } 0.5 \\ \mathrm{Nor}(\mu_2, \sigma_2^2), & \text{with probability } 0.5 \end{cases}.$$

1.8. Second: Force of Adoption Behavior Model

The Force of Adoption Behavior (FA) is determined by:

2) The strength of AM.
3) The perceived Usability of Adoptee (UA).
4) The exponential strength of the Social Image (SI) about the UA.

Thus, the FA Model is:

*FA= AM * UA * (SI)2*

1.9. Third: Counterforce and Advanced Force of Adoption Behavior Model

The counterforce of adoption is the cost(C). The effect of cost is exponential; therefore, the counterforce is higher as the range of the cost is longer.

If an Ideology cost is involved in the adoptee, the Negative Ideology (NI, such as hate, anger, dissatisfaction, discrimination…) will produce significant exponential counterforce for adoption.

Thus, the above Advanced Force of Adoption Behavior (AFA) model is modified to:

$$AFA = AM\frac{UA(SI)^2}{(C\ \&\ NI)^2}$$

4. FACTORS OF THE MODEL

1.10. Adoption Motivation

We believe that Adoption Motivation (AM) is a latent independent variable, i.e., a born attribute of human nature that affects how people behave; in particular, if they have a natural propensity to be adoptees with certain cost/effort and how quickly they make their decisions.

The concept of AM that we put forth here may sound like the term 'innovativeness' from previous studies; but it is even simpler. We could find very little correlation between AM and creativeness, imagination, and novelty seeking propensity, etc. Further, the Adoption behavior of existing adoptees is similar to that of new adoptees. AM is divided into two groups: relatively Active users and Passive users.

The strength of AM might be determined by users' emotional and/or collective response. Emotional response reflects a choice based upon past experience and available information. Few people make any significant effort to collect new evidence, especially contradictory evidence for their decision. Collective response follows an imitation of social image. The social image could be a current advantageous social value judgment or an overwhelming glaring social fashion.

Our definition of Active user / Passive user is totally different from the previous duad Adopter – Laggard. The previous studies assumed that the Adopter says 'yes' and the Laggard says 'no'. We find out that the Active user has additional motivation to acquire an adoptee while the Passive user is 'doing nothing'. For the active users, they have a positive view with respect to adoptees and they are willing to pay to do so. On the other hand, the typical Passive users wait and hesitantly make their decisions. The real story for the very Passive user is that the adoptees 'happen' to him instead of the adoptees being chosen by him (though he still completes the Adoption process eventually).

1.10.1. Deliberation

1) Adoption Motivation will be naturally split into an Active-Passive duad.
2) Under a general environment, the population also will be split into an approximately 50-50 natural balance of the Active-Passive duad,
3) The growth patterns of the Active user and the Passive user follow their own NDF in each group,
4) Thus, a mathematical model could be developed for forecasting purposes.
5) The strength of the Active AM group could be considered as >1, while the strength of the Passive AM group could be considered as ≤1.

1.10.2. Empirical Evidence and other

The existence of Active-Passive duad has been revealed in:
1) The longitudinal data of the Internet Users' Behavior Research Series.
2) The new examination and interpretation on the previous findings of 'twin peaks'.

A meta-analysis and a full scoped of historical events may conclude more evidences to support our perspective.

The progresses of DNA researches also provide a promising expectation that may find out biological evidences to meet our assumption.

1.11. Force of Adoption Behavior

1.11.1. Adoptee Factors: The perceived Usability of Adoptee

Our assumption on the perceived Usability of Adoptee (UA) is also different from the previous 'Rational Choice Theory' that assumes people will engage in searching of evidences then make choice.

We assume that only the group of Active AM may search information before their choice. Mostly, they search for the perceived Usability and available information of their targeted Adoptee.

For the group of Passive AM, they accept the adoptee collectively and also influenced by the perceived Usability of Adoptee.

The AM is 'adoptee dependent', in that a person may have an Active AM with 'adoptee A' but have a Passive AM with 'adoptee B'.

If the 'adoptee' is not from a general / mass population; the proportion within the Active - Passive duad will be varied. For a new adoptee without popular interest, the percentage of Active AM will decrease and the Passive AM will increase according to human emotional and collective nature. On the other hand, for an existing adoptee, the percentage of Active AM will naturally increase, while that of the Passive AM will decrease.

1.11.2. Social Image Factors

The speed of Adoption will form a normal distribution within each group and will produce 'twin peaks' on the growth curve. The portions of fast growth on the curve also reflect how the people behave collectively. However, the two NDF's may be varied owing to strong 'adoptee and Social Image (SI) factors'.

When the Active Adoption process is progressing, it is possible that some users of Passive AM also will be brought in by the SI factors. This kind of activity may be unstable and makes for noise in the analysis. Thus, we have to identify/separate the Active Adoption from the Passive Adoption and purify the measurement of observation.

Furthermore, from a dynamic point of view, the new adoptee will be becoming an existing adoptee and the adoption process continues progressing. Thus, we are able to justify a 'multiple peaks' growth curve.

At the beginning of our research, we assumed that the promotion of internet will be under general activity and will neutralize the effects of SI factors. However, after a couple of years worth of experience, we indeed found significant influences from the SI factors. Therefore, we extended our research scope to bi-test the following:

1) Media coverage is one of core variables of 'Social Image' factors.
2) Media coverage will produce a 'Cultivation Effect' on Passive users.
3) We will discuss what the Cultivation Effect is later.

Furthermore, we suggest the FA is determined by the exponential strength of SI about the UA.

There is tons of literature failed to find out immediate media effect and related famous theories, such as 'Silent Spiral', have proven there is no linear media effect to produce social image.

Our analysis on 'Cultivate Effect' also found the lag of media effect the formation of social image that fit the exponential model.

1.12. Counterforce and Advanced Force of Adoption Behavior

For commodity, goods and services, the counterforce of adoption is mostly the price.

However, if the adoptee is a person, a policy or an identity, the Ideology, especially the Negative Ideology(NI), will play a significant exponential counterforce as cost.

We also have found empirical evidence of the influence of NI from another research series in Voter's Behavior.

Since the complexity of the Advanced Force of Adoption Behavior (AFA) model, we will present and discuss AFA in another paper.

1.13. Current Research Scope: General Environment

We are going to employ the data of 'Internet Users' Behavior' to test our theory, since it fits the ideal general environment.

The general environment indicates the 'adoptee' is for a general / mass population and the 'social factors' are under general activities that is relatively easier to be separately identified.

Under the general environment, the Active - Passive duad will reach a natural balance that may approach a fifty - fifty split. The effect on the collective response of the two groups is that the respective fast growth curves will launch in separate

timeframes. Therefore, there will appear to be a 'twin peaks' growth curve.[1] For the dynamic concept of continuous adoption behavior, generation by generation, one could surmise that a 'multiple peaks' growth curve would manifest itself.

The cost of the addition of internet is relative low and the influence of Negative Ideology tends towards zero. The denominator could be considered as a constant.

Under the general environment, our modeling is able to be empirically tested.

1.14. Modeling: Mathematical and Graphical

A key component to our methodology is the modeling of time-to-adoption. The simplest model that we could use is simply to assume that the adoption times are independent and identically distributed (i.i.d.) normal times. Specifically, suppose that Xi denotes the time-to-adoption for person i, i = 12,…,n. Our baseline model assumes that the Xi's are i.i.d. Nor(μ;σ^2), where μ and σ^2 are typically unknown, and therefore must be estimated from data using standard statistical techniques.

A slightly more-sophisticated and general model assumes that the Xi's are i.i.d., but now from a symmetric composition model. In particular,

$$X_i \sim \begin{cases} \text{Nor}(\mu_1, \sigma_1^2), & \text{with probability } 0.5 \\ \text{Nor}(\mu_2, \sigma_2^2), & \text{with probability } 0.5 \end{cases}.$$

Such a model could be useful in describing the case in which we have two sub-populations among the group under scrutiny. For instance, suppose that 50% of eventual users are 'active' (and therefore likely to adopt early), while the remaining 50% are 'passive' (and therefore are likely to wait a bit before starting to use a new adoptee). Among both individual groups, the times-to-adoption are normally distributed; but the mixture of the two groups results in a so-called normal composition. Notice that this model requires the estimation of four parameters — μ_1, μ_2, σ_1^2, and σ_2^2 — which can again be accomplished via standard techniques.

The final model we consider herein is a yet more-general one that does not assume the 50-50 `balance' between active and passive sub-populations. Here we again draw i.i.d. Xi's, but now

$$X_i \sim \begin{cases} \text{Nor}(\mu_1, \sigma_1^2), & \text{with probability } p \\ \text{Nor}(\mu_2, \sigma_2^2), & \text{with probability } 1-p \end{cases},$$

where p is a fifth parameter that must be estimated — an interesting and potentially challenging problem. This model makes intuitive sense in situations where we are not guaranteed to have a natural proportional balance between the two groups.

Though theoretically the 'individual factors' could be categorized into 'general population- specific' levels, the 'adoptee factors' could be categorized into 'new adoptee / existing adoptee', 'low interest / general interest / high interest' levels, and the 'social factors' could be categorized into 'weak / general / strong' levels, we want to focus on the following four typical cases that fall under a general population:

Case 1: General Interest Adoptee, General Social Factors
Case 2: General Interest Adoptee with Strong Social Factors
Case 3: New, Low Interest Adoptee with General Social Factors
Case 4: Existing Adoptee with General Social Factors

For the dynamic point of view, the new adoptee will be becoming an existing adoptee; therefore, we also want to depict a conceptual case for the Adoption of multiple generations of users.

Case 5: Multiple Generations of Users

[1] Consider the following real-life case study. A large computer company wanted to go public in the late 1980's. This company ran an internal campaign to persuade employees to purchase the company's stock for about US$1.00 per share. The recognition of this opportunity was very minimal in the beginning, and the CEO and President had to call senior employees to convince them to take advantage of the opportunity. Finally, less than half of the management and senior employees bought the stock.

When the date of the IPO was approaching, this company announced the second round of internal recognition at about US$3.00 per share. After all the lower management had recognized the opportunity that purchase represented, suddenly all the remaining employees responded strongly, including introducing outsiders' investments, and they rushed to buy the stock.

The first price on the date of the IPO was US$2.20 per share, after which the price kept on moving down and, until it remained ataround US$1.00 per share for many, many years.

