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Reconsidering Adoption Behavior: Models Beyond Diffusion

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Abstract

Classic diffusion theory is effective and useful at describing adoption of technologies or certain behaviors. However, innovation adoption is not the only kind of adoptive behavior. Communication specialists encourage the adoption of brands, fads, political positions and behaviors that may not necessarily be innovative. This paper discusses an alternative model for the adoption called resonance that is less sensitive to past assumptions. Resonance replaces prior models to describe adoption such as diffusion, critical mass and collective action. Resonance proposes two forces at work a motivating force and a receptive mass. The two work together to create the adoption event. The motivating force provokes the event and the receptive mass supplies the energy. The model is applied to a communication forum to make it more useful to telecommunication systems.

1. Introduction

Classic diffusion theory is effective and useful at describing adoption of technologies. However, innovation adoption is not the only kind of adoptive behavior. Communication specialists encourage the adoption of brands, fads, political positions and behaviors that may not necessarily be innovative. At the same time, the economics of communications has changed dramatically as industries deregulate and converge. Online communication systems continually lower the cost of adoption leading to changes in adoptive behavior not anticipated by current models.

It becomes more difficult to effectively apply traditional diffusion theory as key elements are removed. First, success can be defined as "enough" adoption rather than universal adoption -- even within a group. Second, critical mass of adoption need not occur within a specified time frame. Third, easy and perceptively cheap adoption opportunities lessen the importance of product characteristics.

This paper will reconsider the adoption process within a framework more in tune with current market trends. The goal is not to abandon current adoption studies but rather to enliven them by mixing alternative theoretical foundations. This paper will discuss an alternative model for the adoption that is less sensitive to past assumptions. The goal is to create a model that can be applied to more behaviors and technologies. Specifically, the model should be useful in information systems.

2. Classic Diffusion of Innovations

Diffusion of innovations and its sub-theories, dominate adoption literature for very good reasons. The model achieves an effective parsimony in design. At the same time, diffusion is rich enough in scope to permit multiple testing areas. The long tradition of research in this area makes diffusion one of the most thoroughly applied models in existence today.

Rogers [13] proposed a "diffusion of innovation" model most effectively with his seminal book *Diffusion of Innovations,* first published in 1962. The emphasis of diffusion was to describe the process by which innovations are adopted by a population. Key concepts, most often studied by others, include (a) attributes of the innovation, (b) adopter classes/ innovation life cycle, and (c) the innovation-decision process.

Attributes of the innovation include relative advantage, compatibility, complexity, trialability, and observability [15, p. 210-234]. Successful manipulation of these attributes should result in a greater chance of innovation success. For example, America Online offers 700 hours of its service free to enhance trialability. These attributes are useful for predicting which innovation or marketing plan would be most successful.

The innovation would go though an adoption life cycle complete with heterogeneous groups adopting at different times in the life cycle. The stages include innovator, early adopter (sometimes called early adapter), early majority, late majority and laggard [15, p. 247-251]. Most of the study in this area concentrates on the first two or three stages. The farther along an innovation is in the diffusion life cycle, the more likely it will succeed. This life cycle process tends to take on a normative, pro-innovation stance. For example, the first to adopt are innovators and the last are laggards. Later theorists developed the description of the innovator/early adopter process to enhance the model (see Critical mass section below).

Finally, a too often overlooked area of diffusion studies considers the diffusion process of individual decision makers. The individual might go through five stages in the process including (a) knowledge, (b) persuasion, (c) decision, (d) implementation and (e) confirmation [15, p. 163-195]. At each stage, an effective researcher or

marketer could find the factors to increase the likelihood of innovation adoption. Through these stages, Rogers effectively describes the opportunity for adopter class interaction. However, the model concentrates on information seeking behavior or opinion leadership.

2.1. Critical Mass

Markus [6] modified the traditional diffusion curve to allow for the possibility that non-adopters could affect adopters. Under this model, current adopters will not continue to use an innovation if others do not also adopt. After a finite period of time, if the medium is not adopted by a certain percentage of the community then current users will revert to another technology.

