An Analysis of Theories of Diffusion

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Abstract: Diffusion is a special type of communication concerned with new ideas and is very important to bring about development in the society. For the proper dissemination of innovations, knowledge of the various theories is very important. There are many theories of diffusion which are applicable in the fields of agriculture, sociology and marketing. Among them the four theories given by Rogers are of prime importance in general and field of agriculture in particular. These theories are innovation decision process theory, individual innovativeness theory, rate of adoption theory and perceived attributes theory. Although every theory has a distinct rationale behind it but the universality of every theory is challengeable except the rate of adoption theory. This theory states that innovations are diffused over time in a pattern that resembles an S-shaped curve only universal.

Key words: Diffusion, innovation decision process, individual innovativeness, rate of adoption, perceived attributes theory

I. Introduction

Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. It is a special type of communication, in which the messages are concerned with new ideas. Diffusion is a kind of social change, defined as the process by which alteration occurs in the structure and function of a social system. When new ideas are invented, diffused, and are adopted or rejected, leading to certain consequences, social change occurs. Some authors restrict the term "diffusion" to the spontaneous, unplanned spread of new ideas, and use the concept of dissemination for diffusion that is directed and managed. (Rogers, 1983) The original diffusion research was done as early as 1903 by the French sociologist Gabriel Tarde who plotted the original S-shaped diffusion curve and by German and Austrian anthropologists such as Friedrich Ratzel and Leo Frobenius. Theories of innovation diffusion have been used to increase the adoption of innovative products and practices by a number of professionals. These professionals belong mainly to the disciplines of agriculture, sociology and marketing. Because it is realized that most of the innovations are not being utilized or were utilized to full extent.

A. Theories of diffusion

1. Laws of Imitation

Probably the first theory of adoption was given by Gabriel Tarde who was one of the forefathers of sociology and social psychology. Tarde observed certain generalizations about the diffusion of innovations that he called "the laws of imitation". According to Laws of Imitation

1. The more similar an innovation is to those ideas that have already been accepted; the more likely the innovation is to be adopted

2. Rate of adoption of a new idea usually followed an S-shaped curve over time. At first, only a few individuals adopt a new idea, then the rate of adoption spurs as a large number of individuals accept the innovation, and finally the adoption rate slackens.

3. An innovation is first adopted by an individual who is socially closest to the source of the new idea, and that it then spreads gradually from higher-status to lower-status individuals

Tardes' (1903) S-shaped curve is of current importance because "most innovations have an S-shaped rate of adoption". (Rogers, 1983) The variance lies in the slope of the "S". Some innovations diffuse rapidly creating a steep S-curve; other innovations have a slower rate of adoption, creating a more gradual slope of the S-curve. The rate of adoption, or diffusion rate has become an important area of research to sociologists, and more specifically, to advertisers.

2. The British and German-Austrian Diffusionists’ Theory

Another root in the ancestry of diffusion research was a group of early anthropologists that evolved in England and in Germany-Austria soon after the time of Gabriel Tarde in France. These anthropologists are called the "British diffusionists" and the "German-Austrian diffusionists." The viewpoint of each group was similar.
Diffusionism was the point of view in anthropology that explained change in a given society as a result of the introduction of innovations from another society. The diffusionists claimed that all innovations spread from one original source, which, of course, argued against the existence of parallel invention. They proposed that all social change could be explained by diffusion alone. The dominant viewpoint now is that social change is caused by both invention and diffusion, which usually occur sequentially. (Rogers, 1983) Rogers is considered as mentor of “Diffusion and Adoption” field who contributed with four theories of diffusion/adoption. These are:
- Innovation Decision Process theory
- Individual Innovativeness theory
- Rate of Adoption theory
- Perceived Attributes theory (Kumar and Singh, 2012)


Adoption is essentially a decision making process. Decision making is a process comprising a sequence of stages with a distinct type of activity occurring during each stage. Ryan and Gross (1943) were probably the first to recognize that the adoption of new idea consisted of stages. They distinguished between awareness of hybrid seed corn, conviction of its usefulness, trial acceptance and complete adoption of the innovation. Wilkening (1953) identified four adoption stages – awareness, obtaining information, conviction and trial, and adoption. (Rogers, 1983). Johnson and Haver (1955) gave the following steps of decision-making: (i) Observing the problem (ii) Making analysis of it (iii) Deciding the available course of action (iv) Taking one course (v) Accepting the consequences of the decision.