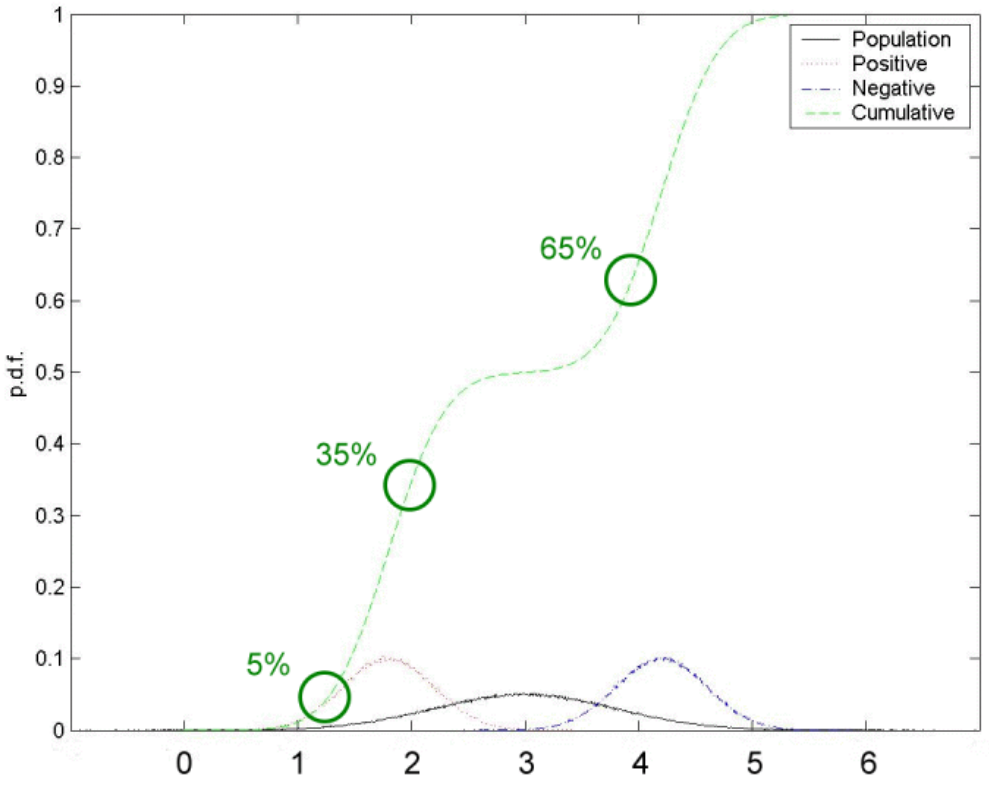
The pure value was US$0.90 per share before this company went public, and this figure was published in the financial statement a long time before the IPO. Few employees made their decision by reading that statement.

As examples of how such distributions might look, we have plotted these cases as follows.

1.14.1. Case 1: General Interest Adoptee, General Social Factors

Under the most general situation, the distribution there will be a 50-50 `natural balance'.
We might expect three inflection points, approximately at:
A time frame around the 1st `standard deviation', with cumulative percentage of 5%.
A time frame around the 2nd `standard deviation', with cumulative percentage of 35%.
A time frame around the 3rd `standard deviation,' with cumulative percentage of 65%.
See Figure 10.
We will forecast a 'twin peaks' growth that is significantly different from former models that consider only a single peak.
This model may also apply to previous examples with twin peaks that were mistaken as errors or bad cases.

Figure 10**.** Case 1: General Interest Adoptee, General Social Factors



1.14.2. Case 2: General Interest Adoptee with Strong Social Factors

For the case of a general interest adoptee, the distribution will remain in a 50-50 natural balance. However, the adoption time frame of the Passive users will be narrowed by strong positive social factors.

We are still able to expect two inflection points approximately at:
A time frame around the 1st `standard deviation' with cumulative percentage of 5%.
A time frame around the 2nd `standard deviation' with cumulative percentage of 35%.

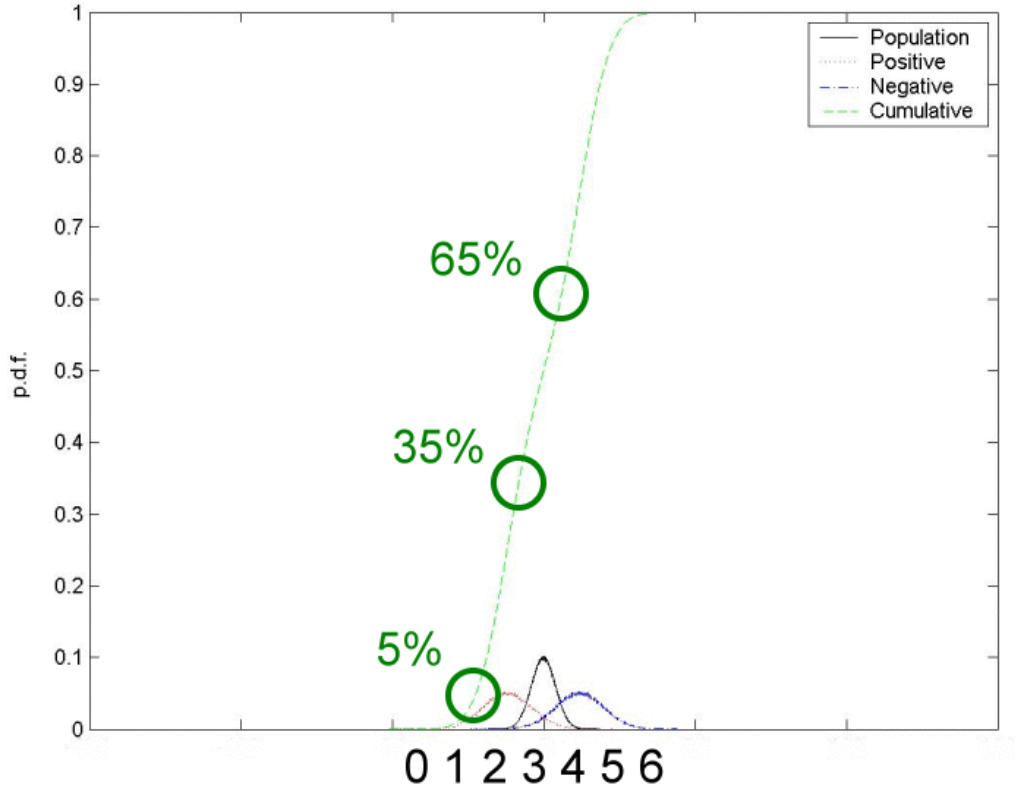
The 3rd inflection point still can be forecasted to appear around the cumulated percentage of 65%, but the time frame will be varied and related to the 'social factors'.

We believe that the social factors will not affect Active users much, but the social factors will positively draw Passive users' attention and accelerate their adoption.

The Cultivation Effect explains why the 'social factors' only influence the second peak of the adoption process.
See Figure 11.

The 'twin peaks' will merge to a single peak. This is the reason most of previous studies detected an S-type curve — since most of new adoptees will come with very strong promotion and other social factors.

Figure 11. Case 2: General Interest Adoptee with Strong Positive Social Factors



1.14.3. Case 3: New, Low Interest Adoptee with General Social Factors

We might expect a 'twilight zone' around the 1st `standard deviation' with cumulative percentage of 5% for the low interest, very difficult adoptees.

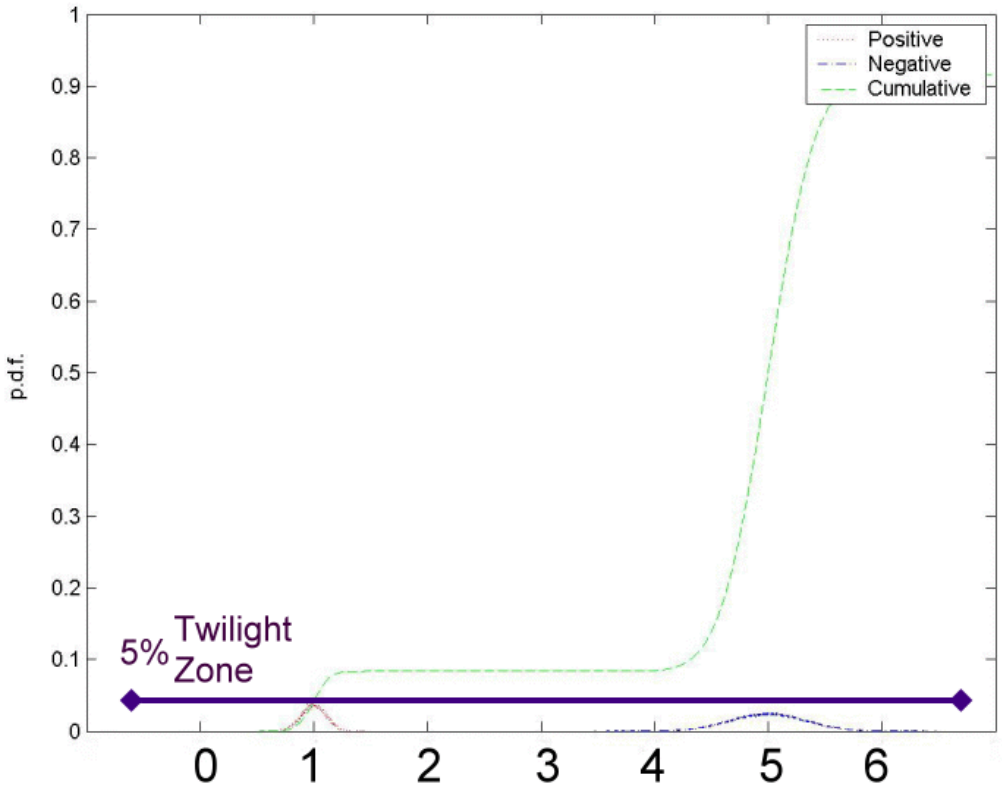
If a new adoptee cannot trigger 5% of people's interest, it will die and never become a population's adoption. Nevertheless, if a difficult new adoptee eventually is adopted by more than 5% of people after a very long time frame, it may suddenly become a popular adoption.

For an extreme example, during the age of Galileo, people did not believe his theories and wanted to put him to death. When the active users — the scientists who have prestige and knowledge — adopted Galileo and legitimized his work, everyone adopted Galileo.

This fact reflects our perspectives and interpretation: the major passive users did not make any rational moves such as collecting evidence, examining contents, comparing competing ideas, etc., before adopting Galileo. The truth is that the adoptee, Galileo, happened to them.

See Figure 12.

Figure 12**.** Case 3: New, Low Interest Adoptee with General Social Factors



1.14.4. Case 4: Existing Adoptee with General Social Factors

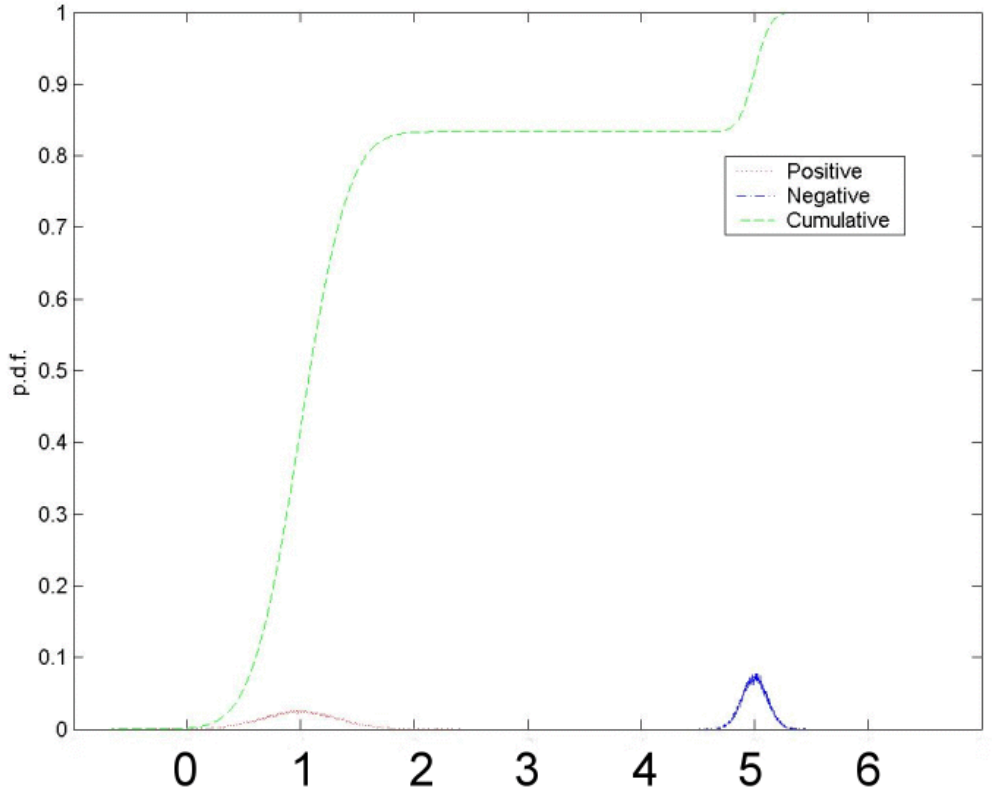
Most people will adopt an existing adoptee quickly, although there will be always a very small proportion of passive users who will wait for a long time.