Critical mass is not a single theory so much as a general concept upon which theoretical models have been built. In many cases, it fails to rise to the "theory" level and is really simply an analogy. The original analogy refers to the term's proper use in physics -- the minimum amount of a nuclear fuel necessary for an explosive chain reaction. In practical use, "critical mass" can be defined as the minimum amount of some resource (people, money, etc.) needed before another condition or product explodes into existence. For example, Hiltz [4] suggested that there was a critical mass of participants needed for the success of a computer discussion forum. The physics analogy also acknowledges the idea that the mass is unstable and in a constant state of decay. If the minimum mass is not collected in time, that which has been collected is lost.

Critical mass enhanced diffusion by allowing for some critical changes. It allowed for reciprocal interdependence of heterogeneous adopter classes. It also left open the possibility of an adopter replacing one innovation (or service) for another. While these options were not excluded from diffusion, they were not as formalized. While adopter classes are theorized heterogeneous, most research focused on differences rather than interaction. At the same time, most work involved adopter classes interacting with society rather than with each other.

3. Collective Action

While diffusion studies dominated mass communications and business research, a second line of adoption studies developed in sociology and political science. Collective action research concentrated on the motivations of the individuals. While there is significant overlap, collective action took a relatively microeconomic perspective compared to diffusion.

The watershed book for collective action was Olsen's *The Logic of Collective Action* [12]. It considered what motivates an individual to participate in a group effort. Collective action involves situations where a group of previously unorganized individuals must work together to achieve some mutually desirable goal. One popular example is where a group of residents must work together to prevent the closing of a nearby school [8]. Another classic study was on the development of riots. Granovetter [3] attempts to predict the development or riots as a collective action. While riots may seem removed from information systems, the same forces are at work. Collective action studies assume that:

1 Participation requires cost or risk.
2 Non-participation will not require cost.
3 A common good may be produced without participation.

In collective action individuals must choose to invest in a common good. If successful, everyone will benefit from his or her effort. If not successful, only those that invested effort will lose. Essentially, collective action theorists look at situations where individuals must invest in an activity where they may never benefit. In addition, others that do not participate may benefit from the action. Non-participants who enjoy the common good are called "free riders" on the collective action.

For example, suppose a local radio disk jockey has been offending the community. A growing group may wish to get rid of him but how do they start? The effort will be time consuming and require a risk to one's personal reputation. It is also possible that the situation could resolve itself if left alone. A local minister is particularly interested and decides to lead the fight. Others choose to adopt the cause as well when their personal interest level is met. If the effort is successful, all interested will enjoy the departure of the disk jockey. If it is unsuccessful, those that participated will have wasted their time and damaged their reputation.

Collective action theorists assume that potential groups are made up of people that have different levels of the desire to participate [7] [9] and who elect to participate either through rational decisions [6] [11] or based on learned behavior [6]. Decisions to participate are based on a combination of perceived cost, anticipated value and personal interest [9]. Most collective actions are caused by action that originates with one person or a few people who plan a campaign and purposely draw others into it [10]. Participants become a part of an interest group desire a collective action, [7]. A collective campaign includes the activities oriented toward that goal while social movements are actions by people who can and do change their responses over time.

What is interesting about a collective action is how fragile or powerful it can be. Collective action describes events that can quite literally change the direction of a society. At the same time, the collective action can fail for the want of a single person. Since inclination to participate is dependant (in part) on a likelihood of success, Dick [2] observed that the lack of a single individual may doom a small collective action. The collective action could also be self-limiting. Oliver [11] effectively described a scenario where potential participants realize that they will not make a significant contribution to a collective action. As such, their motivation to contribute would decline.

Collective action studies do not consider alternatives to the CA. While opportunity costs are considered a part of the costs of a CA, these costs are simply considered the cost of doing "something else." Surely there is no discussion of joining riot A or riot B. Therefore; attributes of the adopted behavior are not well developed.