The North Central Rural Sociology Subcommittee identified five stages of the adoption process, which received world-wide attention. These are: (i) Awareness (ii) Interest (iii) Evaluation (iv) Trial (v) Adoption (Ray, 2006). Rogers initially abide by these five stages in his early work. But in later editions of the Diffusion of Innovations, he changed the terminology of the five stages to: knowledge, persuasion, decision, implementation, and confirmation. He described the innovation-decision process as “an information-seeking and information-processing activity, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation”. According to him the innovation-decision process involves five steps: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. These stages typically follow each other in a time-ordered manner.

![Fig. 1: Steps in adoption-diffusion process](image)

**Knowledge Stage:** The innovation-decision process starts with the knowledge stage. In this step, an individual learns about the existence of innovation and seeks information about the innovation. “What?”, “how?”, and “why?” are the critical questions in the knowledge phase. During this phase, the individual attempts to determine “what the innovation is and how and why it works”. Three types of knowledge is there: (1) awareness-knowledge, (2) how-to-knowledge, and (3) principles-knowledge.

**Persuasion Stage:** The persuasion step occurs when the individual has a negative or positive attitude toward the innovation, but the formation of a favourable or unfavourable attitude toward an innovation does not always lead directly or indirectly to an adoption or rejection. The individual shapes, attitude after knowing about the innovation, so the persuasion stage follows the knowledge stage in the innovation-decision process.

**Decision Stage:** At the decision stage in the innovation-decision process, the individual chooses to adopt or reject the innovation. While adoption refers to full use of an innovation as the best course of action available, rejection means not to adopt an innovation. However, rejection is possible in every stage of the innovation-decision process.
**Implementation Stage:** At the implementation stage, an innovation is put into practice. However, an innovation brings the newness in which some degree of uncertainty is involved in diffusion. Uncertainty about the outcomes of the innovation still can be a problem at this stage. Thus, the implementer may need technical assistance from change agents and others to reduce the degree of uncertainty about the consequences.

**Confirmation Stage:** The innovation-decision already has been made, but at the confirmation stage the individual looks for support for decision. This decision can be reversed if the individual is exposed to conflicting messages about the innovation. However, the individual tends to stay away from these messages and seeks supportive messages that confirm the decision. Thus, attitudes become more crucial at the confirmation stage. Depending on the support for adoption of the innovation and the attitude of the individual, later adoption or discontinuance happens during this stage (Rogers, 1983). According to Singh (1965), the stages of adoption are dynamic and not static. The same five stages do not occur with all the adopters and all the practices. Sequence is not always the same. Sometimes one stage appears more than once. In some cases some stages are too short as to be imperceptible, and in other cases some stages seem to be skipped. There are no clear-cut differences and sometimes the whole process is capsuled and look like a unit act. He gave the following stages: (i) Need (ii) Awareness (iii) Interest (iv) Deliberation (v) Trial (vi) Evaluation (vii) Adoption. Dodgson and Bessant (1996) recognize that ‘success’ in innovation is not simply a matter of moving a resource from A to B, but “the capability on the part of the recipient to do something useful with that resource”, in other words, to innovate effectively. Dodgson and Bessant acknowledge that innovation is not an “instantaneous event, but a time-based process involving several stages”. They have identified these stages as: (i) Initial recognition of opportunity or need (ii) Search (iii) Comparison (iv) Selection (v) Acquisition (vi) Implementation (vii) Long-term use (involving learning and development)