The curve in this situation will grow straight at first; above that most of the remaining people are passive adopters who will ignore the process of growth.

This case highlights one of basic differences of our theory from the previous point of view. We consider that adoption is a general behavior instead of being limited to ‘new innovation’.

See Figure 13.

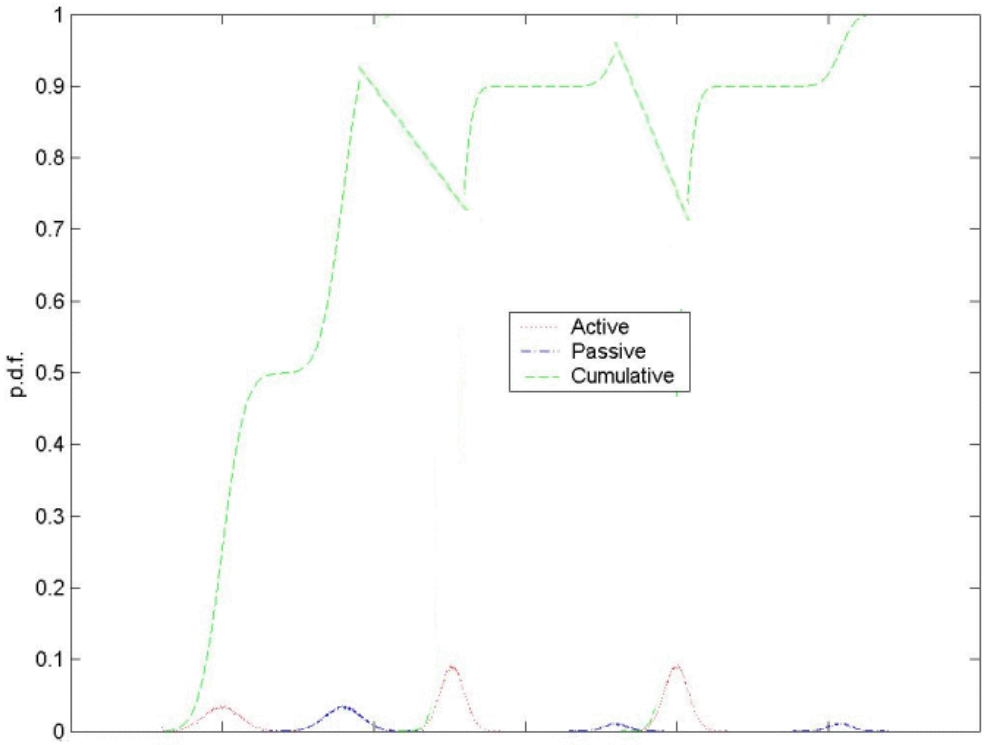
Figure 13**.** Case **4**: Existing Adoptee with General Social Factors



1.14.5. Case 5: Multiple Generations of Users

Figure 14 indicates a 3-generation adoption process. It provides the conceptual idea of the dynamic adoption process. Multiple peaks will appear in this growth curve.

Figure 14. Case 5: Multiple Generations of Users



1.15. Keys for Testing this Model

To summarize the cases above, the key evidence that would support our theory and model when doing empirical tests are:

1) If there are three critical inflection points that appear close to the cumulative percentages of 5%, 35%, and 65%.
2) If these three critical inflection points also appear close to the time frames of the 1st, the 2nd and the 3rd deviations.
3) If the empirical data fits the forecast of either Case 1 or Case 2 or their variations.
4) If the real proportion of Active Users (p) and Passive Users (1-p, q) can be verified.
5) If the consequence of 'social factors' can be observed and estimated, and fits to Case 2 (or its variations).
6) If there is a method to measure the cause of 'social factors' and to explain their influence on users' behavior.

5. EMPIRICAL TEST AND METHODOLOGY

To test the above theory, a longitudinal series of telephone surveys was conducted from 1996 to 2005. The sample sizes and profiles are summarized in Table 3.

Most telephone surveyors use a telephone directory as the sampling frame. However, the percentage of unlisted users is as high as 40%, which already endangers the basis of random sampling. To avoid this problem, we designed and used a virtual population directory with a random dialing method instead of a telephone directory.

Most survey researchers perform replacement when they fail to access a designated sample. The replacement percentage could reach as much as 60% due to the mobility of the population, which distorts the precision of the sampling.

An easily-forgotten principle is: 'Do not replace drawn samples, even if they were difficult to connect to.' (Many current surveys violate this rule.) There was only one exception to the method of sampling from a virtual directory. This method would unavoidably draw a certain proportion of inactive phone numbers that did not exist within the designed sampling frame. The inactive samples may or may not be replaced according to the research resource. Active samples did not affect sampling precision, but determined the real sample size and the denominator of the sampling precision rate.

Since there could be confusion between 'replacement' and 'non-existing sample', if a virtual sampling directory was adopted, we also suggested an online control procedure to lower the difficulty.

We provided two indicators, 'active rate' and 'accessed rate,' to profile our data sets. Active rate reveals the effort required in data gathering; the lower the percentage, the higher cost we paid. Accessed rate describes our effort to locate the specific samples; the higher the percentage, the higher the data quality.

1.16. Sampling

The sampling frame is the Taiwan region including Taiwan Province, Taipei and Kaohsiung Metropolitan areas. The sampling method is the Improved Random Digits Dialing(RDD) method that samples from virtual directories drawn by information systems. A random selection procedure was employed for household selection. No replacement was allowed. The expected errors were within the desired confidence limits and confidence interval based on the research budget and the optimum estimation of Wu's[62] design.

1.17. Measurement

The main questionnaire of the surveys was divided into 3 parts to measure different aspects of the model.

First, the survey attempted to identify whether the respondent was an internet user and (if so) identify the user as an Active AM user or Passive AM user.

For users, to measure their understanding about the internet and information applications, the survey asked their usage place(s), time(s), and behavior with respect to e-commerce, including their favorite sites; the resources, services, and product categories they considered; their purchase history; and comments.

For non-users, the survey measured how much they knew about the internet and information applications, whether they had related equipment and potential motivation to become users, and the reasons why they were not users yet.

Some question items and item values were updated each year to keep pace with information technology development and market change.

Demographic data was collected at the end of the interview.

1.18. Interviewing

Surveys were conducted by telephone interviewing with a monitoring procedure. 5% of complete interviews were interviewed more than once to verify and measure the reliability of interviewer. The continuous call back method (Wu[62]) was used to access selected respondents who were not home.

1.19. Data Analysis

1.19.1. Identifying Users and Purifying Measurement

Many previous studies measured adoption by 'counting heads'.

We believe that a 'head' is a demographic variable; it is not a real, latent variable that fully reflects the strength of Adoption.

We found a heuristic clue from two internet users survey series of CommerceNet/Nielsen's (C.N.) Internet Demographic Survey[12] and Find/SVP 's (C.D.) the American Internet User Survey [23]. Both surveys were based on a probability sample of persons 16 years or older among households in the USA and Canada. They employed very similar questionnaires, telephone interviewing and analysis techniques. However, their findings, conclusions and suggestions are contradictory to each other.

C.N.'s numbers of users were much higher than C.D.'s every year. The difference was from 50% to 250% (see Table 2). C.N. declared 'Join e-commerce now, or it will be too late' while C.D. warned 'Do not inflate the scale of e-commerce'.

Table 2. Brief comparison of the estimation of users

Year	1995	1999
CommerceNet/Nielsen	16%	41%
Find/SVP/ Cyber Dialogue	6.40%	30%

We figured out that C.N. was based on general user (they did not specify this term, but they considered all users as part of the same general group) definition while C.D. used a qualified user (i.e. our Active user) definition. This difference produced the conflicts between the two reports.

General users were defined by many studies as people who had experience accessing the internet within the last 6 months. However, C.D. advocated a rigid concept of 'qualified users' who had to have an ISP account and had to use at least one internet application.

The difference between the C.N. and C.D. surveys highlights our concept of 'people are different in Active or Passive AM' and also explained why C.N. had a higher percentage of users. A general user was one who had a chance to have a glance at the internet or borrow an internet account to have a peek occasionally. It was not necessary he/she displayed real Active AM behavior.

Because of changes in the internet market, people obtain at least a browser in addition to email when they apply for an internet account. So, it seems that C.D.'s two rules could be combined into one. Therefore, we suggested employing the question 'does the user have a personal email account' to filter active users and to measure adoption behavior. The Active user is willing to pay (money and/or effort) to activate his/her email account while the Passive user likely does not bother.

1.19.2. Estimating User Numbers

There are two popular methods to estimate the user percentage for a good or service: use the household percentage instead of personal user percentage, or use a weighting scale to modify the household percentage into an estimated personal user percentage.

All former internet user studies interviewed only one respondent who answered the phone in the sample household. It was highly possible that there were more than 1 user in a household, so some users were being missed. On the other hand, if the respondent answered that he/she was not using the internet, then 1 household would be added to the non-users record. On the contrary, the truth might be there were other users in the household. It would therefore be easy to incorrectly estimate the user percentage by using household percentage as a proxy.

Many studies reported that they employed 2 possible ways to compensate for such flaws. Some used a weighting scale by demographic variables, especially by sex and age. They took a further step to formulate their own ratio to estimate the user number. The basis of the formulation was heavily dependent upon the researchers' experience and intuition. This reveals why there were such large gaps between different organizations' surveys, and even between multiple surveys by the same organization.

We suggest a 3-step procedure to solve this problem.

In the opening section of interview, the interviewer asks the respondent if there was anyone who was using the internet in the household. If there was, the interviewer must ask to speak with the user. If the user was not home, the interviewer must make an appointment and call back until the user is located.

In the closing section of the interview, the interviewer asks the respondent how many members are in the household, how many other members are also internet users, and how many of them obtained their own email accounts.

Thus, 2 tables can be produced from the collected data of steps 1 and 2, and can be used to formulate a quantitatively-determined ratio of household users and personal users.

