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Technical Report

SOME CONCEPTUAL DESIGNS FOR UNDERSTANDING ADOPTION AND DIFFUSION PROCESSES IN ACTION

by

V. R. Gaikwad

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IIM AHMEDABAD

INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD

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Title of the report .....Some Conceptual Designs for Understanding Adoption and Diffusion Processes in Action.

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ABSTRACT (within 250 words)

This is the collection of some conceptual design for understanding adoption and diffusion processes in action. The topics covered are (1) Linking Individual adoption process with diffusion process in a community (2) calculation of AMO & NAR components under certain assumptions (3) variations in independent variables (4) Location of contribution of variables in adoption process or change inducing capacities of independent variables (5) information conversion capacity (6) the diffusion effect (7) Inter-link of rate of diffusion and rate of development of technology and (8) the key sources of information.

Please indicate restrictions if any that the author wishes to place upon this note ....

Date 5/8/74....

Signature of the Author

V.R.Gaikwad

CONTENT

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SOME CONCEPTUAL DESIGNS FOR UNDERSTANDING ADOPTION AND DIFFUSION PROCESSES IN ACTION

by

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There is no dearth of empirical studies on adoption and diffusion of innovations. However, in the absence of conceptual designs, efforts made to bring together the findings of these studies in a meaningful way have not been very successful. Furthermore, this lacuna is responsible to a great extent for a sort of stagnation; one sees study after study covering the same areas, following the stereotype methods, and bringing out more or less the typical results without breaking any new grounds. What is now needed is logical, conceptual designs which would encourage new questions, and open up new vistas for research. In this monograph some attempt is made in this direction.

I Linking of Individual Adoption Process with Diffusion Process in a Community

The diffusion process is generally defined as a process by which a new idea or practice is communicated from its source of invention or development to its ultimate users or adopters[1]. Adoption process functioning at individual level is a sub-process within the wider diffusion process which encompasses whole social system. Operationally, the two processes are interlinked. The duration of diffusion process (the diffusion period) is measured from the point of time the first individual is aware of innovation until it has reached complete adoption in a given social system[2]. Within this diffusion period each individual member of the community gets involved in the diffusion process, or 'enters' the process at a point of time, the point of 'entry'[3] being generally different for different individuals. The initial phase of involvement in diffusion process is the awareness of innovation. For an individual it is this **point of time when the** adoption process also starts simultaneously. Thus, adoption and diffusion processes are simultaneously in action at a common point of time when the individual first becomes aware of innovation.

The point in time when an individual enters the diffusion process, and also the duration of adoption period vary from individual to individual. The spread of entry points on a time scale makes diffusion process a socially dynamic phenomenon distinct from adoption process of an individual. For, if entry points of all the members in a social system are one and the same, i.e., when all the individuals become aware of innovation simultaneously, then the diffusion period would be equal to the longest adoption period time taken by a member in that social system.

The diffusion process is 'visible' in the form of ignorant individuals becoming aware of innovation and going through a sequence of stages. As such, it could be qualified in terms of number of persons moving from one stage to another (ignorance being the initial stage) at a particular point of time or within a given time slot. Since different individuals enter diffusion process at different points in time, and since the number of individuals entering the process also varies from time to time, the volume of change taking place in the community will be different at different points of time. Hence, understanding diffusion process would essentially mean understanding this continuous changing pattern of change.

Traditionally the process of diffusion is analysed only at a point of time giving only a static picture of a cross-section of this continuously changing phenomenon[4]. The following design provides a continuously operating method of analysis enabling us to plot movements from one stage to another at different points of time or during different time periods. covering the entire diffusion period.

To begin with the design is based on the following four assumptions:

1. The innovation remains unchanged throughout the diffusion period.

2. Adoption process is uni-directional and irreversible. It means that the individual moves from the state of ignorance and goes through certain stages as awareness, interest[5], trial, evaluation and ultimately adopts or rejects the innovation. Once the individual has reached a specific stage there are only two alternatives for him. In the course of time, either he remains at the same stage or moves forward to higher stages; he cannot go back to earlier stages. In this sense, the process could be considered as uni-directional and irreversible.

3. Stages in adoption process reached by different individuals could, in general, be determined by the relative points of entry of these individuals in the diffusion period. This, in other words, means that if A and B are two individuals (or groups of individuals), and if A is the first to be aware of the innovation, then there is a high probability of A reaching the subsequent stages in adoption process earlier than B. (It is also possible that the early starter may not always be the winner in adoption process. A late comer may skip a stage or stages and reach adoption stage earlier than early starter. Skipping of stage means individual has spent extremely short or no time at the intermediate stage).

4. Independental variables remain unchanged during the diffusion period.

Based on the above assumptions it could be seen that if individuals in a group are at different stages of adoption process, then within a time period, some would move over to higher stages, while some would remain at the same stage where they were at the beginning of the period. The former could be referred to as 'Affected Moved Over (AMO)' component, and the latter as 'Not Affect Residual (NAR)' component.

It is these two components at each stage whose numerical values change continuously throughout the diffusion period.