4. **Individual Innovativeness Theory**

In this theory the individuals are classified into different categories according to their innovativeness. This classification includes innovators, early adopters, early majority, late majority, and laggards. In each adopter category, individuals are similar in terms of their innovativeness: Innovativeness is the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system (Rogers, 1983). Braak (2001) described innovativeness as a relatively-stable, socially-constructed, innovation-dependent characteristic that indicates an individual’s willingness to change his or her familiar practices. Rogers categorized the adopters based on innovativeness as (i) innovators (ii) early adopters (iii) early majority (iv) late majority and (v) laggards.(fig. 2) Although this is a widely accepted theory but perhaps the most criticized also. If we talk about the consistency in innovativeness of an individual towards all the innovation, then Roger himself said that there is no clear-cut evidence as to whether or not innovating behaviour is completely consistent. He postulated however that it is doubtful whether and individual who is innovative in one aspect is laggard for another idea. But contrary to this we can find many examples where innovator of one aspect falls in other categories for other e.g. in package “programmes” in India, innovative behaviour was not shown towards all practices recommended in a package of practices for the given crop by the so-called innovators or early adopters of seed and fertilizer. Further the adopter categories also change over time as adoption categorization is similar to a snap-shot that pictures an individual at one time. He does not necessarily remain in the same position in a social structure at later point in time. So there is no general innovator or universal laggard for all innovations and over period of time as is often implicitly assumed by some diffusion researchers. (Chamala et al 1980). Based upon their research on different innovations, Siddaramaiah and Nithyashree (2005) give a new adopters’ categories and nomenclature. They divided the adopters into four groups named as: (i) **Pioneers** (ii) **Rationalists** (iii) **Imitators** (iv) **Murmurers**. As this model has identified two groups of adopter categories on either side of the mean, the distribution is said to be in equilibrium. Hence, the model is called as PRIM (E) model of adopter categories in which E means equilibrium. The first group, Pioneers consists of 15 per cent of adopters. They are venturesome and originators in testing and adopting any new idea they come across. The second group rationalists constitute a highest of 35 per cent is sensible and try to explain everything by reasoning. The imitators and murmurers are 32 and 18 per cent respectively. But there is nothing new in this model except the merging of first two categories given by Rogers i.e. innovators and early adopters.

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**Fig 2: Adopter categories**
Gill (1967) categorized adopters on the basis of speed (time taken) and extent (area put under practice) of the innovation. He found on this basis the innovators, early adopters, early majority, late majority and laggards were in the percentage of 3.12, 7.03, 18.75, 56.25 and 14.85 respectively.

5. Rate of Adoption Theory.

The third widely-used diffusion theory discussed by Rogers (1983) is the theory of Rate of Adoption. Rate of Adoption theory states that innovations are diffused over time in a pattern that resembles an s-shaped curve. Rate of Adoption theorizes that an innovation goes through a period of slow, gradual growth before experiencing a period of relatively dramatic and rapid growth. The theory also states that following the period of rapid growth, the innovation’s rate of adoption will gradually stabilize and eventually decline. He defined the rate of adoption as the relative speed with which an innovation is adopted by members of a social system. For instance, the number of individuals who adopted the innovation for a period of time can be measured as the rate of adoption of the innovation. The perceived attributes of an innovation are significant predictors of the rate of adoption. In addition to these attributes, the innovation-decision type (optional, collective, or authority), communication channels (mass media or interpersonal channels), social system (norms or network interconnectedness), and change agents may increase the predictability of the rate of adoption of innovations.