This procedure might be more precise than other similar surveys.

1.19.3. Data Processing

There are six steps of data processing to identify the users and estimate the cumulative percentage; see the above discussion, for further analysis.

1) Household percentage

Given:
Fj: The percentage of the households that have at least one user, at the jth observed year

i.e. Fj is the 2nd column of Table 4.

2) Population percentage

Given:
Pj: The percentage of users in the population, at the jth observed year
A: average users in a household
B: average people in a household

That is:

$Pj = Fj * A/B$

i.e. Pj is the 3rd column of Table 4.

3) Active AM users' household percentage

Given:
Gj: The percentage of households that have at least one user with email, at the jth observed year

i.e. Gj is the 4th column of Table 4.

4) Active AM users' population percentage

Given:
Qj: The percentage of users with email in the population, at the jth observed year
C: average users with email in a household
B: average people in a household

That is:

Qj = Fj * C/B

i.e. Qj is the 5th column of Table 4.

5) Active AM users' percentage of entry per year

Given:
Zij: The percentage of people who began to be a user at entry year i, observed at year j

i.e. Zij is Table 6.

6) Active AM users' cumulative percentage

Given:
i: The earliest year observed
k: The latest year observed
Rij: The cumulative user percentage at year j, observed at year k

That is:

$$\text{Rij} = \sum_{i=1}^{j} Z_{ij} * Q_k / 100$$

i.e. The k year's Rij is the 3rd row of Table 7.

Given:
R2ij: The cumulative user percentage at year j, observed at year k-1
T2: The correct ratio for year k-1 to match the observation at year k

That is:
$T2 = 100 - Z_{kk}$

Thus:

$$\text{R2ij} = \sum_{i=1}^{j} Z_{ij} * Q_{k-1} / 100 \quad * T2/100$$

i.e. The k-1 year's R2ij is the 4th row of Table 7.

The same procedure can be used to calculate R3, R4, R5,….

Thus, the average of the Active AM users' cumulative percentage is the 2nd row of Table 7.

6. FINDINGS

1.20. Sampling Analysis

A sampling analysis is shown in Table 3.

A new random sample set was drawn from Taiwan every year from 1996 to 2001. For 2002 through 2004, revisiting was accomplished by redrawing panel samples from a database of the Taipei metropolitan area. Since we used the RDD method, the active rate reflected the extra cost to locate samples.

The accessed rate was gradually improved by experience and control procedure annually. Rates above 80% could be considered as convincing, while rates above 90% could be very convincing. The series sampling precision was above average except our first survey in 1996.

Two additional procedures were employed to test sampling precision. The first was to compare the gender distribution of sample and census data. The second was to compare the usage time distribution of users' activities reported by respondents with the records from the server.

The gender distribution differences were all within and/or lower than expected errors of sampling design.

Regarding the time distribution of internet usage, this study matched the report by the Education Ministry.[20] The multiple analyses could support the acceptance of this research series.

Table 3. Sampling analysis

	Original samples	Updated samples	Active samples	Active rate	Accessed sample	Accessed rate
2005	3000	4642	4421	57.9%	4390	99.7%
2004*	3103	0	2436	78.5%	2410	98.9%
2003*	2683	0	2308	86.0%	2142	92.8%
2002*	1600	0	1323	82.7%	1266	95.7%
2001	4000	2099	4000	65.6%	3606	90.2%
2000	3200	800	3225	80.6%	2896	89.8%
1999	1600	556	1600	74.2%	1434	89.6%
1998	2000	224	2000	89.9%	1668	83.4%
1997	3000	0	2766	92.2%	2261	81.7%
1996	1500	0	1202	80.1%	905	60.3%

*Modified panel study employed.

1.21. Users Structure

The respondents were categorized into general users, active users, or non-users.

Since the sample unit was household, the researcher asked further questions about how many people were in the household and whether other people in the household also used the internet. Based on the ratios, the estimate of the users' structure was summarized (see Table 4). The weighting of the average user numbers per home is shown in Table 5.

An interesting observation in Table 4 is that the general users' percentage of Taipei's population reached the halfway milestone (50.6%) in 2000, one year later than in the USA. The percentage of general users appeared to retreat in 2001, as also happened in the USA.

However, the growth rate of active users, people who owned an email account, had a relatively slower but steady progress. It followed the expected growth curve even through the recent years of the dot-com recession.

Table 4. Users and non-users (%)

	General Users		Active Users		Non-Users	
	Household	Personal	Household	Personal	Household	Personal
2005 Taipei	58.2	37.4	48.6	37.8	41.8	62.6
2004 Taipei	56.8	46.2	47.2	34.8	43.2	53.8
2003 Taipei	64.3	42.8	58.6	36.6	35.7	57.2
2002 Taipei	61.2	38.7	47.7	26.7	38.8	61.3
2001 Taipei	48.0	17.3	36.2	11.6	52.0	82.7
2000 Taipei	42.2	14.7	24.8	7.6	57.8	85.3
1999 Taipei	25.2	7.6	15.5	4.1	74.8	92.4
1998 Taipei	26.2	7.9	16.5	4.1	73.8	92.1
1997 Taipei	27.2	9.0	17.5	5.1	72.8	91.0
1996 Taipei	17.2	-	9.9	-	82.8	-

Table 5. User information (%) per household

	Household members who use the internet						Household members who have an email account					
	1	2	3	4	5+	Ave.	1	2	3	4	5+	Ave.
2005	11.2	27.6	28.0	20.4	12.8	3.0	2.6	13.6	30.9	29.2	23.8	3.6
2004	8.0	29.0	33.7	21.0	8.3	2.9	14.1	34.0	30.7	14.7	6.5	2.7
2003	12.0	32.3	28.4	18.5	8.8	2.8	15.6	37.2	25.2	13.6	8.4	2.6
2002	17.8	29.6	28.5	17.5	6.6	2.7	24.4	35.9	24.7	10.4	4.6	2.4
2001	75.9	8.6	6.4	6.5	2.6	1.5	81.5	8.2	5.4	3.7	1.2	1.3
2000	76.1	10.0	7.9	3.7	2.3	1.5	82.8	9.9	4.4	2.2	0.7	1.3
1999	85.4	6.9	4.7	2.0	1.0	1.3	91.7	6.1	2.0	0.1	0.1	1.1
1998	86.0	6.1	4.6	2.4	0.90	1.26	96.8	2.1	0.7	0.3	0.1	1.0
1997	75.7	13.5	6.8	3.7	0.30	1.39	85.0	9.5	4.6	0.6	0.3	1.2

1.22. Cumulative S-typed Curve

The year that users began to use the internet is summarized in Table 6. The data, weighted by the figures shown in Table 4, produces the cumulative percentage of active users (see Table 7).

The figures produced by the above weighting model matched the S-type curve.

Table 6. Year that active users began to use the internet (% of active users)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2005	0.5	0.8	1.0	0.5	9.5	5.0	6.8	7.3	9.8	11.8	15.5	11.8	10.8	5.3	1.8
2004	1.2	0.2	1.0	4.6	2.4	8.7	3.9	8.2	12.3	13.8	16.9	11.6	11.1	3.6	
2003	0.8	0.3	4.0	1.4	2.3	8.1	10.5	13.1	11.7	17.2	16.8	11.4	2.4		
2002	0.9	2.5	0.9	1.8	3.2	9.6	12.5	14.1	15.7	17.3	16.6	3.6			
2001	1.1	0.5	1.5	2.5	4.3	11.3	11.6	17.2	20.1	18.5	10.6				
2000	0.5	0.5	1.8	1.9	5.2	10.7	14.9	18.0	31.1	14.2					
1999	1.5	0.3	1.7	2.3	4.4	13.4	26.5	32.8	17.2						
1998	0.8	1.1	1.8	6.6	13.9	31.9	37.7	6.3							
1997	1.4	1.8	2.7	4.1	15.8	42.5	31.7								

Table 7. Cumulative percentage of active users (% of total population)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Ave.	0.1	0.3	0.5	0.9	1.7	3.0	4.5	6.9	10.3	15.2	21.8	28.5	33.7	35.2	37.1
2005	0.2	0.5	0.9	1.0	4.6	6.5	9.1	11.8	15.5	20.0	25.9	30.3	34.4	36.4	37.1
2004	0.4	0.5	0.8	2.4	3.2	6.2	7.5	10.3	14.5	19.3	25.0	29.0	32.8	34.0	
2003	0.3	0.4	1.7	2.2	3.0	5.7	9.3	13.7	17.7	23.6	29.3	33.2	34.0		
2002	0.2	0.7	0.9	1.3	2.0	4.1	6.9	10.0	13.4	17.2	20.9	21.7			
2001	0.1	0.1	0.3	0.5	0.8	1.7	2.7	4.1	5.7	7.3	8.1				
2000	0.0	0.0	0.1	0.2	0.4	0.9	1.5	2.2	3.5	4.1					
1999	0.0	0.0	0.1	0.1	0.2	0.4	0.9	1.5	1.8						
1998	0.0	0.0	0.1	0.1	0.3	0.8	1.3	1.4							
1997	0.0	0.0	0.1	0.1	0.3	0.9	1.3								

7. CONCLUSIONS AND SUGGESTIONS

1.23. General Adoption Model

1.23.1. Two Inflection Points Forecasted

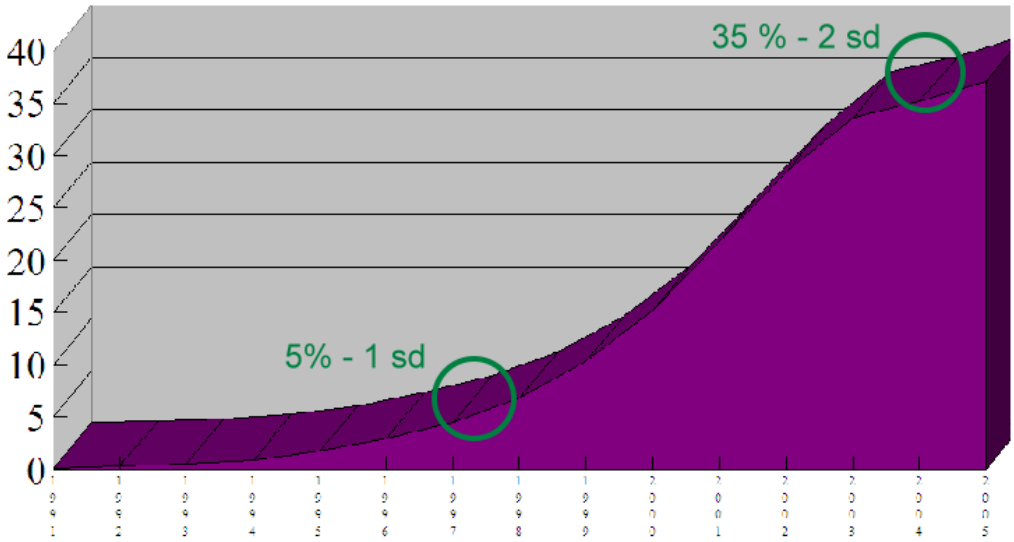
Figure 15 shows the visual trend of the findings from our data above. We find consistency of the normal distribution function in shape and trend. The figure not only matches the S-typed CDF curve, but also produces quantitative insights based upon the normal distribution.