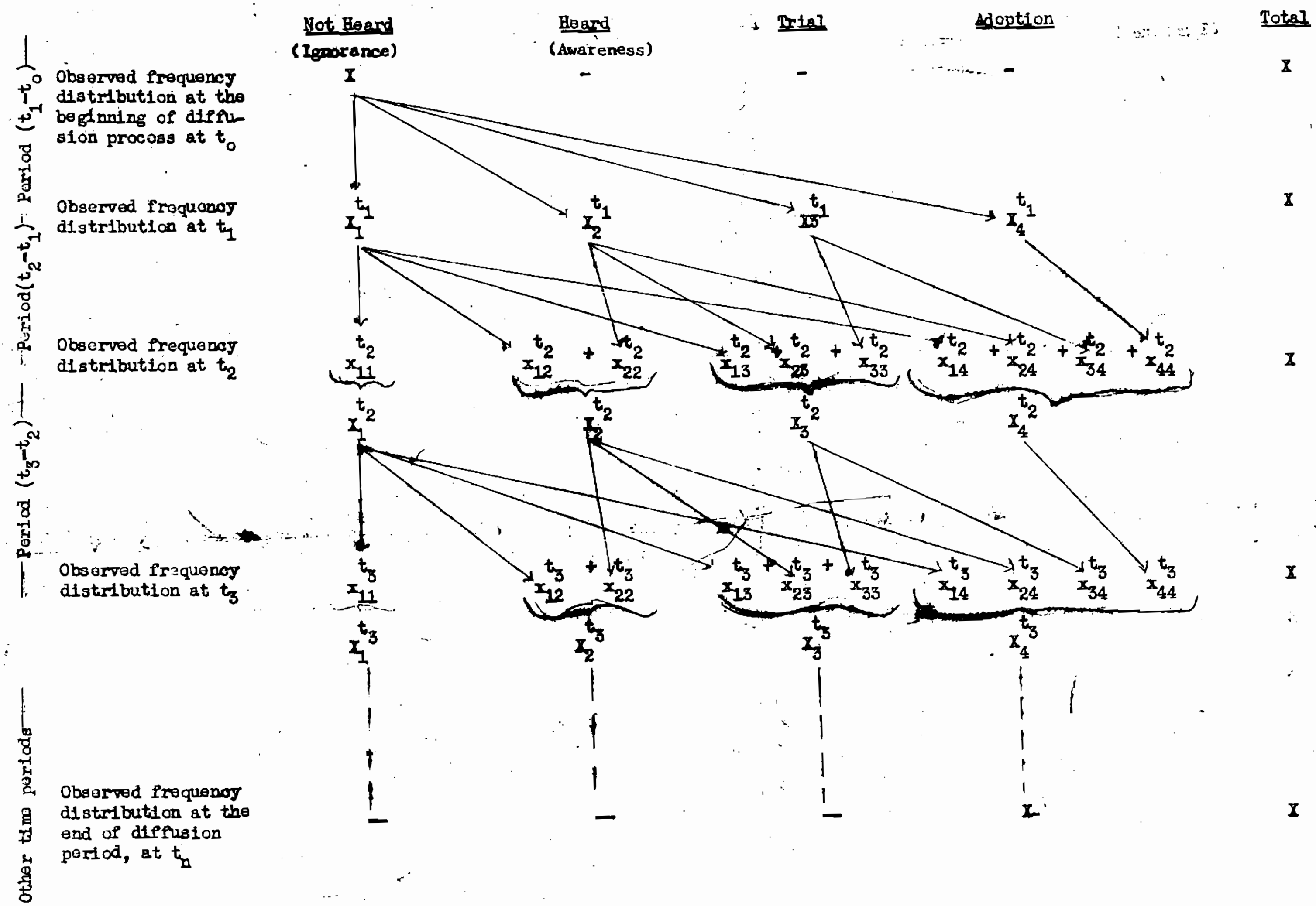
An important dimension of the AMO component is its span. By span is meant here the number of stages covered during a given time period by this component. Span tells us whether the individuals have moved over to next consecutive stage and have stayed there for some time, or directly to same higher stage skipping the intermediate stage or stages.

The movements of these two components are presented in figure 1.

Figure 11 Flow-Diagram of Adoption-Diffusion Process

Irreversible Adoption Process

Adoption of Stages*



*Any number of stages could be considered. Here for the sake of convenience only four stages are considered.

As shown in the flow-diagram, at the starting point t_0 of the diffusion process all the potential adopters (x) would be ignorant of the innovation. Only after a lapse of time $(t_1 - t_0)$ there would be individuals at awareness[7], trial and adoption stages. The observed frequency distribution of individuals at different stages of adoption process is $X_1^{t_1}$, $X_2^{t_1}$, $X_3^{t_1}$, and $X_4^{t_1}$.

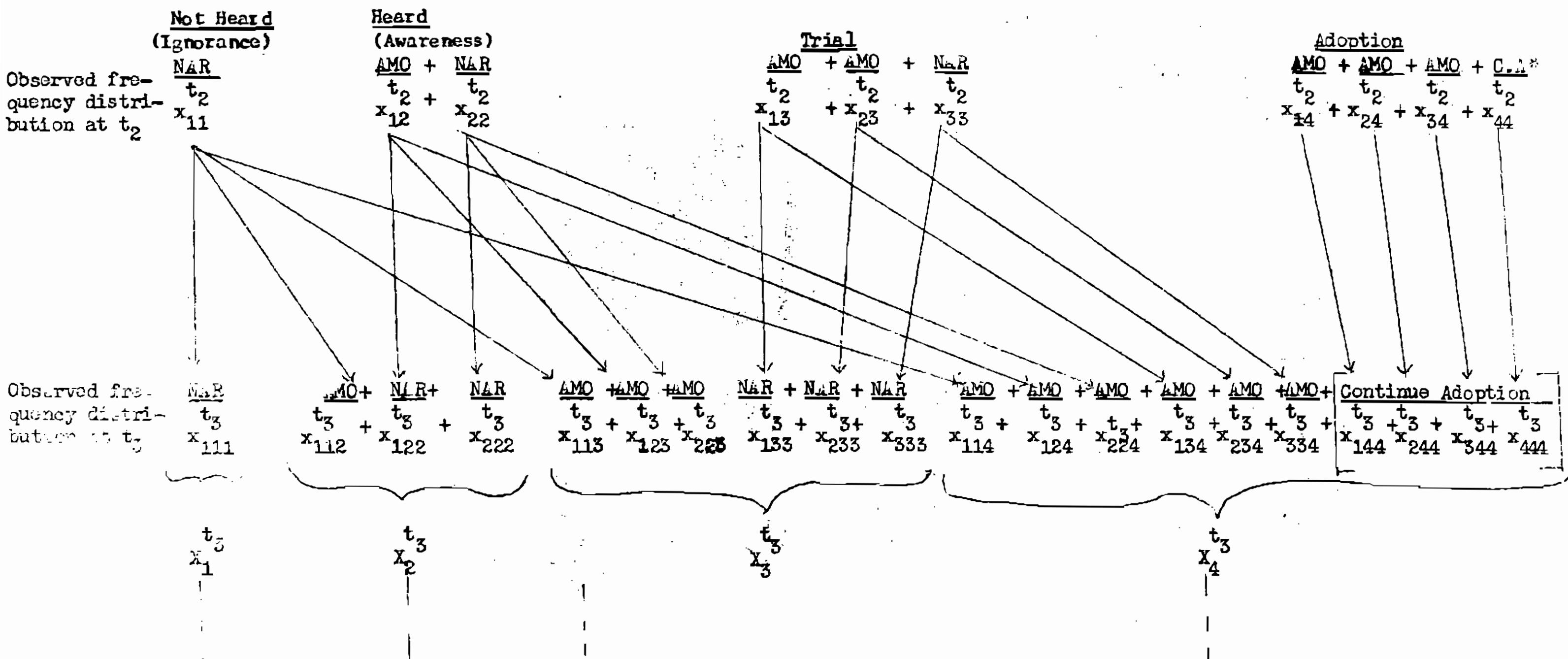
At t_2, that is at the end of another time period $(t_2 - t_1)$, $x_{12}^{t_2}$, $x_{13}^{t_2}$, $x_{14}^{t_2}$, $x_{23}^{t_2}$, $x_{24}^{t_2}$ and $x_{34}^{t_2}$ are the AMO components. And $x_{11}^{t_2}$, and $x_{22}^{t_2}$ and $x_{33}^{t_2}$ are the NAR components, and $x_{44}^{t_2}$ is the number of adopters who continue to be adopters. Here the first subscript denotes the stage from which they have come and the second, the stage to which they have moved. If the observed frequency distribution at t_2 is $X_1^{t_2}$, $X_2^{t_2}$, $X_3^{t_2}$ and $X_4^{t_2}$, then $X_1^{t_2} = x_{11}^{t_2}$; $X_2^{t_2} = x_{12}^{t_2} + x_{22}^{t_2}$; $X_3^{t_2} = x_{13}^{t_2} + x_{23}^{t_2} + x_{33}^{t_2}$; and $X_4^{t_2} = x_{14}^{t_2} + x_{24}^{t_2} + x_{34}^{t_2} + x_{44}^{t_2}$. It could be seen that in case of $x_{12}^{t_2}$, $x_{23}^{t_2}$ and $x_{34}^{t_2}$ the span is one stage, in case of $x_{13}^{t_2}$ and $x_{24}^{t_2}$ it is two stages, and in case of $x_{14}^{t_2}$ it is three stages. As shown in the flow-diagram the new distribution at t_2 again undergoes changes during the next consecutive time period $(t_3 - t_2)$, giving a new distribution at the end of the period. Such changes continue till the end of diffusion period, when the diffusion process would be over and all the individuals would be at the adoption stage.