6. Perceived Attributes Theory

According to this theory there are five attributes upon which an innovation is judged: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability. Rogers (1983) stated that individuals’ perceptions of these characteristics predict the rate of adoption of innovations. Relative Advantage is the degree to which an innovation is perceived as being better than the idea it supersedes. The cost and social status motivation aspects of innovations are elements of relative advantage. However Burkman’s theory of a user-oriented instructional development (UOID) rejects the idea that technological superiority is a sufficient condition for the adoption of an instructional product. In UOID, the opinions, needs, and perceptions of the potential adopters are seen as the primary forces that influence adoption. (Burkman, 1987). Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters. Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use. As Rogers stated, opposite to the other attributes, complexity is negatively correlated with the rate of adoption. Trialability is the degree to which an innovation may be experimented with on a limited basis. Observability is the degree to which the results of an innovation are visible to others. In addition to these characteristics of innovation, Napier (1991) has given one additional attribute “predictability”. It refers to the degree of certainty of receiving expected benefits from the adoption of an innovation. Singh (1968) gave the following characteristics of innovation: (i) Cost (ii) Relative advantage (iii) Compatibility (iv) Complexity and (v) Risk. Supe (2011) mentioned that the innate characteristics of innovation are: (i) Cost (ii) Complexity (iii) Visibility (iv) Divisibility (v) Compatibility (vi) Utility and (vii) Group action However every author has logic for their ideas, but the most widely adopted characterization given by Rogers. But in practice many strange situations arise where in addition to these attributes we have to find other responsible characteristics of innovation. One such situation is when people encounter two or more innovations at a time which are perceived as similar as a whole. Let us say that three varieties of a crop are released at same time by different agencies or one agency or so. These were named as var A, var B and var C. Now some innovator farmers evaluated all the three on the mentioned attributes and these comes to be similar or perceived as equal in every aspect. Then to which variety one farmer will prefer? Either they will go on the trial of three or two or will choose one. Here what attribute does the innovation have which lures the innovator of a one variety. This is simply the “chance selection” of the innovation. We can define chance selection of an innovation as the probability of selecting an innovation among the set of equally perceptible innovations by the people. So in this way we can have one more factor associated with innovations i.e. chance selection.

7. Theory of Cultural lag

The term cultural lag refers to the notion that culture takes time to catch up with technological innovations, and that social problems and conflicts are caused by this lag. The term was coined by sociologist William F. Ogburn in his 1922. According to Ogburn, cultural lag is a common societal phenomenon due to the tendency of material culture to evolve and change rapidly and voluminously while non-material culture tends to resist change and remain fixed for a far longer period of time. Due to the opposing nature of these two aspects of culture, adaptation of new technology becomes rather difficult. Dr. James W. Woodward explained that when the material conditions change, changes are occasioned in the adaptive culture, but these changes in the adaptive culture do not synchronize exactly with the change in the material culture, this delay is the culture lag. Cultural Lag Theory suggests that a period of maladjustment occurs when the non-material culture is struggling to adapt to new material conditions (anonymous, 2014a).

Cultural Lag theory resonates with the ideas of Technological Determinism, in that it assumes that technology has independent effects on society at large. Ogburn posited four stages of technical development: invention, accumulation, diffusion, and adjustment.

(i) Invention is the process by which new forms of technology are created.
Accumulation is the growth of technology.

Diffusion is the spread of an idea from one cultural group to another, or from one field of activity to another.

Adjustment is the process by which the non-technical aspects of a culture respond to invention.

Fig 3: Adjustment in Cultural Lag Theory

Cultural lag creates problems for a society in a multitude of ways. The issue of cultural lag tends to permeate any discussion in which the implementation of some new technology is a topic. For example, the advent of bioengineering research has given rise to many new, potentially beneficial medical technologies; however these new technologies have also raised serious ethical questions about the use of bioengineering in medicine (anonymous, 2014 b).

8. Bass Theory

This theory was given by Bass (1969). The Bass model is the most popular model in the field of marketing. It is a mathematical model of diffusion. Bass model assumes that potential adopters of an innovation are influenced by two means of communication—mass media and word of mouth. In its development, it further assumes that the adopters of an innovation comprise two groups. One group is influenced only by the mass-media communication (external influence) and the other group is influenced only by the word-of-mouth communication (internal influence). Bass termed the first group “Innovators” and the second group “Imitators.”