Two of the key issues to test our theory and model (see Section 3.3) are shown by the data:

1) Inflection points appear close the cumulative percentages of 5%, 35%, and 65%.
2) The first two inflection points appear close to the time frames of the 1st and the 2nd deviation.

Unlike many other adoption models, this one appears to be able to forecast growth in advance rather than explaining growth only after it happens.

Figure 15. The growth of active internet users

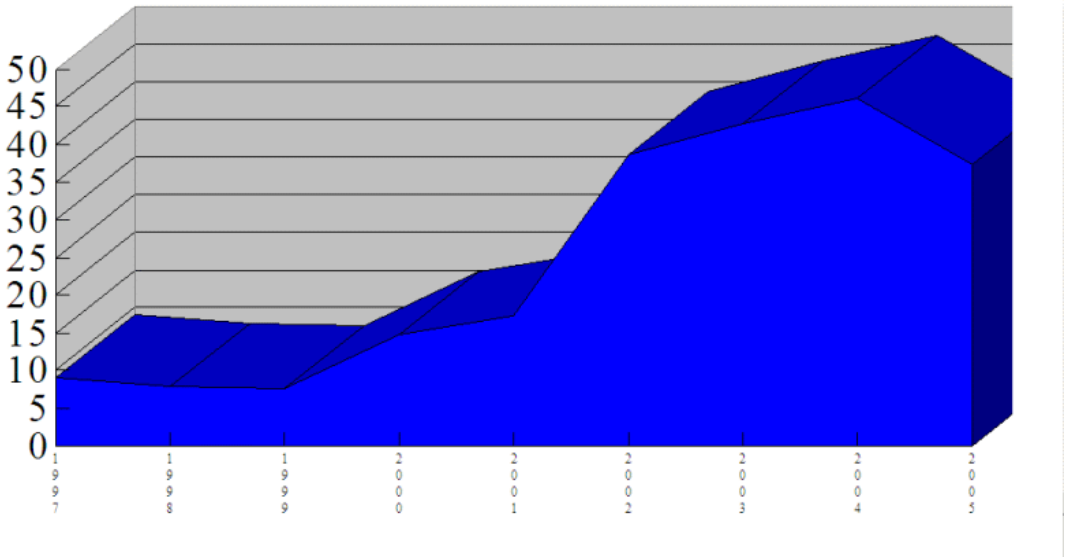


1.23.2. Comparison with General User Estimate

If we did not have the idea to distinguish ‘active users’ from ‘general users’ and instead followed the conventional methodology, the data would suggest that the growth of internet users would be as in Figure 16.

Although this approach displays a rough approximation to an S-type curve, the surface noise blurs the real growth.

Figure 16. The model of the growth of general internet users: a comparison



Comparing Figure 15 with Figure 16, we see that the active users have smooth growth while general users have an irregular change; the same phenomenon also has been found in the USA. It suggests that there were some Passive AM users who might have been attracted to try the internet for awhile, but who did not have stable adoption yet. The come-and-go phenomenon resulted in noise that makes it difficult to observe the true growth of adoption.

Comparing our new model with other internet-usage studies and other innovation diffusion research, our findings might give support for the following advantages of our model:

Our model has a higher fitness to S-typed growth.

We have a different insight that we used to develop the theory and measurement methods to observe the key variables.

We have reached a more quantitative model than the former (more-qualitative) models to explain and forecast adoption. However, human behavior is not deterministic; we want to be careful to characterize our model as a quantitative/hybrid model. Hereafter, we use ‘quantitative’ as short for quantitative/hybrid.

Since we collected data regarding an on-going event (internet adoption), the results agree with our hypothesis that adoption is a dynamic behavior, and support our General Adoption Theory.

1.24. Parameters: Explanation & Forecast

There are 3 heuristically-determined parameters in our model: 5%, 35% and 65%. These 3 numbers predict the breakpoint percentages of active users and also reflect the density of the normal distribution.

If we assume the total population consists of 6 standard deviations (as an approximation), these 3 numbers match the positions of the 1st, 2nd and 5th deviation and clearly cut the processes of adoption behavior into 4 periods. We name the 4 periods and explain the adoption behavior as follows.

Fermenting Adoption Period: Only the extremely active users are interested enough to adopt in the earliest days. Since the portion of this kind of users is less than 5%, the growth in this period is relatively slow.

Fast Adoption Period: When the user population reaches to 5%, this critical mass will trigger the people with high active AM users to acquire the new adoptee, e.g., the internet, and produce a collective momentum to realize a very fast growth until 35%.

Slow Adoption Period: The people with medium AM begin to use the internet seriously and the internet will become a real part of their life. It will be a long period (equal to the sum of the previous 2 periods) until 65%.

Passive Adoption Period: It will take another long time for the people with passive AM to accept the internet. The internet will "happen to them" but never play a significant role in their life.

We summarize the properties of the General Adoption Model in Table 8.

Table 8. Properties of Adoption Model

Period	Fermenting	Fast growing	Slow growing	Passive
Cumulated User Percentage	5	35	65	~95
Standard Deviation	1	2	4	~6
User's Adoption Motivation	Extremely active	Very active	Mid-way	Passive
Adoption Behavior	Enthusiastically emotional	Collectively emotional	Collective	Don't care

We found strong empirical data to support our theory. In Figure 15, there are 2 significant critical points that appear around 5% and 35%.

The slow, long and flat fermenting journey of the left tail ends at the 5% level; this corresponds to the time that internet was just taking off in Taiwan in 1997.

The first fast growing peak ended in 2003 in Taiwan. The numbers of active users was 35%; they were the real force, and the optimistic maximum number of Active AM users. After that began the slow growth period.

As the S-type Adoption Model we developed is a qualitative model, we are able to forecast the following:

According to the empirical data, it took 6 years, equal to 1 standard deviation, to finish the fast growing adoption period; we suggest that it will require another 12 years to finish the slow adoption period. It will take longer for everyone to become an active internet user.

These numbers may provide more help to plan strategies involved in internet activities such as e-commerce, e-learning and other services. Our model helps to understand:

The customer pool size: The current customer pool size is over 35% of the population and rising. An optimistic estimate for the size in the near future is expected to be around 65%. It will be very difficult to gain the rest of the population's participation soon.

The time frame: We have already passed through the fast growing period. There is still a good opportunity to continue growing. However, we need double the current elapsed time to double the current customer pool size.

Strategy: During the fast growth period, 'product-driven' strategy could be used since the active users themselves were driving their participation on the internet. Facing the new slow growth period and the mid-way AM users, 'market driven' and 'service-driven' must become the core strategies. Business has to identify the segmented users and their applications and provide more usability for the users because they are not as willing to overcome difficulties by themselves.

Though the above numbers came from Taiwan, it might be also a worldwide perspective since internet users share a lot in common (behaviorally) regardless of their cultural background.

1.25. Application: Dot-Com Crisis Alert

There were many studies that reported a much more optimistic vision than ours. Our experience suggests keeping a more careful forecast. Based on the Adoption Model, Wu, one of the authors, announced an alert to e-commerce industry at the 'International Conference on Communication Technology' in December, 1999. The basic message of this conference was, 'Invest in e-commerce now, before it is too late'. Wu[66] was the only one to step on the brake. In March 2000, 4 months after our alert, the 'dot-com disaster' really happened.

The alert was based on the use of a tool we developed to assist in forecasting growth with the General Adoption Model. This tool is the Ambiance Expectation Thermometer, a measure based on content analysis of media coverage.

The internet was introduced in Taiwan in 1991 and became a very hot item after 1995. All major newspapers had a special page, or pages, and a special list of internet events in their Sunday edition. Every TV network presented internet coverage from time to time. These media activities created an ambiance of expected internet growth, and we wanted to measure that

ambiance.

We examined the content of the highest-circulation newspaper in Taiwan every day, and recorded the numbers of topics related to the internet (see Table 9).

The visual comparison of the Active Adoption Model data and the Ambiance Expectation Thermometer is shown in Figure 17.

Table 9**.** Ambiance Expectation Thermometer

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Items	287	382	490	736	1254	2468	2934	3469	5736	9560	7438	5910	6070	5924	5589
Ratio to 1991	1.0	1.3	1.7	2.6	4.4	8.6	10.2	12.1	20.0	33.3	25.9	20.6	21.1	20.6	19.5

Figure 17**.** Comparison of Active Adoption Model and Ambiance Expectation Thermometer

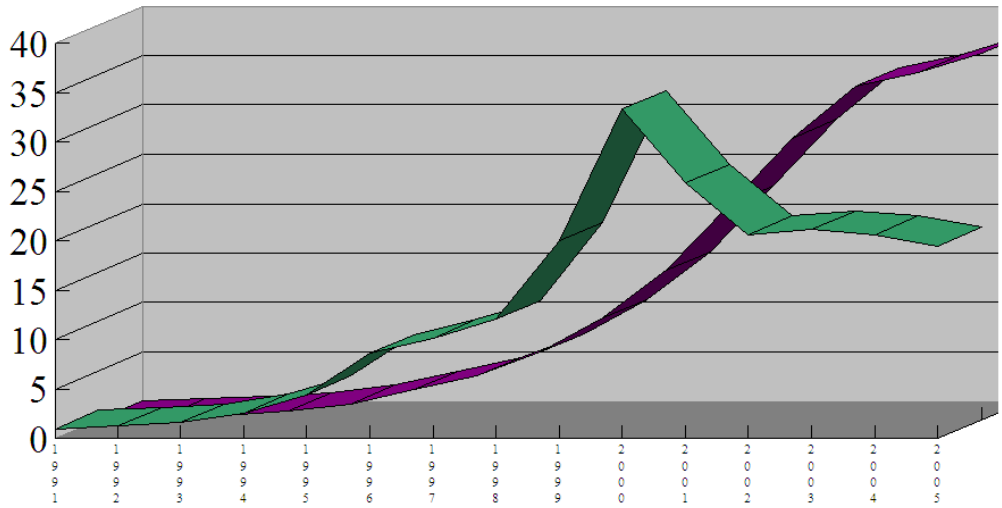


Figure 17 shows how the media had an increasing gap between their coverage and the real growth of Active Adoption beginning in 1995; the gap reached its peak in 2000, the year of Dot-Com Crisis. We noticed the enlarging gap and hypothesized that something was wrong.

A further examination of the correlation between active growth and ambiance expectation is given in Table 10. Since we began to our research in 1996 and the earliest usage was in 1991, we defined 6 years as a time frame. We found the ambiance expectation and the growth of internet active users to be consistent with each other from 1991 to 1995, with a correlation above or around .98 annually. The ambiance expectation began to get 'overheated' beginning in 1997. In 1999, the correlation had reversed to the negative (-.426) for the first time. In 2000, the correlation was -.936 with significance P<.01, and it was that exact year when the 'Dot Com Crisis' occurred.

Table 10. Correlation between Active Growth and Ambiance Expectation

Year	Correlation
2000	-0.936**
1999	-0.426
1998	0.212
1997	0.552
1996	0.854*
1995	0.985**
1994	0.983**
1993	0.962**
1992	0.987**
1991	0.994**

*P<.05, **P<.01

Since we had found a significant trend by the end of 1999, we decided to present this analysis at an international conference

and to release an alert of the overheated e-commerce ambiance. Nevertheless, few people agreed with our forecast at that time. The 'Dot-Com Crisis' hit less than three months after our public forecast.