In the above flow-diagram (figure 1) that at t_2 we have grouped the AMO and NAR components to get $X_1^{t_2}$, $X_2^{t_2}$, $X_3^{t_2}$ and $X_4^{t_2}$, and based on these combined frequencies we have shown the new distribution at t_3. If the AMO and NAR components are not combined at t_2 but are treated as separate components then we get a more accurate though complex picture of the diffusion-adoption processes as given in figure 2.

It could be seen that at t_3 the number x has three subscripts. The first subscript indicates the stage where these x number of persons were at t_1, the second subscript indicates the stage they were at t_2, and the third indicates the stage they are at t_3. Thus, it is now possible to trace the point of 'entry' of each individual in diffusion process and also trace his progress towards adoption in any given period or throughout the diffusion period.

The above discussion is based on our initial assumption that adoption is uni-directional and irreversible. So far, we have not considered the possibility of rejection or discontinuance of innovation. However, a person can reject innovation at any stage in the adoption process. He can also discontinue the use of innovation after adopting it for some time.

Figure 2: Flow-Diagram of Adoption-Diffusion Process for a Given Period



* C.A. = Continue Adoption

AMO = Affected Moved over Component
NAR = Not Affected Residual Component

Such a person cannot be again put under any of the stages in adoption process through which he has once passed. No doubt, he could be considered under the general "non-adopter" category. But, it must be realised that he is a very much different person compared to those non-adoptors for whom the adoption process has not even started (i.e. ignorants), or from those who are at different stages of adoption for the first time, and have yet to reach the ultimate stage of adoption.

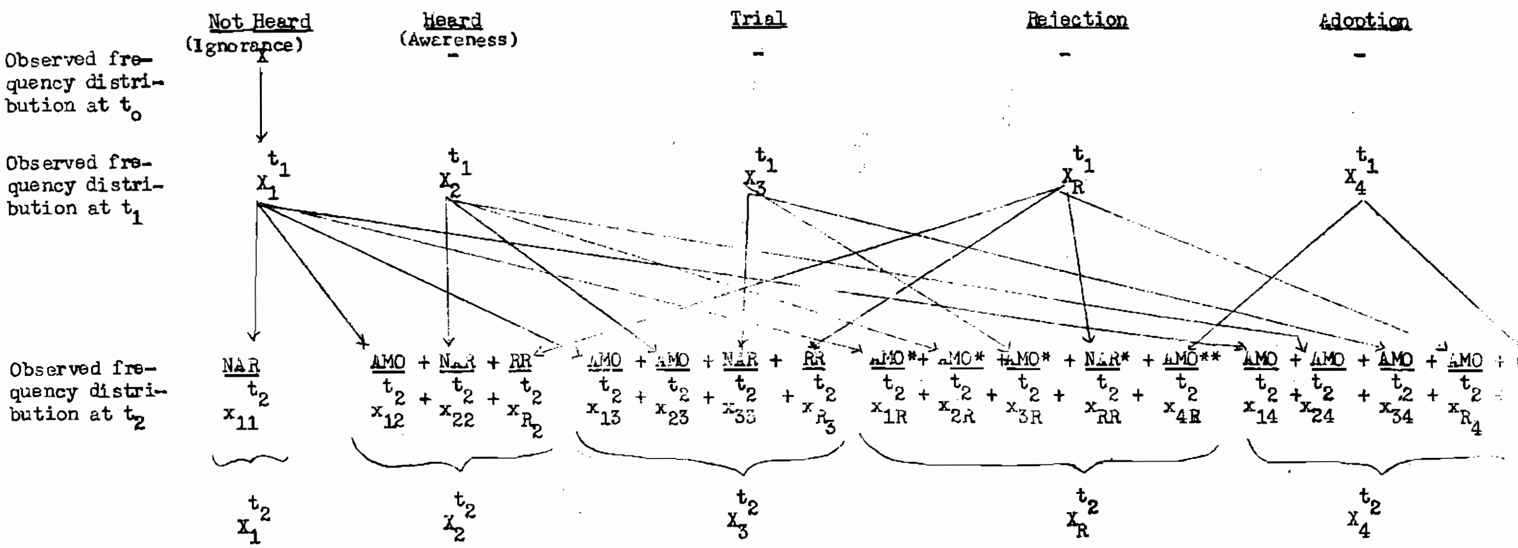
Again, in case of a person who has rejected the innovation at any stage, re-starting of adoption process is possible, if and when the rejector becomes aware of some new aspect or characteristic of the innovation which could be of benefit to him. For him the adoption process could again start though on a different psychological level. He might give another trial to the innovation before finally adopting it.[8]

Similar process is possible even in case of rejection after adoption. This revitalization of adoption process needs to be considered while developing designs for understanding diffusion process. We now have to add a new component, i.e., Rejectors Revitalised (RR) component. The movement of the three components namely, AMO, NAR and RR would be as shown in the following flow-diagram (figure 3).