There are certain assumptions of this model as under:
- Diffusion process is binary (consumer either adopts, or waits to adopt)
- Constant maximum potential number of buyers (N)
- Eventually, all N will buy the product
- No repeat purchase, or replacement purchase
- The impact of the word-of-mouth is independent of adoption time
- Innovation is considered independent of substitutes
- The marketing strategies supporting the innovation are not explicitly included

The Bass model proposes that the likelihood of purchase of a product at time ‘t’ denoted by \( L(t) \) is a linear function:

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L(t) = p + \frac{q}{N(t)}
\]

Where

- \( p \) = Coefficient of innovation (or coefficient of external influence)
- \( q \) = Coefficient of imitation (or coefficient of internal influence)
- \( N(t) \) = Total number of adopters of the product up to time t
- \( N \) = Total number of potential buyers of the new product

Fig. 4 The Bass model

9. Model of Eastlick and Lotz

Gatignon and Robertson’s model (1985) was constructed to explain the process of diffusion of innovations. This model assumes that the variables related to the intrinsic characteristics of each individual influence the process
of adopting innovation. Eastlick and Lotz (1999) given a improved version of that model. It was designed to investigate the personal characteristics, attitudes and habits of innovators facing adoption of new technologies.

The model of Eastlick and Lotz (1999) shows that the elements, which have a direct influence on the decision of adopting or non-adopting a new technique or technology, are:

- Attitude towards innovation. This attitude can be positive or negative depending on an assessment of innovation attributes made by the individual in question.
- Habits which, up till now, involve some usage behaviour and which should change as consequence of adopting a new system. Theory states that the more the new behaviour is close to old habits, its adoption becomes easier.

This model takes into account the interrelation between attitude and perceived risk. On the one hand, there are attitudes that people manage more easily felt risks than others and proceed with the adoption of an innovation. On the other hand, a high perceived risk may deter some individuals from adopting this innovation. This model also implies that attitude is formed under the influence of three factors: old habits, the innovative features of the person and the intrinsic characteristics of the innovation. (Gazbar, 2013)

10. Technology Acceptance Model (TAM)
The technology acceptance model (TAM) was developed by Davis (1989) to study intentions of adopting an information system. To the theory of innovation diffusion of Gatignon and Robertson, Davis has included two new factors: ease of use and perceived usefulness of the system. According to Taylor and Todd (1995), the practical usefulness of this model lies in the fact that the constructs "Perceived usefulness" and "ease of use" are the key factors for future adoption and use and on which the system designers have some degree of control. Ajzen and Fishbein (1977) consider that intent is the only determinant of the future use of the studied technology. Davis (1989) justifies this new feature referring to workplace reality where an employee may develop a negative attitude vis-à-vis a given technology but uses it anyway because he/she believes that it is advantageous in terms of performance.

According to Taylor and Todd (1995), the more technology is easy to use, the more useful it will be and more positive the attitude and intention to use it later are. The main feature of this model is that it brings about a small number of factors to explain the use of a technology and which are easy to understand and handle. These factors are specific but generalizable. (Gazbar, 2013)

11. Theory of Planned Behaviour (TPB): The theory of planned behavior (TPB) was developed by Ajzen (1991) which considers intention as a combination of three variables:
- The attitude adopted by a person before opting for a behaviour or action.
- The subjective norms imposed by social pressure which each individual faces in social environment and which dictate some course of action.
- The perception of control that each individual has on the adopted system and this in terms of their own abilities and available resources.
B. A retrospective analysis of the studies on theories of diffusion

The process of diffusion has been the main concern of all the extension professionals which is evident from number of adoption and diffusion researches being carried out across the world (Kumar and Singh, 2001). Diffusion research was started in Punjab during the year 1963, when Dhaiwal studied some important factors affecting the adoption of a few selected agricultural practices by the cultivators. Incidentally it was the first ever research study of the Department of Extension Education, Punjab Agricultural University, Ludhiana on record. He reported that practices even comparatively complex in nature and involving a high capital outlay, but showing an immediate and reasonable profit are adopted more readily than merely simple but otherwise less advantageous practices. Age of farmers, distance between village of residence from block headquarters was inversely associated to adoption, whereas economic status, farm size, education, social participation and extension contacts are positively associated with adoption. Adding to this, physical and economic factors were found to be the most important factors influencing the adoption of the improved practices (Bhasin, 1966). After this Gill (1967) categorized first time the adopters on the basis of speed (time taken) and extent (area put under practice) of the innovation. Previously only the speed was considered to categorize the adopters. He found on this basis the innovators, early adopters, early majority, late majority and laggards were in the percentage of 3.12, 7.03, 18.75, 56.25 and 14.85 respectively.