This result reflected an asymmetric phenomenon: the media campaign and the social ambiance expectation were not proportional to the real adoption. Despite the media campaign, the internet was not yet sufficiently attractive for Passive Adopters; although they might have dabbled with the internet, they were not active users.

1.26. Cultivation Effect

This finding led us to perform an extended investigation of 'social factors' concerning adoption: the Media Effect, Recognition Dissonance, and the Cultivation Effect.

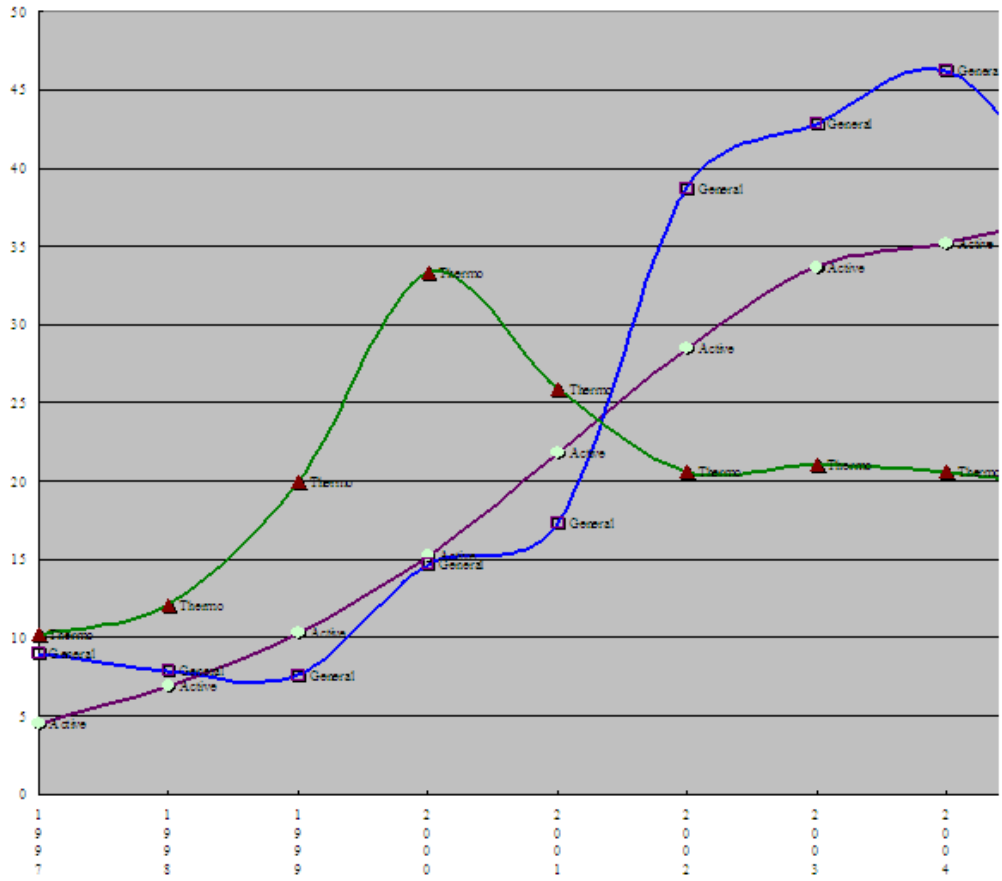
With regard to how users' behavior interacts with media exposure, the relevant literature is inconsistent and its conclusions have been reversed several times. Do media have effects? The answers have progressed through several stages: 'Yes-No-No-No-Yes-Maybe'. Most of literature has advocated that the media has no effect. A popular theory, Recognition Dissonance, explained that people recognize a dissonance between their behavior and what they recognize from the media. Today, a common point of view is that media 'may' have effect, but that the current behavioral research methods can not find it.

There were rich studies done on 'TV cultivation theories', especially with regard to children, in the 1970s and 1980s (Anderson[3], Hughes[30], Gerbner et al.[26]). Scholars advocated that there television has a heavy influence on children. They also found that television builds up a 'media reality' which is far different from the 'real reality'. 'TV children syndrome' was discovered and considered a serious problem.

There was a more than important methodological issue: many of the cultivation theories were supported only by qualitative approaches. It was and is very difficult to measure and collect data on the effect of cultivation in the short term.

From our new finding, this old theory deserves a new evaluation. Using our data, we generated a further visual comparison of Active Adoption, General Adoption, and the Ambiance Expectation Thermometer together (see Figure 18) and we found that there is a more similar pattern between Ambiance Expectation and General Adoption. We also discovered there is a 4-year lag time between the two curves.

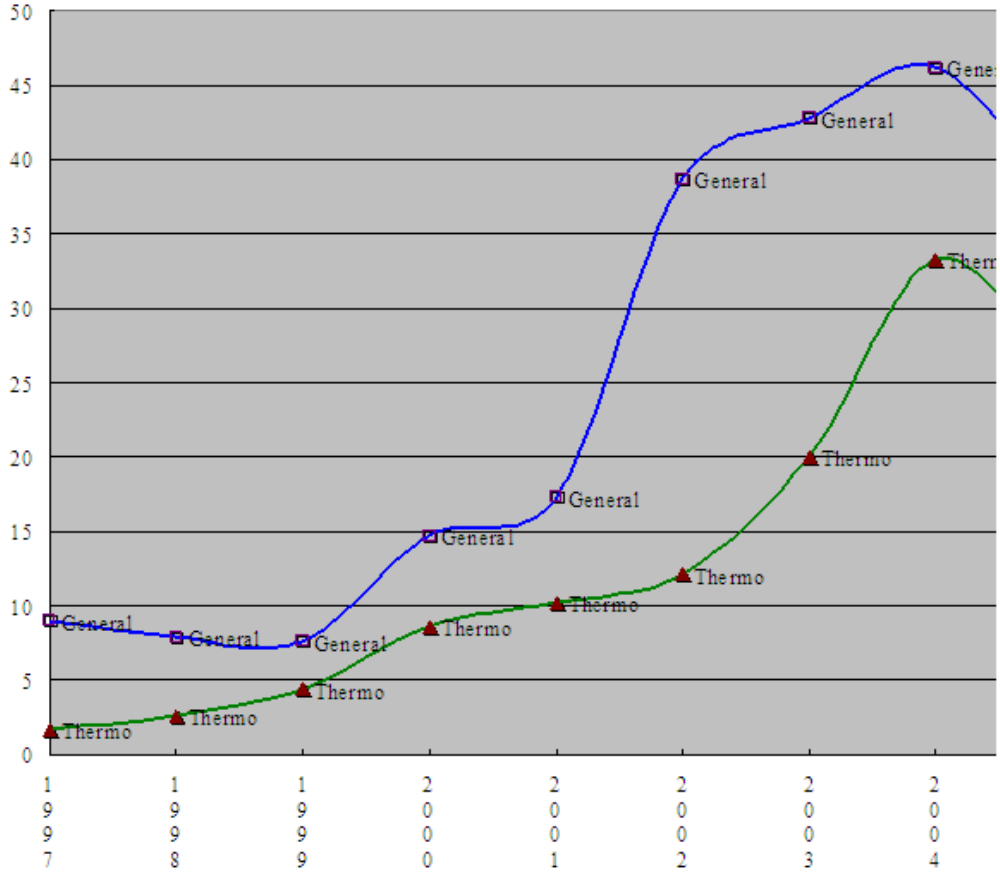
Figure 18**.** Active Adoption, General Adoption and Ambiance Expectation Thermometer



Therefore, we shifted the curve by the lag time and redrew the diagram as Figure 19; the two curves almost perfectly match each other (we ran a Person Correlation test and obtained r= .893 and sig.= .001).

This significant finding suggests some possible consequences:
Media coverage will considerably affect general user's behavior after a certain time lag.
Media effect is an awareness (recognition) effect instead of adoption (behavior) effect.
This awareness effect is the source of the noise in the real adoption process.
The time lag is quite long and explains why the former studies did not find it.
This finding confirms the idea of the Cultivation Effect.

Figure 19**. Cultivation Effect with 4-year Time Lag**



To validate our model, we need more than 2 tools and 2 traits to measure a latent variable, so this effort was also a useful procedure to support our study.

Overall, we believe it is possible that our research has observed some core reliable predictors to understand the internet users' Adoption Model and produced a valid theoretical framework.

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（三）研究方法、進行步驟及執行進度

1、抽樣設計

(1) 調查時間與母群範圍（抽樣地區）：

本三年期（2008-2010）的抽樣設計爲：母群爲全臺灣地區，每年 1 次共進行 5 次調查。

(2) 縣市家戶比例抽樣

根據內政部統計處「中華民國臺閩地區內政統計月報」揭露之最新台灣地區縣市人口分配，各縣市依照其住宅戶數佔台灣地區總住宅戶數的比例分配抽出適當樣本數。
按，坊間常見之「分層隨機抽樣」一詞，實易滋生誤解。統計學上定義之「層(stratum)」，必須符合觀察變項之變異數(variance)「層內變異最小、層見變異最大」之前提，其推算方法也不同。就本研究而言，顯然不符其假設；一般看見的「分層隨機抽樣」結果，也不符其推算方式。故本抽樣方法實爲按地理區域依家戶比例進行之「比例抽樣法」。

(3) 尾數隨機撥號

本研究將採用電話訪問。臺灣地區電話不登記比例，估計在都會已超過 50%，在鄉鎮地區也達到 33%-全體三分之一以上，亦即母群清冊不完整的情形相當顯著，若採用一般的電話簿抽樣法，將嚴重傷害抽樣隨機性與樣本的代表性。因此採用可涵蓋所有樣本的隨機撥號法，應有相當必要。在經過實證研究後，在各種隨機撥號法中，建議採用本研究者所發展的資訊系統隨機尾數法，而以單尾數或雙尾數爲優先適用。

本調查資訊系統所提供樣本資料庫，將以電話簿抽樣爲來源，以電話簿的區域碼(area codes)與群碼爲基礎，資料庫內含隨機尾數抽樣公式，可輸出末尾隨機雙數或單數，減少不登記者的誤差。

2、戶中抽樣:

(1) 戶中抽樣法的選擇

抽樣法的選擇，不外考慮「成本與效益」，故比較分析如下：

	優點	缺點	適用類型	成本
隨機戶中抽樣法	個人行爲重於家庭行爲 目標對象在家庭中爲多數	當目標對象在家庭中爲少數時，目標受訪者數必然比下述方法大幅減少，受訪者資料深度將降低。	選舉 大眾型產品市場調查	約爲下述方法的 2.7 倍。
訪問目標樣本法	家庭行爲重於個人行爲 目標對象在家庭中爲少數	採用本方法對「非目標受訪者」的資料精度預料將提高，但可能不是本研究最需要調查的問題。	網路使用 分眾型產品市場調查	