4. Linking it Together

What are the common elements between the two foundations?

Heterogeneous participation: Both foundations allow for heterogeneous levels of participation. In diffusion, adopter classes are described as distinct subgroups of the larger population -- complete with demographic and psycho graphic differences. Collective action theorists go further to postulate an individualize "inclination to participate." Some even use a formula to describe a rather mechanical decision making process based on an individual's perception of the potential adoption [9].

Adoption at a cost: Whether it is personal embarrassment or financial loss, both traditions recognize perceived costs as an inhibiting factor for adoption. For example, the main difference between innovators and early adopters in diffusion is the willingness to risk adopting an unsuccessful innovation. Collective action assumes people assess cost, benefits, and likelihood of success before adopting the group behavior.

Critical Mass: Critical mass is a term that comes most from diffusion literature. However, both traditions assume there is a threshold. In diffusion, that threshold happens to be societal. In collective action, each person has a threshold. Once a personal threshold is met, the individual adopts the behavior.

Levels of interaction: Diffusion allows for the possibility of information seeking behavior. This implies that an opinion leader could have a direct influence on the adoption decision of a later participant. Collective action tends to suggest a more passive level of interaction. In effect, the individual will look at other individuals who may or may not be participating in the collective action to see if their personal threshold has been met. This does not imply direct interaction but, at least, an awareness of others.

Time line: A required time line is implicit in collective action. There is, after all, a fine line between a riot and one rebel with a brick. If the brick is thrown and others join in, the rebel becomes a leader. If others do not join, the rebel is arrested. Still, establishing a time line is not center of collective action research. Diffusion has a rather strict timeline. Critical mass theorists formalize the deadline. Establishing the time line is explicitly researched.

Free rider: The free rider comes from collective action models. The free rider is the person that can enjoy the collective good without participating in the production. Diffusion researchers tend to believe that the free rider can be excluded from the innovation. Still, diffusion researchers' normative approach to adopter classes suggests resentment toward the laggard.

Many of these elements still hold true in practical applications. Despite earlier criticisms, these elements are all useful and should be retained in a new model. A single model that can unify all the above elements should be even more powerful.

5. Resonance

The goal of this study is to suggest a new framework for analysis. This new framework should take the best from diffusion, critical mass and collective action research. Goals for the new model include:

1 A more flexible timeline.
2 A greater sensitivity to the interaction between adopters.
3 An ability to consider smaller scale adoptions.

Since two of the previous models used an analogy to a process borrowed from the hard sciences, this model will as well. A more apt analogy for collective action is that of resonance. Academic American Encyclopedia Letcher [5] describes resonance as:

> *... the large absorption of energy and the resultant large amplitude of motion that occurs when a vibrating system is driven by an external force at its natural frequency of vibration.*

Resonance is a generalized concept used in many fields of study, including physics, electronics, quantum mechanics and chemistry. While individual readers may understand the term from the point of view of one discipline or another, for parsimony, it must be discussed in more generalized terms. In general terms, resonance is used to describe many systems that are dependent on waves of energy in a moving system.

The principles of resonance are at work when a person pushes a child in a swing; the greatest effect will be achieved for the least effort if the force is applied at the natural frequency of the swing and in phase with the motion. Two opposing forces - inertia and restoring force determine the resonance frequency. Inertia causes objects in motion to want to continue to be in motion. Restoring force causes the object to want to return to its resting state. Using a swing as an example, input energy drives the swing beyond its resting state. Inertia would cause the swing to continue away from its original position if it were not for the restoring force (i.e., gravity and a good sturdy rope). When the restoring force overcomes inertia, the swing moves back to its resting position but is carried by inertia beyond. In this way, the input energy activates a chain of forces - each reacting to one another. At resonance frequency, input energy only needs to overcome the mechanical friction of the system. Below resonance frequency, Input energy must overcome mechanical friction and the restoring force. Above resonance frequency, input energy must overcome mechanical friction and inertia.