II Calculation of AMO and NAR Components Under Certain Assumptions

Assuming that (1) the possibility of individuals moving ahead in the adoption process one stage at a time is the highest as compared to two or three stages, and (2) there is no rejection of innovation at any stage, it is theoretically possible to calculate the values of AMO and NAR components, given the distribution of total observed values at each stage at any two points of time in the diffusion period. The mathematical exercise would also indicate theoretically the span i.e., the number of stages the individuals should have moved forward in the time period. The necessary steps required to calculate the theoretical values of AMO and NAR components would be as follows:

Figure 3: Flow-Diagram for Diffusion-Adoption-Rejection-Discontinuance Processes



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*Affected moved over towards rejection — ** Discontinuance of innovation -- C.A. = Continue Adoption

Given the observed values at two points of time, that is at t_1 and t_2, as $X_1^{t_1}$, $X_2^{t_1}$, $X_3^{t_1}$, $X_4^{t_1}$ and $X_1^{t_2}$, $X_2^{t_2}$, $X_3^{t_2}$, $X_4^{t_2}$, respectively, as shown in figure 1, then the four equations known to us could be arranged in the following manner:

$$
\begin{array}{rcrcrcrcl}
x_{11}^{t_2} & + & x_{12}^{t_2} & + & x_{13}^{t_2} & + & x_{14}^{t_2} & = & X_1^{t_1} \\
 & & x_{22}^{t_2} & + & x_{23}^{t_2} & + & x_{24}^{t_2} & = & X_2^{t_1} \\
 & & & & x_{33}^{t_2} & + & x_{34}^{t_2} & = & X_3^{t_1} \\
 & & & & & & x_{44}^{t_2} & = & X_4^{t_1} \\
\hline
X_1^{t_2} & + & X_2^{t_2} & + & X_3^{t_2} & + & X_4^{t_2} & = & X
\end{array}
$$

In addition to these four equations we know that the number of ignorants cannot increase, hence $X_1^{t_2} \leq X_1^{t_1}$. Similarly, $X_4^{t_2}$ can not be less than $X_4^{t_1}$, since those who are adopters cannot be again non-adopters, hence, $X_4^{t_2} \geq X_4^{t_1}$.

If, $(X_4^{t_2} - X_4^{t_1})$ is the number of persons who have adopted the innovation during the time period $(t_2 - t_1)$ then, according to our assumption, this addition should be the AMO component from the previous stage i.e., trial stage. Whether such is the case or not would depend upon whether,

$$X_4^{t_2} - X_4^{t_1} \lesseqgtr X_3^{t_1}$$

which is the same as whether,

$$X_4^{t_2} \lesseqgtr X_3^{t_1} + X_4^{t_1}$$

If, $(X_4^{t_2} - X_4^{t_1}) < X_3^{t_1}$ then, we get,

$$x_{34}^{t_2} = X_4^{t_2} - X_4^{t_1}$$

$$x_{33}^{t_2} = X_3^{t_1} - (X_4^{t_2} - X_4^{t_1})$$

$$x_{24}^{t_2} = 0$$

$$x_{14}^{t_2} = 0$$

(For, if $(X_4^{t_2} - X_4^{t_1}) < X_3^{t_1}$, then $X_4^{t_2} - X_4^{t_1}$ i.e. $x_{34}^{t_2}$ portion of $X_3^{t_1}$ should be the <u>AMO</u> portion from trial to adoption, and $X_3^{t_1} - (X_4^{t_2} - X_4^{t_1})$, i.e., $x_{33}^{t_2}$ should be the NAR at the trial stage; Since $X_4^{t_2} = x_{14}^{t_2} + x_{24}^{t_2} + x_{34}^{t_2} + x_{44}^{t_2}$, substituting the value of $x_{34}^{t_2}$, we get, $x_{14}^{t_2} + x_{24}^{t_2} = 0$; hence, $x_{14}^{t_2} = 0$, $x_{24}^{t_2} = 0$).

Again, $(X_3^{t_2} - x_{33}^{t_2})$ is the <u>AMO</u> component at trial stage. According to our assumption of one stage 'span' it should come from heard stage.

Whether such is the case or not would depend upon whether, $X_3^{t_2} - x_{33}^{t_2} \lesseqgtr X_2^{t_1}$; or substituting the value of $x_{33}^{t_2} = X_3^{t_1} - (X_4^{t_2} - X_4^{t_1})$, whether $(X_3^{t_2} - X_3^{t_1}) + (X_4^{t_2} - X_4^{t_1}) \lesseqgtr X_2^{t_1}$. This is same as whether $X_1^{t_1} \lesseqgtr X_1^{t_2} + X_2^{t_2}$. (For, $X_3^{t_2} + X_4^{t_2} = X - (X_1^{t_2} + X_2^{t_2})$, and $X_3^{t_1} + X_4^{t_1} = X - (X_1^{t_1} + X_2^{t_1})$.)

Considering the three possibilities separately:

If $(X_3^{t_2} - X_3^{t_1}) + (X_4^{t_2} - X_4^{t_1}) < X_2^{t_1}$ i.e., if, $X_1^{t_1} < X_1^{t_2} + X_2^{t_2}$, then

we get,

$$x_{23}^{t_2} = (X_3^{t_2} - X_3^{t_1}) + (X_4^{t_2} - X_4^{t_1})$$

$$= (X_1^{t_1} + X_2^{t_2}) - (X_1^{t_2} + X_2^{t_2})$$

$$x_{22}^{t_2} = X_2^{t_1} - \left[(X_3^{t_2} - X_3^{t_1}) + (X_4^{t_2} - X_4^{t_1}) \right]$$

$$= X_1^{t_2} + X_2^{t_2} - X_1^{t_1}$$

and $x_{13}^{t_2} = 0$

If, $(X_3^{t_2} - X_3^{t_1}) + (X_4^{t_2} - X_4^{t_1}) \geq X_2^{t_1}$ i.e., if $X_1^{t_1} \geq X_1^{t_2} + X_2^{t_2}$,

then in both the situations we get,

$$x_{23}^{t_2} = X_2^{t_1}$$

$$x_{22}^{t_2} = 0$$

and $$x_{13}^{t_2} = (X_3^{t_2} - X_3^{t_1}) + (X_4^{t_2} - X_4^{t_1}) - X_2^{t_1}$$

$$= X_1^{t_1} - X_1^{t_2} - X_2^{t_2}$$

Again, $(X_2^{t_2} - x_{22}^{t_2})$ is the AMO component from not heard stage to heard stage;

If, $X_1^{t_1} < X_1^{t_2} + X_2^{t_2}$, then we get, $x_{12}^{t_2} = X_2^{t_2} - x_{22}^{t_2} = X_1^{t_1} - X_1^{t_2}$ (substituting the value of $x_{22}^{t_2} = X_1^{t_2} + X_2^{t_2} - X_1^{t_1}$) and $x_{11}^{t_2} = X_1^{t_2}$

If $X_1^{t_1} \geq X_1^{t_2} + X_2^{t_2}$, then we get, $x_{12}^{t_2} = X_2^{t_2}$ and $x_{11}^{t_2} = X_1^{t_2}$

Similar analysis could be continued considering the remaining two possibilities, viz., where $X_4^{t_2} - X_4^{t_1} \geq X_3^{t_1}$. The theoretical values of the two components at each stage, in terms of observed values, i.e. $X_1^{t_1}, X_2^{t_1}, X_3^{t_1}, X_4^{t_1}$ and $X_1^{t_2}, X_2^{t_2}, X_3^{t_2}, X_4^{t_2}$ at two points of time respectively at different stages, are summarised in Table 1.