根據去年資料，合格網路使用者仍未達絕對多數，故本計畫建議：

網路使用行爲：採用訪問目標樣本法，如果戶中有 1 人以上使用網路，則一定要訪問到使用者之一。
選舉行爲：一定要使用戶中抽樣法，並實驗以下建議之「全戶訪問法」。

(2) 抽選與預約受訪者

如果家庭使用者不在，則使用 CATI 進行線上預約。

3、避免配額抽樣

由於採用戶中抽樣法的成本偏高，而不採用戶中抽樣有可能發生資料的偏差，所以不少調查機構採用的是配額法，就是規定訪員每訪問一定數量的受訪者時- 譬如２０人，必須有１０位男性、１０位女性；如果女性的配額已經滿了，以後只允許訪問男性。這是一種「看起來」好像很平均的方法，其實根本違背了基本的「白馬非馬」的邏輯與統計原理。抽樣如果具備隨機性，樣本所附帶的人口特徵，譬如性別等，就會自然符合正常大約１比１的分配，也就是具備了代表性。值得注意的是：隨機是「因」，人口特徵是「果」；反過來，則是不成立的，一半男、一半女組成的樣本，不一定有代表性。
當前不少 CATI 系統都是使用配額法，卻是一種不值得鼓勵的方法。

4、嘗試全戶抽樣

在檢討過各種抽樣方法之後，本研究者願意提出一個更基礎的問題：「爲什麼每個樣本家庭只訪問一個人？」爲什麼沒有在文獻上看過有人提出過這樣的問題？
也許是習以爲常，也許是早年以經濟爲主題的調查，譬如人口數、家庭財產…等，任意成人回答就可以了，造成了調查人員的習慣。只有在涉及個人態度與行爲的主題時，家中某１人的意見，代表性就會不足。
如果家庭已經是隨機抽出，那麼在調查個人化主題時，何不回歸以全戶成員爲訪問對象呢？就不存

在戶中抽樣的問題，而且，戶中抽樣究竟是增加了調查推論過程中的轉換程序，多一道手續，多少還是會影響原始樣本的隨機性。
當然，在實行全戶訪問時，可能有相當比例的家庭，不會全員在家，可能要預約、連續訪問好幾次，會增加時間與成本的負擔。但是，這方面和執行戶中抽樣的情形差不多。
而在本資訊系統的協助下，預約和連續訪問的處理可以大幅簡化，提高了全戶訪問的可行性。而且，在總樣本數不變下，每戶的受訪者增加，樣本家庭數則可減少，負擔不見得會增加。

因此，我們是否可以提出以下的假設：

總樣本數相同時，較少戶數的全戶訪問，其代「效益/成本」比優於較多戶數的單一受訪者訪問。亦即，假如調查１５００個樣本，５００個全戶訪問（假設每戶平均３人）的「效益/成本」比，優於１５００戶的單一訪問。

如果這項假設成立，很可能是調查工作的一項重要革新。
本研究者在１９９６年總統選舉中，首度以少量樣本實驗全戶訪問，初步應有可行性，但資料量尚不足以驗證其「效益/成本」的實況。其後尚無法作大規模的實驗，主要還是成本的問題。
本研究團隊如果獲得本次委託，樂意提供配合款，增加實驗樣本數，進行全戶抽樣與其他研究方法改善方式的對照實驗。

5、樣本數

影響樣本數的因素有兩類，第一類是數理統計的因素，包括：抽樣出入、抽樣把握、母群變異數和樣本資料型態。
當樣本爲隨機抽出，在某一臨界樣本數（依據人文社會科學的研究經驗，通常是 3000）以下時，樣本數愈大，代表性愈能明顯提高。不過，其間並不呈直線正比關係。同時，超過此一臨界樣本數後，樣本數即使再大，代表性提高的程度卻極微小。
決定樣本數的第二類因素，則是研究經費與調查成本的因素。
本研究故依據合理預算，規畫預訂達成每次「回應樣本數」爲 3000。

6、實驗對照樣本數

同時，本研究期望增加以比較研究方法爲目的的樣本 1000 份。
但因實施隨機尾數法，按照研究經驗「不存」比例相當大，一般在 20-35%左右，故預期更新後樣本數將超過 6000。
又，2004 年發生極爲特殊的情形，不知是否因爲國內電話詐欺事件激增，受訪者接到電話立即掛斷的情形比歷年暴增數倍，這種樣本不宜歸納爲「表態拒絕」，所以在「回應率」不合理偏低時，因視調查實況而增加回應樣本。
衡量以上各種因素，最後每次調查總樣本極可能超過 1 萬份。

7、誤差控制:

抽樣出入（誤差）與抽樣把握（信心水準）設計，根據研究預算與吳統雄的設計方法。約在 95%

的把握下，出入在 3%至 5%之間。
按，一般調查研究常逕以「二項分配的樣本數」中，p=q=.5 的情形來報告誤差，有可能不盡適當。因爲觀察變項是否爲「二項分配」？（通常均不是）是否屬於 p=q=.5 的情形？

8、不可替換樣本/延長訪問時間

本研究基於樣本代表性的考量，嚴格限制不得替換樣本。
鍥而不舍，連繫率達到 90%以上，即預訂達成存在樣本 4000，連繫樣本 3600 以上。
樣本選定之後不能輕易更換，但是電話訪問不免會遇到打不通的情形，過去（以及現在）的許多調查，便逕行替換部分樣本。這個作法其實會傷害資料的品質。
會發生打不通的原因，存在於兩個程序：
抽樣：抽出來的電話號碼不是家庭電話，尤其「隨機撥號」更容易碰到空戶。
訪問：沒有人接聽電話，或找不到適當受訪者。

因抽樣所發生的空號問題，屬於抽樣效率、作業成本的問題，空號的電話其實原來並不在母群範圍之內，所需要的是更新、補正式的替換，在理論上來說，並不影響樣本數與代表性的關係。
而在訪問過程中，如果只因爲找不到而替換，就影響了原始樣本平均受訪的機會，從而降低抽樣隨機性。尤其社會行爲變遷的影響，當前第一輪訪問能夠找到受訪者的情形，通常低於 25%，如果逕行替換掉 75%，對樣本代表性影響實在很大。
Deming 指出：替換樣本有增大樣本數的效果，卻不能完全避免因爲替換引起的誤差，更不能代替原始樣本。所以非不得已時--譬如經費考量，或調查重視的是「只分析樣本」，而非「推論母群」--不得更換樣本。
譬如說，抽出了 1000 個樣本，隨後替換了 750 個樣本，最後訪問了 1000 個樣本。這並不表示達成了 1000 個樣本數代表性的 100%，而只是 1500 個樣本數的 25%。
從統計來說，高受訪率、高品質的小樣本，代表性往往可能高於低受訪率、低品質的大樣本。可是對非專業研究人員而言，往往很難體會，而以爲樣本數愈大愈好。一遇到找不到受訪者，立刻就要替換樣本。同時，不可替換樣本法，由於必須鍥而不舍的追蹤，在人力、時間、經費…等成本上，比可替換樣本法要高出許多。對非專業研究人員而言，也往往沒有機會深思：爲何小樣本比大樣本的經費還高。（注[2]）
委託單位經常以爲投入了費用，就要看到源源不斷的樣本，事實上，化時間、經費去追蹤很難找到的樣本，效果可能更好。
另外，有的調查機構，對訪員採取論件計酬制，如果管理不善，訪員遇到難找的受訪者，也有可能任意替換樣本。
本研究以延長訪問時間、增加訪問時段、連續追蹤不易找到的受訪者的方式來提高連繫率，而不以

（注[2]）這種情形在調查實務上，問題特別大。譬如，作者所發展的選情預測方法，在１９９３年的縣市長選舉中，已廣爲各民意調查機構所採用。國民黨並在這次選舉後，開始採用民意調查作爲提名的依據之一，其所委託的研究機構主持人，就是擔任本研究者從前協同研究的同儕，亦聘請本研究者擔任顧問，協助建立調查系統，並以本研究的架構爲參考對象。

本文作者在校內所主持的公益研究，依然獲得準確的結果；但是，黨部的委託機構卻無法獲致相同的成果，發生了「複製力」的問題。也就是在理論架構之外，還有研究方法與研究執行的問題。其中最大的問題之一，就是替換樣本。

因爲訪問的第一輪，當時運氣最好的訪員，大概也只能接觸到半數的受訪者，按照調查規範，訪員就要停工準備第二輪。在場觀察的委託單位代表，便覺得不滿意，認爲是受託單位不夠努力，而有所抱怨。在這種壓力下，只好不斷替換樣本，打不通就換，愈換愈多，其實也就愈來愈不準。

增加替代樣本來腫大樣本數。

9、測量與問卷結構

調查問卷包括可供系列比較的主要結構與各年強調的特色。主要結構可分爲三部分，以測量不同的問題：

１、確認受訪者是否爲網路使用者。

２、使用者: 測量使用者對於網路及資訊的了解，及電子郵件的個數與地址。並區別其是否爲合格使用者，以符合本研究定義。因本研究之理論建構，就是要針對不同的使用者，預測模式才有較佳的預測力。

３、非使用者: 測量非使用者是否知道網路；測量是否具備相關的設備及潛在的動機成爲使用者及爲什麼；詢問爲何尚未成爲使用者，以及是否可能改變，爲什麼。

10、　測量變項選擇

有些調查樂於多問，但根據研究經驗，有些問題或選項的觀察值，很可能低於誤差值。

有些問題的知識背景要求較高，一般人可能不具備相當程度；有些問題涉及隱私，一般人也不願明確回答。這些問題即使獲得答案，可能也是冒充(pseudo) 資料。

本研究團隊建議，如發生以上問題，可考慮適當取捨，而將調查資源盡量放在可信、有深度的資料收集上。

11、　測量的文化意義

調查的問題爲態度問題時，國內一般調查都是使用５刻度的李克總加量表。但根據國內研究經驗，本研究者建議以使用百分刻度與百分評分法頗爲理想，而有以下優點：

（1）符合文化適域性

我國從小學開始，就實施百分評鑑法，而不同於國外的５等評鑑法。因此國人對百分法的內涵意義均十分清楚而敏銳：６０就是普通（及格），８０就是很好（或很贊成），９０以上就是非常好了，６０以下則是不好（或不贊成），５０以下很不好，３０以下更是非常不好了。

在這種文化情境下，較容易使受訪者態度與評分刻度呈現自然、與相互呼應的結果。

（2）容易評分與回答

傳統的評分法，在設計格式時係以視覺爲主，但在電話訪問中，如果反復詢問「您非常不贊成？很不贊成？不贊成 … …非常贊成？」，問不了三、四題，雙方頭都昏了。因此，宜改用適合聽覺的百分評分。

（3）可以區分「沒意見」和「不知道」

如果研究者想觀察真正的「中立態度」時，就是６０至６９分區間的受訪者。

另外，在答案中增加「不知道」的選項，反映真正「不知道」的受訪者。

在訪問過程中，形式上既然沒有中間分數，就不會發生以中間分數搪塞的系統性偏差，使不想動腦筋的人，無隙可遁，不致使中間分數太多造成統計困擾的情形。

但從科學的角度言，最好能夠有對照研究的機會，進一步證明本研究團隊的主張。可惜也是成本的因素，過去無法同時採用「全盤西化」的量表，和「適域文化」的量表。

這也是本研究團隊提出提供配合款的構想，增加實驗樣本數，進行這方面對照實驗的原因之一。

12、 預試、訪員訓練、訪員手則(FAQ)

問卷草案先召開專家會議審議、修訂。
再挑選 60 人，進行小型的預試，根據預試受訪者的反應，再次修訂問卷。
其次執行兩次訪員訓練，除熟悉訪問的目的、流程、問題與解決外，並練習國語、臺語訪問。
將訪訓過程中發現的歧議與共同解決方案，整理成「訪員手則(FAQ)」，以提升訪員信度。

13、 訪談與監察

方法：電話訪談
監察：執行線上監聽，以確認訪問者按照規範作業。

14、 電訪資源與人力

本研究團隊所屬的「世新大學民意調查中心」，是當前國內規模、人力最大的調查機構，歷史攸久，工作人員均有１０年以上的專業經驗，所從事過的研究案，在國內學術界、實務界當耳熟能詳。本中心有６０線訪問能力，常備資深訪員在１５０人以上。

（四）預期完成之項目

15、 General Adoption Model 部分

本節由國際團隊共同處理，故以英文陳述如下。

Having been conducted over a decade-long time frame, this work might be a rare successful forecast of adoption behavior. We have found a set of reliable variables and made longitudinally coherent measurements that complement previous marketing, management, communication, and other behavioral research. If this General Adoption Model is able to stand up to further testing, we may learn more from its generalization in the future, including:

Various Applications: It may help us to understand and forecast how people adopt a new product, a new service, a new idea, even a new person such as a candidate in an election campaign.