It was also tried to categorize the adopters on the basis of rationality and a study suggested that among the adopters there were four categories on the basis of rationality i.e. least rational, somewhat rational, rational and most rational. These categories existed in the percentage of 10, 40, 40 and 10 respectively. But it did not find relationship between adopters’ categories and rational categories (Hansra, 1968). Then a study pertaining to active adoption and active rejection which evolved that depending upon the nature of the innovation, there was existence of active adoption or active rejection or both in any community. The overall percentage of active adoption and active rejection was 19.8 % and 2.7% respectively. However the active adoption and active rejection was not uniform in different villages. Size of the village also did not affect the active adoption and active rejection. Some farmers were active adopter or active rejecter of one practice only whereas other were active adopter or active rejecter of group of practices. Further some active adopters were also active rejecter of some other practices concurrently (Khosa, 1968). Adding to the innovation characteristics theory, Singh (1968) given that the Cost, relative advantage, compatibility, complexity and the risk as the characteristics of innovation that affect the adoption. Risk was turned out to be most important and cost was least important characteristic of an innovation. Then it was observed that the extent of adoption of all of eight selected practices (method of application of fertilizers, dose of fertilizers, seed rate, method of sowing, use of micronutrients, wheat threshing, wheat varieties, and seed treatment) is significantly associated with the level of motivation of the farmers. Farmers having higher level of motivation were found to have higher level of adoption (Jassi, 1972).

Adoption of innovation was a function of rational (urban) values. A farmer who is predisposed to rational values is more likely to adopt innovations in farming. Emphasis upon individualism, activism, futurism and scientism were likely to be more conducive to change. In mechanized farmers the education level, size of holding, higher extension contacts, social participation, material possession, socio-economic status were higher than their counterparts (Singh, 1972). After this, Grewal (1976) found that among the adopters of high yielding wheat technology, 24 per cent were high adopters, 49 per cent medium and 27 per cent low adopters. Further the farm size, availability of production credits, level of knowledge, extension contacts, mass media behaviour and wheat enterprise efficiency index were found to be conspicuously associated with the adoption of high yielding wheat technology. One more study asserted that the knowledge about selected improved practices was having a highly significant and negative relationship with their perceived uncertainty in the adoption. Perceived uncertainty in the adoption of selected farm practices was positively associated with their perceived risk in the adoption. So the knowledge of farmers about improved farm practices plays a significant role in minimizing their perceptual uncertainty in the adoption of the improved farm practices (Verma, 1977). One astonishing fact was found by Nanda (1998) that there was no significant relationship between the age of adopters and non-adopters of the agroforestry. Recent study on diffusion theory revealed that although almost all of the adopters had passed through all the stages of adoption but the evaluation and trial stage was missed by 10 per cent and 15 per cent respectively in case of adoption of happy seeder in wheat crop. Whereas none of the non-adopter passed through all the stages and only 12.5 per cent reached up to trial stage and further they take more time than the adopters at each stage of adoption. (Singh, 2011)

II. Conclusion

Diffusion is a very important phenomenon which brings about the development in the society. All innovations don’t diffuse in the social system due to one or other factors. The diffusion of innovations can be studied by different theories, but there is not a single theory which could explain the process meticulously. Every theory has its own identity and importance but also have many shortcomings. It is due to the fact that diffusion of innovations is a very complicated process which is affected by so many variables like time, innovativeness, cost, individual preferences etc. Research concerning the diffusion of innovation process has increased significantly.
the past several decades due to its versatility. Despite so many differences a universality or similarity found amongst the various research studies on the diffusion of innovation process is that the adoption process or the rate of diffusion can be charted on an S-shaped curve. Apart from this commonality, exceptions are there for all of the theories.

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