Table 1: Theoretical Values of NAR and AMO Components at Different Stages in Terms of Observed Values at Two Points of Time

Nature of observed distribution / Components		$X_4^{t_2} < X_3^{t_1} + X_4^{t_1}$		$X_3^{t_1} + X_4^{t_1} \leq X_4^{t_2} <$	$X_2^{t_1} + X_3^{t_1} + X_4^{t_1}$	$X_4^{t_1} \geq X_2^{t_1} + X_3^{t_1} + X_4^{t_1}$
		$X_1^{t_1} < X_1^{t_2} + X_2^{t_2}$	$X_1^{t_1} \geq X_1^{t_2} + X_2^{t_2}$	$X_1^{t_1} < X_1^{t_2} + X_2^{t_2}$	$X_1^{t_1} \geq X_1^{t_2} + X_2^{t_2}$	
NAR	$x_{11}^{t_2}$	$X_1^{t_2}$	$X_1^{t_2}$	$X_1^{t_2}$	$X_1^{t_2}$	$X_1^{t_2}$
AMO	$x_{12}^{t_2}$	$X_1^{t_1} - X_1^{t_2}$	$X_2^{t_2}$	$X_1^{t_1} - X_1^{t_2}$	$X_2^{t_2}$	$X_2^{t_2}$
AMO	$x_{13}^{t_2}$	0	$X_1^{t_1} - X_1^{t_2} - X_2^{t_2}$	0	$X_1^{t_1} - X_1^{t_2} - X_2^{t_2}$	$X_3^{t_2}$
AMO	$x_{14}^{t_2}$	0	0	0	0	$X_4^{t_2} - (X_2^{t_1} + X_3^{t_1} + X_4^{t_1})$
NAR	$x_{22}^{t_2}$	$X_1^{t_2} + X_2^{t_2} - X_1^{t_1}$	0	$X_1^{t_2} + X_2^{t_2} - X_1^{t_1}$	0	0
AMO	$x_{23}^{t_2}$	$(X_1^{t_1} + X_2^{t_1})$	$X_2^{t_1}$	$X_3^{t_2}$	$X_2^{t_1} + X_3^{t_1} + X_4^{t_1} - X_4^{t_2}$	0
AMO	$x_{24}^{t_2}$	0	0	$X_4^{t_2} - X_4^{t_1} - X_3^{t_1}$	$X_4^{t_2} - X_4^{t_1} - X_3^{t_1}$	$X_2^{t_1}$
NAR	$x_{33}^{t_2}$	$X_3^{t_1} + X_4^{t_1} - X_4^{t_2}$	$X_3^{t_1} + X_4^{t_1} - X_4^{t_2}$	0	0	0
AMO	$x_{34}^{t_2}$	$X_4^{t_2} - X_4^{t_1}$	$X_4^{t_2} - X_4^{t_1}$	$X_3^{t_1}$	$X_3^{t_1}$	$X_3^{t_1}$

Note: X stands for observed values; x stands for NAR or AMO components as the case may be. Subscripts 1,2,3,4 stands for stages as follows: 1 - Ignorance, 2 - Awareness, 3 - Trial, 4 - Adoption; Under the column 'Components' the first subscript denotes the stage from which the persons have come, and the second the stage to which they have moved in the time period $t_2 - t_1$.

III Variations in Independent Variables

There is every possibility that during the diffusion period an independent variable itself may undergo certain changes. For example, at the beginning of diffusion process the individual may be young, uneducated, with small landholding, low participation, etc. However, over a period he would become older and may get education, increase his landholding, and participation in more institutions. On the other hand, he may, say, start with high participation in institutions, and high landholding, but during the period of diffusion he may lose one or both.

Traditionally, the adoption-diffusion studies consider characteristics of individuals as these are at the time of study and not what these were at the start of adoption or diffusion period, and at various stages.

If variations in the independent variables are considered then these may considerably affect the interpretation of data. This would specially be the case when the diffusion period for an innovation is of long duration.

Similarly, if an innovation, which has been introduced long time back, is the subject of study then the interpretation based on existing characteristics of respondents may lead to wrong conclusions.

There is other danger also. In a community in which an innovation has been introductive long time back, everybody is likely to be the adopter. Under such conditions the innovation ceases to be an innovation. In such a community the independent variables would not be associated with adoption. It would create serious problem of comparison when this community is compared with some other community where the same innovation has been recently introduced. Thus, for any meaningful comparison of communities it is necessary to keep in mind the time factor, i.e., when the innovation was introduced in each community, and the characteristics of respondents in relation to the time factor.

It could, thus, be seen that the three components AMO, NAR and RR whose numerical values change continuously during the diffusion period would be affected by the possible changes in the characteristics of independent variables during the diffusion period.

IV Location of Contribution of Variables in Adoption Process or Change Inducing Capacity of Independent Variables

In most studies dealing with adoption of practices the enquiry is often limited to the examination of the end product or final stage of the process with little or no effort to understand functions of different variables at different stages in the process. Excepting the four generalizations relating adoption stages with other variables, listed by Rogers[10] in his list of 52 generalizations, and a few studies examining the adoption process and the function of information sources, no major effort has been made in this direction.

The general approach in most of the adoption studies consists of isolation of individual socio-economic and other characteristics which are significantly associated with adoption of either a single practice on an index of adoption. Often efforts are made to understand the consistency with which the characteristics differentiate between adopters and non-adopters of a number of specific practices.

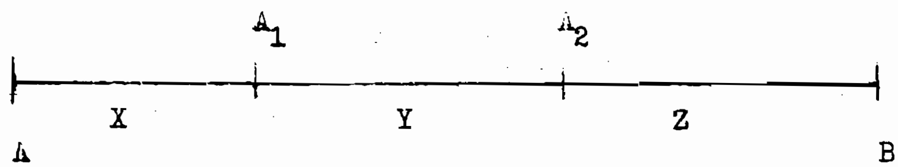
The relationship of independent variables with adoption is generally examined by using statistical tools such as chi-square test and pearsonian correlation coefficient method. In a number of studies the net contribution of each of the independent variables, when all others are controlled, is calculated by using the technique of highest-order partial correlations.

Such quantitative explanation alone of the individual contribution of variables does not, however, give a clear picture of the behaviour or functioning of these variables. This is because, even though the individual contribution of a variable is known, the location of this contribution in the process is not known. This means, it is not known whether the 'contribution' is scattered throughout the process or whether it is concentrated in certain stages of adoption process.

It will be of interest to know whether each independent variable, significantly associated with adoption, plays a distinct role in the adoption process. If it is known that the contribution of a particular variable is mostly at a specific stage or stages of adoption process only, then, it would help a great deal towards understanding of the role played by this variable in the process. Such understanding would further help in deciding priorities in the use of characteristics which are effective in inducing change.