Threshold: If a new adoptee or innovation will fail, it will be gone before it reaches 5% adoption (the breakpoint at which fast adoption begins). For a new adoptee or innovation to be successful, it must have enough resources to sustain itself through the long fermenting adoption period to reach 5%.

Dynamic Adoption: The adoption behavior we studied is in an open system and continues forward. We need a dynamic and cumulative point of view to analyze the adoption process and to understand what happens to an existing adoptee under the General Adoption Model.

Planning Strategy: We need different strategies to deal with different adoption periods. For the fermenting period, it is the promotion of the new idea; for the fast growth period, it is promotion of the new adoptee itself; for the slow growth, it is the quality and peripheral services; for the passive period, it will be price, convenience, and ubiquity.

Investment and Expansion Strategy: We discovered how social factors, i.e. media coverage, promotional campaigns, etc., will increase the ambiance expectation and may accelerate the growth speed; however, it will have a long lag and create an initial false demand. Many past and current innovations, e.g., TV portals, have experienced dramatic rises-and-falls and have ultimately failed because of overoptimistic strategy and investment. This model suggests a better way of understanding how to collect and interpret relevant data in order to develop a careful strategy.

This General Adoption Model should be considered as a quantitative/hybrid model since it is highly correlated with two qualitative factors: ‘adoptee factors’ and ‘social factors’. There are still questions and that remain:

The population: Seed, medicine, IT, etc. are often targeted at special groups while TV, computers, the internet, etc. are targeted to everyone. Those differences require further deliberation and should be examined separately.

The adoptee: Different adoptees will produce different means and standard deviations; that is, the time frame will not be the same. We need more observations to examine whether there are good ways to determine ranges for the parameters.

The social factors: Though we found a significant variable ‘Media Coverage’ in this research, the other sources of social factors are still many and the design of appropriate measurements to analyze them will be very difficult.

Inferences: The highlighted cases 3 and 4 are logically inferred from our theory. Though they may look historically true, it

will be very difficult to design an empirical study to testing them.

We learn a very invaluable lesson from Bass. He made a significant improvement in his predictions; however, he missed the 'twin peaks' phenomenon because his observation timeframe was not long enough. Before we suggest that this General Adoption Model is indeed correct, we will consider three major issues which we discuss in the next section.

1) The Third Key Forecast

First, we have to continue to observe the progress of internet adoption to test the final key prediction. Though we have found the first and the second inflection points as forecasted, we will be unable to tell for several years whether the third inflection point will appear where we forecast. If it appears close to the position in case 1 or case 2 of our theory, it will significantly strengthen the credibility of our model and will provide a good set of parameters to help generalize the theory.

2) The Continuity of the Cultivation Effect

Second, we will attempt to further investigate the Cultivation Effect. We have found a highly-significant correlation of a four-year long Cultivation Effect for the past several years, and we will track it to see whether it will last as we forecast. Furthermore, we have hypothesized that the Cultivation Effect will affect Passive users; we need to investigate whether it indeed does affect Passive users' adoption behavior, i.e. whether the third inflection point will appear around the position in case 2. If so, it will be evidence of adoption behavior. In the long run, we hope to be able to parameterize media coverage and 'social factors' in the adoption process.

16、 國際合作部分

本研究將尋求何種國際級的研究成果，以及本研究的國際合作者，參與的程度爲何？
以下是美國喬治亞理工學院教授 Dave Goldsman，代表該校共３位合作教授的說明。

Dear Reviewers,

We would like to extend our research project and believe that our further questions are centered around two foci:

1. Why do we want to continue our research on the "General Adoption Model" and extend it to a "Covariate Adoption Model"?

2. What is the commitment and contribution of our international research team?

Before giving you my statement, I would first like to remark that I am speaking on behalf of my American colleagues with respect to participating this research.

I am a professor in the School of Industrial and Systems Engineering (ISyE), at the Georgia Institute of Technology. (ISyE has been rated as the top industrial engineering program in the USA for the past 16 years, and Georgia Tech is generally regarded as one of the top 3 or 4 engineering schools in the USA.) I am quite familiar with a number of prominent researchers in Taiwan, and I was recently lucky enough to be honored as an International Keynote Speaker at the NSC in Taiwan. In any case, in 2005, the School of ISyE reviewed Dr. Wu's research project on the "General Adoption Model" and invited him to campus as a NSC Visiting Scholar / Fulbright Scholar. I was his host and co-researcher during his visit from Sep. 2005 to Feb. 2006.

We had regular seminars and public presentations with faculty and graduate students during his stay. His presentations also drew the interest of my colleagues Dr. Joel Sokol and Dr. Craig A. Tovey, and they subsequently decided to join our research effort. We have carefully and thoroughly examined Dr. Wu's theory, methodology, and original data --- enough so that we have gained a thorough understanding of this research project and feel confident that we can contribute to its further development.

The reasons we want to continue our research on the "General Adoption Model" and extend it to the "Covariate Adoption Model" are the following:

1. A potential new paradigm

We have thoroughly reviewed the literature and have investigated a set of brand new quantitative modeling tools to predict human adoption behavior. One specific application area pertains to internet usage; and we have obtained a great deal of data in that domain.
According to our model, there will be three critical turning points in internet usage.
In fact, during the last decade, Dr. Wu successfully predicted the first two critical points --- a rare and surprising finding at the time. We believe we may have an opportunity to explore a potential new paradigm.

2. Complete empirical evidence of a behavioral cycle

We intend to continuously gather the data on internet users that will (hopefully) validate our prediction model. Indeed, we require complete and substantive empirical evidence to support the hypothesis that we have proposed an accurate new paradigm. Due to the obvious temporal characteristics of this line of behavioral research, we could not "run" or validate this research in the lab and could not collect the proper data in the short period that we were physically together in the USA.

3. Full-scale theory development

The ultimate objective of our research is to develop a full-scale theory of Adoption. We found that the internet usage data might support the fundamental finding of our "General Adoption Model". However, many adoption behaviors may involve some "pre-dominant interest" (i.e., ideology), and this has led us to propose a further "Covariate Adoption Model". According to previous relevant work of Drs. Wu, Sokol, and Tovey, we believe that voter behavior data will provide an excellent example on which to test this model.

Though we, the American colleagues, work in the field of classical industrial engineering, we are very interested in interdisciplinary approach. We certainly appreciate Dr. Wu's work, and we feel that it carries original initiative and convincing behavioral approaches from the scientific and statistical points of view. We also believe that Dr. Wu's long-term dedication is the key factor that may lead to new theoretical

results in behavioral studies.
Upon consideration of the above evaluation and involvement, we are pleased to commit ourselves to contribute to the further development of this research. Indeed, Dr. Wu, Dr. Sokol, and myself are currently working together closely to organize the current and (possibly) future findings in our internet usage work, and to prepare proper publications.
Dr. Sokol and Dr. Tovey will put in additional effort with respect to the next "Covariate Adoption Model" since they have already had experience in dealing with voters data.

We understand what we are doing is fundamental, structural work; and so it will be difficult to accomplish a "quick achievement". This is why we are now launching a "longitudinal devotion" to this research that may hopefully result in a significant research contribution.

To sum up, we believe this project has a great potential for substantial and meaningful international research collaboration. We are excited at what we have chosen to do and extremely pleased to work with Dr. Wu.

We sincerely make this request for your highest support.

Dave Goldsman
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附件 1 ：CIE 邀請函

這項研究的第一期成果，已在 36th International conference on Computers & Industrial Engineering 發表，並進一步獲選爲重要國際期刊 *Computers & Industrial Engineering* 的候選論文，邀請函如下。

Dear Tung-Xiung Wu:

On behalf of the organizers of the 36th International conference on Computers & Industrial Engineering held in Taipei, Taiwan, R.O.C. June 20-23, 2006. I would like to express our appreciation for your presentation of papers in the Conference. We enjoyed meeting with you during the conference.

The theme selected for the Special Edition of the *Computers & Industrial Engineering* based on papers from the 36th ICC&IE is *Challenges for Advanced Technology Industries*, which was also the theme of the conference. Based on the criteria of conformance with the theme of the issue and the quality of papers,

your paper as indicated below have been selected for consideration in the special edition.
Paper ID: CIE00565
Paper title: General Adoption Model and Cultivation Effect
Authors: Tung-Xiung Wu, Dave Goldsman, Joel Sokol and, Craig A. Tovey

We would like to invite you to submit a full length version of your work to the Journal for consideration for publication in the special issue of the journal edited by Professors U.P. Wen, S.L. Hwang, D.B. Perng and D.D. Sheu. The paper will be subject to the rigorous blind-refereeing procedure followed by the Journal.

Full papers have to be submitted through the new web-based Elsevier Editorial System (EES), according to the procedure described in the attached Word file, "Author Instructions for EES-CIE36." Please make sure you select "Special Issue" as Article Type and "ICC&IE 36-Taipei" as Section/Category. Instructions on how to prepare the manuscript are given in the "Guide for Author" on the EES website. Please follow the instructions carefully in order to avoid delays in processing your submission. The full papers have to be submitted by October 31th, 2006 to be considered for the special issue.

If you are interested in submitting your paper for the special issue, please e-mail your intention with a copy of your full length paper to Professor D. Daniel Sheu at cie2006@ie.nthu.edu.tw**.** Professor Sheu will acknowledge the receipt of your intention and full paper upon receiving your paper. **If we do not hear from you by that time, we will assume that you are not interested and your paper will not be considered for further processing.**

Thank you for your interest in Computers & Industrial Engineering and its conferences. We look forward to seeing you again in one of these gatherings.

Sincerely Yours,

Mohamed I. Dessouky, Ph.D., P.E.
Editor-In-Chief
Computers & Industrial Engineering: An International Journal