In another example, resonance can be used to describe the relative ability of a musical instrument to produce sound. The instrument is a vibrating system and any such system would have at least one resonance frequency. Energy is applied to the instrument through air movement or vibrating strings. When energy is applied at the proper frequency and time (in phase with the output), the greatest output is produced for the expended effort. At resonance, output power reaches a peak for a consistent effort.

At resonance there should be qualitative changes as well as a quantitative. In a musical instrument, resonance

produces overtones as harmonic frequencies are excited. The entire tonal output becomes more complex and thereby changing the quality of that output. In a practical application, the successful adoption activity may seem to lose focus in resonance as used start to adapt the behavior.

6. The Resonance Model

The resonance model assumes that any successful adoption is comprised of two groups. First, a motivating force of people interested enough to lead. Second, a receptive mass that is ready to adopt *something* – not necessarily this adoption. If the motivating force successfully excites the receptive mass to action, the adoption activity is successful. The keys are the availability of receptive mass and the ability of the motivators to excite the mass.

The relationship between these two groups is more interactive than the normal opinion leader/follower relationship. The resonance model assumes an interaction between current and future adopters. The strength of the model should lie in the ability accommodate adoption. The interaction between adopters and non-adopters can accommodate adapt ion in two ways. First, on the individual level, those encouraging the innovative behavior must push adoption when the non-adopters are ready. There is an implicit assumption of a social negotiation that would demand adaptation. For example, the American cable channel MTV works very hard to be source of new fads. Still, it does not declare something cool and leave it at that. MTV's research department finds trends with an innate appeal to its demographic group [15]

Second, an interrelationship between past and future successes (or failures) suggests a continuous trial and error process. When Dick [2] studied online forum activity as a collective action, he found that almost all discussion areas had little to no activity. In this study, fifty-six percent of the discussion groups accounted for all of the activity. However, Further, Dick's results indicate a dramatic slope in the distribution where most of the real activity was concentrated in very few areas. If this pattern exists in general adoption behavior, most adoption research concentrates only on relatively rare instances where innovations approach success. For every innovation that gets studied, one thousand may have already been discarded. Adapt ion occurs by survival of the fittest. We can see this kind of adapt ion today in the various short messaging/instant messaging services -- each one upgrading to optimum quality. The goal should be to expect adaptation as a normal part of adoption.

6.1. Resonance and New Media

A key to the success of a new telecommunication service is a valid estimate of the potential market. Too often, universal adoption is the assumed standard for success [1]. There are good reasons. After all, a communication system cannot be effective unless there is someone with whom to communicate. The natural logic would be that a system is most efficient when everyone is using it. However, the pace of change is such that we cannot depend on universal adoption before obsolescence. Rather than striving for 100 percent market penetration, new communication systems should change their definition for success to be more realistic. There are several communications activities where even large-scale adoption is undesirable. The tattooed, body-pierced teenager might be horrified to find her parents joining in. In the same way, a citizen band channel is useless if everyone is using it.

Online discussion groups, or forums, provide the framework for our remaining discussion of adoption behavior. These discussion areas are popular on many services, and are seen as an important method for system owners to communicate with their audiences. At the same time, the forum requires the same forces of any adoption behavior. The forum requires shared adoption. There is uncertainty that adoption will yield benefits while it wastes time. As such, they are a reasonable starting point.

Online forums may be studied for a critical mass where the forum fluctuates around a specific level of traffic. A forum provides represents both a communication medium and a collection of individuals that must make a joint investment for a common good. The forum participant must adopt more than just the medium. They must also invest in a project that is only successful if others act in a similar way through replying to the messages. Collective action theory has been extensively developed but has suffered in field trials due to the inability to accurately record the collective action. Since forums records and archives from creation to degeneration, forums offer the researcher more choices in field trials of adoption behavior. What this means to the forum is: Forum leaders (motivating force) drive a previously non-involved group of individuals (receptive mass). The group produces its maximum output at or near a certain frequency.