To elaborate this point, let it be supposed that variables X, Y and Z are three independent variables which are mainly effective at the initial stages (AA_1), middle stages (A_1A_2) and last stages (A_2B), respectively, of the adoption process indicated by AB in figure 4. Under such a situation the effectiveness of variable Z, however large may be its individual contribution to adoption, will essentially depend upon the effective functioning of variables X and Y which, through their effective functioning at earlier stages, would create base for the functioning of variable Z. Similarly, the effective functioning of X would create base for the functioning of Y.

Figure 4



The above model indicates that no single variable (or a group of variables) would be effective unless a suitable base for its effective functioning already exists. While in the present model the effectiveness of three variables is assumed to be concentrated in three distinct regions of the process of adoption, it is likely that in actual practice, not all the variables would behave in this manner; the effectiveness of some of the variables is likely to be scattered throughout the process, indicating the possibility of the existence of some inherent inter-lined sub-characteristics in such a variable which, among themselves, have potential for creating base for further growth. It is also possible that combination of certain type of characteristics at certain stages in the adoption process may be detrimental to growth, even when individually, each characteristics has a potential for pushing the individual towards adoption.[11]

I

V Information Conversion Capacity

Adoption studies in India have stablished that rich farmers generally have high status, high participation in various institutions, and greater exposer to information. When they get the right kind of information through various media they use it and become more prosperous. The areas that needs to be explored are: (1) To be most effective, what kind of information, in what form, and in what 'quantity' should reach the weaker sections having meagre resources. II III

Right quality and quantity of information in proper form motivates a farmer to make better use of available resources and get better returns. It also helps him to generate better resources. In this sense, the information is a form of power or energy that is ultimately converted into capital or additional resources. In most cases the conversion from energy to capital requires a large quantity of catelytic agent, i.e., resources, without which the conversion can not take place. This means that either sufficient resources have to be provided simultaneously with information, or information has to be of such magnitude and in such form that it could be converted into future capital with smaller quantity of catelytic agent i.e. meagre resources.

High magnitude information cannot be 'tolerated' by a farmer with limited conversion capacity. Instead of motivating him, it would demotivate him, and also create frustration. Thus, it is necessary that studies on adoption cover this information conversion capacity of individual farmer or the community, as well as the step by step analysis of the conversion process.

The information conversion models that could be built are as follows:

	Condition	Input	Conversion		Output
I	$MI > CC$	Information (MI) →	Farmer (CC)	→	Grustration
II	$MI < CC$	Information (MI) →	Farmer (CC)	→	Dis-satisfaction, Indifference
III	$MI = CC$	Information (MI) →	Farmer (CC)	→	Increase in capital or resources and with it conversion capacity (CC) itself.

MI - Magnitude of Information; CC - Conversion Capacity of Farmer

If farmer's information conversion capacity (CC) is low, say CC_1, at t_1 time then the process that could be adopted is as follows:

Period	Condition	Input		Conversion
t_1	$MI_1 = CC_1$	MI_1	→	Farmer CC_1
				↓ output
t_2	$MI_2 = CC_2$	MI_2	→	Increase in CC from $CC_1 \rightarrow CC_2$
				↓ output
t_3	$MI_3 = CC_3$	MI_3		Increase in CC from $CC_2 \rightarrow CC_3$
				↓
				and so on

We can now link the conversion capacity model with the location concept developed in Section IV. It is clear that not only location and change inducing capacity of each variable or a combination of variables has to be studied, but also the relationship of the magnitude of these variables and combinations with the conversion capacity of the individual has to be studied.

VI The Diffusion Effect

Interrelation between the spread of knowledge about an innovation in a community and its rate of adoption is an area which has not been explored to any great depth. By spread of knowledge, we mean, the number of persons knowing or being aware of an innovation. The term 'spread' is preferred here to commonly used 'degree' of knowledge, because it is felt that degree indicates depth dimension, i.e., how much is known, and not how many know about it.

The spread of awareness at any given point of time indicates the effectiveness of communication media in action in a community. This is because the immediate result of communication is information. The first action in communication is to plant the idea. Once the idea is planted, that is, once an awareness is created by any process of communication, then such awareness has potential of generating interpersonal communication in a community and, ultimately, action at the individual and community level. Interpersonal discussion could be meaningful and fruitful when like-minded persons are aware of an innovation of common interest.

The discussions in a small group or community helps the individual in two ways. Firstly, since different individuals perceive an innovation in different manner, in the course of discussion each individual learns about different facets of the innovation and thus enriches his own understanding as well as of others. Secondly, the process of interpersonal discussion brings out the general feelings about the norms of the system which are likely to be disturbed if the innovation is adopted. And if the innovation is really 'attractive', such discussion also brings out socially acceptable ways of avoiding conflict with such norms. As Kalz has pointed out, "the function of interpersonal relations is not only to transmit information but to 'legitimate' decisions (or to veto them), as well as to provide the kind of social support necessary for taking innovative risks"[13]. That the interpersonal discussion helps the individual to come to decision about adoption has been emphasized by Lionberger, Hagerstrand, Katz and many others.

One of the connecting links between awareness and adoption could be shown thus:

Awareness → Interpersonal communication initially among those who became aware, and after adoption starts, including adopters → Influence exerted on individuals who are aware of innovation → Adoption

It could be seen that here interpersonal communication between the **'awared'** and ignorants, and between the adopters and ignorants is not considered. We have only considered interpersonal communication among those who are aware of the innovation, because the assumption is that adoption can only take place in this group of awared.

A normal relationship between the numerical values of ignorant, awared and adopters could be as follows:

Time	Ignorant	Aware	Adopter	Likely condition
to	N	-	-	N
t_1	a_1	b_1	-	$a_1 > b_1$
t_2	a_2	b_2	c_1	$a_2 > b_2 > c_1$
t_3	a_3	b_3	c_2	$a_3 = b_3 > c_2$
t_4	a_4	b_4	c_3	$a_4 = b_4 = c_3$
t_5	a_5	b_5	c_4	$a_5 < b_5 > c_4$
t_6	a_6	b_6	c_5	$a_6 < b_6 < c_5$
t_7		b_7	c_6	$b_7 < c_6$
t_8			$c_7 = N$	$c_7 = N$

Diffusion period

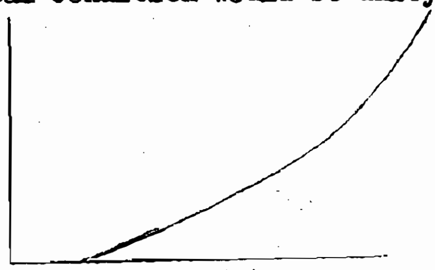
The spread of awareness in a community, which is a complex process in itself, depends to a great extent upon the degree of homogenity in the community. Our interest here is not in describing the spread of awareness, but in describing the relationship between the spread of awareness and is possibly effect on adoption.

Our assumption is that awareness is a prerequisite for meaningful discussion. If only one person is aware of an innovation and others are total ignorant there cannot be any meaningful discussion and hence no possible influence is generated at the initiation of such discussion. However, as the awareness spreads, say from one individual to other, there could be meaningful discussion between the two, possibly influencing both the persons. If two persons have received information from the same source or from different sources, and if they have a discussion the influence generated would be more since different facets of topic or innovation would be discussed.

The influence generated due to interaction between two persons could be considered as a unit influence. Or, such interaction itself could be considered as a unit of influence, since it affects the decision making. Under the condition where every single 'awared' or knowledgeable individual meets every other 'awared' or knowledgable individual, the possible units of influence would be $n \frac{(n-1)}{2}$, where n is the number of persons aware of innovation in a community at a point of time.

Under such condition the relationship between the number of persons aware of innovation and the influence generated by the free interaction among them is not linear but curvilinear and the curvilinear correlation coefficient under ideal condition would be unity.

Influence $\frac{n(n-1)}{2}$



Awareness (n)

It could be said from the above that as the spread of awareness in a community increases, influence on those who are aware also increases. This, in other words, means that when, say, only 5 per cent of the individuals in a community are aware of an innovation, the degree of influence upon a 'awared' individual to adopt (or reject) the innovation would be quite different from what it is when, say, 95 per cent have become aware of the innovation.

If interpersonal communication influence has a direct bearing on adoption, it follows that there should be correlation between the number awared and the number adopted, and this relationship is likely to be curvilinear.

Rogers has put these ideas in a much better form. He has used the term "diffusion effect" to define the system's self-generated pressures toward adoption. "The <u>diffusion effect</u> is the cumulatively increasing degree of influence upon an individual to adopt or reject an innovation resulting from the increasing rate of knowledge and adoption or rejection of the innovation in the social system."[14]

When the spread of information is low it may not generate sufficient influence or pressure for adoption. As discussed earlier, this may be because low spread is not likely to bring about (i) all the facets of the innovation, and (ii) true public opinion and ways of avoiding conflict with the existing norms. It follows that first socially acceptable adoption is likely to result only after a 'minimum' required number of persons in a community have become aware of the idea and discussed it. This threshold point is bound to vary from community to community, and for the same community from innovation to innovation.

It also follows from the above discussion that in case of an innovation, the subject matter of which is not usually discussed freely in a community (for example family planning practices), there may not be any diffusion effect. In such cases it would be necessary to first remove the taboos or inhibitions for discussion of the subject matter in the community before such effects could be achieved.

In our above measure of degree of influence, i.e., $\frac{n(n-1)}{2}$, we have assumed that even those who adopt as a result of influence generate further influence or pressure when these adopters interact among themselves. However, since adoption in the end result of influence, further interaction among the adopters themselves is of little consequence as it is not going to result in further adoption. (Though this may have some effect on the continuation of adoption). Hence, in the measurement of degree of influence we should consider interpersonal communication among those (1) who are only aware of innovation, and (2) between these 'awared' individuals and the adopters.

Thus in a community pressures would be generated under five conditions.

	Condition	Possible positive effect
(a)	Interaction between ignorant and 'awared' (including outsiders)	Awareness
(b)	Interaction between adopters and ignorant	Awareness
(c)	Interaction between those who are awared	Adoption
(d)	Interaction between adopters and awared	Adoption
(e)	Interaction between adopters	Continuous adoption

It is generally assumed that the number of adopters in a given period is determined by the number of those who have already adopted the innovation. It is, however, felt that once the initial process of adoption starts in a community after the initial breakdown of resistance and inhibitions, the rate of adoption should depend to a greater extent on the number of potential adopters, i.e., those who have become aware of innovation rather than on number of earlier adopters. Here again, it should be the interpersonal communication among the potential adopters, plus the interpersonal communication between the potential adopters and the number of adopters that should determine the number of new adopters.

VII Inter-link of Rate of Diffusion and Rate of Development of Technology:

For an adopter an innovation does not remain an innovation in a real sense after a sufficiently long time of continuous adoption. In case entire community has adopted the innovation for a long time, then ultimately the innovation gets the status of old traditional method. Hence, state of continuous adoption is potentially a state of ignorance with reference to next possible related innovation or modification of the existing one. As an initial assumption we can say that every society goes through a cycle of two time periods - one of diffusion period and the other continuous adoption period (Figure 4).

Figure 4

Diffusion Period	Period of Continuous	Diffusion Period	....(and so on)...
For Innovation 'A'	Adoption of 'A' or of ignorance with reference to 'B'	for Modified version of 'A'. i.e., 'B'	

Diffusion period varies from society to society, depending upon various socio-cultural and other factors. Similarly, period of continuous adoption would vary from society to society depending upon the rate of development of technology. The technological development could be indigenous or it could be borrowed or imported.

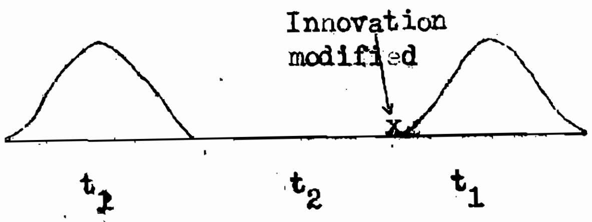
Rate of change and nature of change in a society would depend upon whether,

Rate of diffusion $\gtreqless$ Rate of development of technology.

If rate of diffusion is say (i) 50 per cent less, or (ii) 50 per cent more, or (iii) equal to rate of development of technology then theoretically we get the patterns of change in the society as shown in figures 5, 6 and 7.

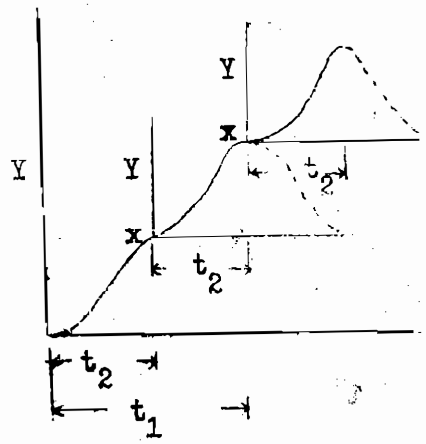
It could be seen that under conditions (i) and (iii) (figures 5 & 7) for the members of the society the adoption process for the modified innovation would start only after all the members have adopted the earlier innovation, while under condition (ii) figure 6, it could start before all the members have adopted the earlier innovation. Under condition (ii) our earlier assumption that the innovation remains the same throughout the diffusion period cannot stand. Once the innovation is modified then the adopters have two options: either they continue to follow the old one, or they could switch over to the modified version, and as such for them a new adoption process would start. Also, the leggards, who in respect of first innovation are