If the driving force is removed or reduced, the group as a whole can lose its natural frequency and thereby the positive effects of resonance. The *quality* of the conversation is dependent on the *frequency* of the conversation (activity level).

Even though a simultaneous force is necessary, this force can be achieved, lost, re-achieved and even become too powerful. Forum leaders are in the position of tuning that force to the proper frequency.

Although the resonance model is used to replace critical mass, it augments the base established in collective action research. The model can be used to better describe the collective action process by dividing it into stages. Individual participation decisions still drive the growth of the collective action. Heterogeneity of participants is emphasized by the categorization of participants into separate classes.

6.2. Developing Adoption

In a study of forum activity [2], two critical break points were described. First, critical mass was described as the point at which there was a dramatic increase in the amount of activity. Second, critical saturation was used to describe the point at which activity was so heavy that there was a dramatic decrease in activity. Resonance can be defined as the period of time between these two criti-

cal break points. In the resonance model, these two points become two parts of a single condition. Critical mass becomes the lowest possible frequency of resonance. Critical saturation then becomes the point where the frequency of activity becomes detrimental to future activity going beyond resonance. While some simultaneous force is necessary, this force is not as dependent on a time period from an artificial starting point - such as the building of the swing. Resonance can be achieved as soon as the forces are marshaled. From this point on, the terms "critical mass" and "critical saturation" will not be used. The forum is either in a state of resonance or not.

6.2.1. The Motivating Force

Forum leaders become the motivating force, though not the only force in creating the successful adoption. Not only do they define the forum's environment, they supply the initial energy that activates the mass of potential participants (receptive mass). In this way they give the forum its direction and the mass of participants supplies a reactive energy that gives the forum its real activity. One of these two groups is not enough. The forum leaders reacting without the aid of the mass is similar to the musician attempting to perform without an instrument. The reverse might naturally be true except that leaders might naturally emerge from the mass and become the needed motivating force.

For a forum to become active, it is necessary to have a group of willing participants. Sheer quantity of participants is necessary but not sufficient to start the active forum. Assuming that there is a normal distribution of inclination to participate, the true success relies on the presence of those individuals with an unusually high inclination. A successful forum requires not just a number of people but the *actual people* willing to participate first. If even one of these people is missing, an otherwise active forum may languish. The group may be willing to participate, if only someone else would start. The leaders provide that initial energy necessary to activate the resulting mass. In this way, the actions of others are, to a great extent, dependent on them.

6.2.2. The Resonance Curve

In the resonance model, qualitative changes and quantitative changes happen together. The result is more of a life cycle model and can be broken up into several stages. Each stage will have its own unique characteristics and will be discussed below.

It should be noted however, that the model represent possible stages of the forum's life cycle *not necessary stages*. A forum may never leave the "quiet stage." The forum, in this model, must pass from quiet, to definition, to resonance but it may never achieve super-resonance. It is also possible that after recession, it can return to resonance. To emphasize the optional nature of these stages, super-resonance will be discussed after recession.

6.2.3. Quiet

The quiet stage of the life cycle can be viewed in one of two ways. First, it could be at a time in the forum before the driving force is applied. Second, quiet areas could simply uninteresting topics. Forum leaders do not often know what topics will be of interest to participants. Since resonance requires both leaders and a mass of participants, leaders do not wish to cut off an area that could be potentially active. These areas are trials that have not yet succeeded.

6.2.4. Definition

At some point prior to resonance, the forum should define itself and its market. Like the swing that is trying to overcome the restoring force, the forum is trying to become something other than inactive. To accomplish this, the forum must establish a direction. The definition stage is one where activity and interest level interact. The forum cannot be all things to all people any more than the swing can move in all directions at the same time. The forum will become more interesting to some and less interesting to others. The activity level of past participant affects the qualitative interest level of the forum.