Figure 5



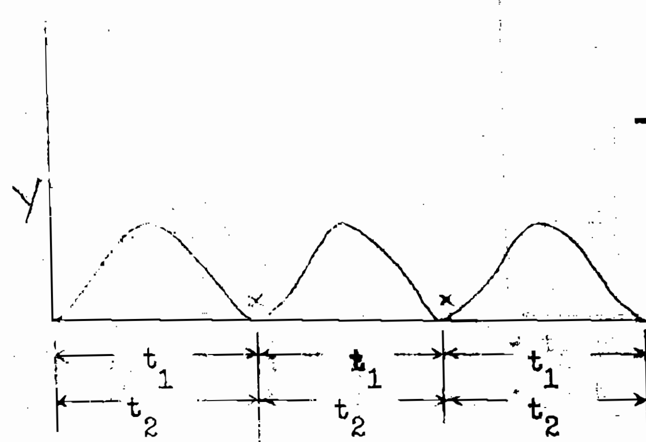
$\frac{t_1}{t_2} = 0.5$

Figure 6



$\frac{t_2}{t_1} = 0.$[illegible]

Figure 7



$\frac{t_1}{t_2} = 1$

t_1 = Diffusion period, t_2 = [illegible] Time after which modifications in Innovation take place;

y = Number of adopters

x = Point of time innovation modified

at different stages of adoption process and have yet to reach the adoption stage, have similar options; either they go through the adoption process with reference to old version, or they may switch over to the modified version of innovation. Modified version of innovation may also influence the earlier decision of rejectors.

So far we have assumed that the distribution of adoption is normal. However, if it is not normal but skewed to left or right, then the impact of differential rate of development of technology under different situations would give us a series of interesting growth models.

For example, let us assume that in a society the rate of development of technology is low. This would mean that entreprenures would have less chances of using new ideas. However, in the same society there are sections of population who have resources to get turn-key projects, or new ideas from abroad as soon as these are developed there. Due to various types of resources constraints the technology and new ideas would not diffuse quickly in the society, and the common entreprenures would continue to use outmoded and often inefficient techniques, and would produce traditional products. On the other hand those with 'borrowed' or turn-key projects would prosper creating a major gulf between them and the others. If the rate of development of technology within the society is high and resource constraints for the individual of low order, there would be less disparity in terms of growth in the society.

VIII The Key Sources of Information

New ideas and knowledge of new technology generally originate from various institutions of learning and research. These could also originate at the individual level without the institutional support. In initial period the ideas thus originated generally flow in their more or less pure form through various institutionalised media such as research journals, newspaper, bulletins, conferences and seminars, radio and television.

Once a new idea is fixed in the form of a product, information about it again flows to the ultimate consumer through various channels such as mass media (radio, television, newspapers, magazines etc.), instituionalised sources (the extension agency personnel and commercial agencies), and non-institutionalised sources (community leaders, web of friendship and family ties, word of mouth etc.). All these are closely connected circuits.

Traditionally, adoption-diffusion studies cover consumer's direct sources of information and do not cover the complete circuit.

The results generally indicate the percentage of consumers who learnt about the product or idea from institutionalised sources, from social circle and from mass media. A comparison of these (to find out relative importance of these channels) based on such percentages may not give accurate picture. To get an accurate picture it would be necessary to find out sources of these individuals (members of social circle) who have been mentioned by the respondent; And if some of these individuals again mention other individuals (friends, relatives, leaders etc.), then the sources of these other individuals, and so on.

In actual practice such tracing of the source circuits would be highly time consuming, and may not be even possible. However, under some assumptions, these practical problems could be solved to some extent.

If in a community X, Y, and Z, number of persons have mentioned extension agent, social circle and mass media, respectively, as sources of information, and if the sources of information of those mentioned by the Y number of respondents is X_1 , Y_1 and Z_1, then it could be assumed that ratio of $X_1:Y_1:Z_1$ would be the same as $X:Y:Z$. Similarly, the sources of information of those mentioned by Y_1 would be in the same proportion.

Foot Notes

1. E.M. Rogers, Diffusion of Innovations (New York, Free Press, 1964) p. 76

2. Ibid, p. 76

3. 'Entry' is not the appropriate word since it connotes conscious effort, i.e., as if an individual deliberately enters the process, which may not be the case. However, for the sake of convenience, the term 'enter' or 'entry' is being used here, keeping this limitation in mind.

4. According to Hagerstrand, "More is, however, known of the results of diffusion processes than the process in action. for the obvious reason that process of this kind are extremely hard to observe." See T. Hagerstrand, "Diffusion," in International Encyclopedia of Social Sciences, Vol. 4, 1968, pp. 174-77.

5. Rejection could take place at any stage in the adoption process. Discontinuous is the rejection of innovation after adoption. The process of rejection is examined separately.

6. These terms have been used earlier by the author in "Location of contribution of variables in Adoption Process," Behavioural Sciences and Community Development, Vol.3, No.1, March 1969, pp.23-27; and "Trends of change in Eight Indian Villages," BSCD, Vol.4, No.2, September, 1970, pp.92-127.

7. The time gap between ignorance and awareness is infinitesimal and hence impossible to measure. Only if we consider degrees of awareness and operationally define these in terms of degrees or levels of knowledge, there is any possibility of measuring the time gap between ignorance and awareness.

8. From this it could be hypothesised that awareness of all possible aspects of dimensions of innovation would reduce the possibility of rejection to minimum. This, in other words, means that a rejector is likely to be the one who is not aware of all possible aspects or dimensions of a basically sound innovation at the beginning of the adoption process.

9. Author acknowledges the help of Mr. S. Balkrishna, Jt. Director (Statistics), National Institute of Community Development, Hyderabad, in preparation of Table1.

10. Ibid, pp.311-314

11. Author has tried these ideas in his two papers - "Location of contribution of variables in Adoption Process," Behavioural Sciences and Community Development, Vol.3, March 1969, No.1, pp. 23.37; "Adoption Process and Change Inducing Capacities of Characteristics," Indian Journal of Agricultural Economics. Vol.XXIV No.1, Jan-March, 1969

12. E. Katz, Encyclopedia of Social Sciences, Vol. 4, 1968, p.179.

13. Katz has observed, "given an undifferential population, communicating freely and continually with one another, it is posssible to specify mathematically the properties of the growth curve that would describe the flow of innovation ... Such mathematical models have long been of interest to diffusion researchers (Trade 1890; Chapin 1928; Dodd 1958; Coleman 1964; Hagerstrand 1965)" Op. cit. p.183.

14. E.M. Rogers with F. Floyd Shoemaker, 'Communication of Innovations: A Cross-Cultural Approach, (The Free Press New York, 1971, Second Edition), pp.161-63.