If you assume incoming messages are valuable, then a mass of messages should increase everyone's inclination to participate. But that assumption does not consider a basic premise of resonance -- heterogeneity among participants. If users are truly different, then the values of certain messages are equally different. Messages should cause an increase in the inclination to participate for some users while a decrease for others. As messages increase, a conversation becomes more specific in both topic and level (intellectual, maturity, etc.). The activity will cause the forum to be more *in*teresting but to a smaller group of potential participants. In effect, the collective action is defining its market. This market definition is similar to an instrument being tuned to produce the strongest output (harmonic frequencies).

This portion of the life cycle is probably most similar the original critical mass model. Each system user is making individual participation decisions based on what they believe to be the potential rewards. Loyalty to the group has not yet been established so the restoring force continues to have its greatest effect.

6.2.5. Resonance

During the time of resonance, forum managers have successfully excited the group into action. The leaders' participation should become more enjoyable. The leaders may actually increase their activity (in relation to the rest of the group) at this point simply because it takes less effort and because their experience with the forum lets them know “where the action is.” The friendship of the mass of participants should increase as well because information is being exchanged freely and the participants are benefiting from the public good that has been created. At this point, loyalty should develop among participants. This loyalty allows the forum to continue even if there is a momentarily lose of resonance.

6.2.6. Recession

Oberschall [9] suggested that the successful collective action could be reversed by the loss of a minor percent-

age of the group. This idea can be included in this resonance model. For example, assume that summer starts and a forum leader leaves for other activities. Even if most participants are not affected by the change in season, all participants receive less interaction and the value of the forum drops. Since everyone's inclination to participate is equally reduced, other current users withhold participation and the probability of reward diminishes further. An active forum dies due to the introduction of a variable that may not even be important to even a majority of the participants.

Recession is the point when the forum loses its resonance frequency and drops to a level of relative inactivity. Since forum leaders are the driving force, they should be the first to leave at times of recession. Recession may, in fact be caused by their driving force running out of energy. This may be due to a loss of interest in the current topic and a desire to move on to other areas. Using the swing analogy again, recession would occur when the child grows tired or bored and moves on to other toys.

The mass of participants may experience an entirely different effect at the time of recession. Loyalty has been created in the group. Also, since leaders are most likely to be the first to send messages, the mass of participants is more likely to try to continue the topic (not yet bored). The energy originally invested by the leaders will remain for some time after resonance. Inertial energy provided by the receptive mass may push the forum back into resonance.

6.2.7. Super-resonance

Super-resonance occurs when activity exceeds resonance. At this point, management of the interaction should become more difficult because there is much more activity. Conversations should lose their focus and multiple topics should be present. Like the swing that wants to fly off away from the tree, the forum flies away from its center of interest.

Super-resonance may not be enough to kill forum activity but it may motivate participants to limit their contributions. Two separate effects may cause super-resonance. First, participants may simply be unwilling or unable to process too many messages at one time. Participants may find ways to limit their commitment to the group (e.g., put off responding for another time). Second, as Oliver [11] suggested, the forum may reach a point where participants feel they have little to add. In either case, forum activity should not be expected to exceed some maximum level - at least not for long.

7. Conclusion

We have already seen communication systems (e.g., citizen band radio, audio cassettes, and microfilm) that are successful on the own terms but will never be universally adopted. It is time to consider these scenarios as we consider adoption.

New opportunities to look at adoptive behavior are available today. This study presents the first attempt to develop this new model for adoptive behavior. The author believes it is time to start the discussion in a fresh direction. The first step is to lay a theoretical foundation rich enough for further study. The next step is to test past assumptions and those included in this model in light of the demands of current technology.

The model outlined above provides a rich basis for innovative study. First, adoption research needs to look at a greater variety of adoption behaviors. Second, researchers need to look the entire adoption lifecycle including the relationship between one adoption event and the next. Finally, greater attention needs to be paid to the dynamics of the adoption decision.

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