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AUTHOR Silver, Wayne

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ABSTRACT

A description of the communication behaviors in high innovation societies depends on the application of selected principles from modern systems theory. The first is the principle of equifinality which explains the activities of open systems. If the researcher views society as an open system, he frees himself from the client approach since society generates its own innovation and diffuses it through internal processes. The second principle is mutual causation. The concept of mutual causation is crucial to an understanding of innovation diffusion in rapidly changing societies since it allows an examination of complex interdependent sets of communication behaviors. Finally, the notion of purpose in modern systems theory explains how open systems strike a satisfactory balance between deviation-amplifying processes, such as the diffusion of innovation, and deviation-counteracting processes. Through the exercise of choice, systems evolve in healthy fashion and avert the communication disintegration which Toffler believes is the inevitable byproduct of an accelerating rate of technological change. (Author/WR)

RECONCEPTUALIZATION OF THE DIFFUSION PROCESS: An application of selected principles from modern systems theory.

WAYNE SILVER

UNIVERSITY OF UTAH

WAYNE SILVER
UNIVERSITY OF UTAH

RECONCEPTUALIZATION OF THE DIFFUSION PROCESS: APPLICATION OF SELECTED PRINCIPLES FROM MODERN SYSTEMS THEORY

This paper initially outlines prevailing conceptions of the diffusion process or the communication of innovations from one individual to another in a social system over time. In their book, Communication of Innovations: A Cross-Cultural Approach, Rogers and Shoemaker catalogue most of the past research on the diffusion process and develop a paradigm to explain how innovations spread through various social systems.

Since past research deals primarily with the diffusion process in rural areas or peasant subcultures, Rogers and Shoemaker portray social systems as essentially closed and relatively impenetrable. Only through the efforts of professional change agents do innovations find their way into social systems and diffuse throughout general populations.

The client system in which change agents operate fosters a linear and mechanistic notion of communication and the diffusion process. While this interpretation, along with a structural classification of "adopters," explains the diffusion process in the societies to which Rogers and Shoemaker allude, it does little to explain communication behaviors in high innovation societies.

A description of the latter depends upon the application of selected principles from modern systems theory. The first is the principle of equifinality which explains the activities of open systems. If the researcher views society as an open system, he frees himself from the client approach since society generates its own innovation and diffuses it through internal processes.

The second principle is mutual causation. The concept of mutual causation is crucial to an understanding of innovation diffusion in rapidly changing societies since it allows an examination of complex, interdependent sets of communication behaviors.

Finally, the notion of purpose in modern systems theory explains how open systems strike a satisfactory balance between deviation-amplifying processes, such as the diffusion of innovation, and deviation-counteracting processes. Through the exercise of choice, systems evolve in healthy fashion and avert the communication disintegration which Toffler believes is the inevitable byproduct of an accelerating rate of technological change.

The last decade witnessed a "tremendous increase in research on the diffusion of innovations." (Rogers and Shoemaker, 1971: xvii) According to the same writers (1971: xvii) "Not only have the number of publications increased, but the nature of diffusion studies has become much more varied." In an effort to construct a useful model of the diffusion process, Rogers and Shoemaker (1971) derived numerous generalizations from a distillation of more than 1,500 reports of past research. The result of their efforts is a well detailed paradigm of the communication of innovations through certain channels over time among the members of a social system. (Rogers and Shoemaker, 1971: 18)

The purposes of this paper are to describe the central features of the Rogers-Shoemaker paradigm, identify its limitations and propose a new model to explain interrelated communication behaviors in rapidly innovating societies. The suggested reconceptualization draws upon selected principles of modern systems theory and data from Toffler's (1971) analysis of future shock.

THE ROGERS-SHOEMAKER PARADIGM

Rogers and Shoemaker summarized diffusion research dealing primarily with the communication of innovation in rural areas or peasant subcultures. The consequence of this focus is a conception of social systems as highly closed and relatively impenetrable. That is, initial conditions bind the social system and retard innovation by filtering out almost all information from the environment.

Since Rogers and Shoemaker consider their social systems essentially closed, it is only a small step for them to embrace the client system. The client system is one in which a professional change agent sponsors the diffusion of a particular innovation throughout a social system. The change agent operates within boundaries prescribed by a power elite which screens out all innovations harboring the potential to restructure the system.

The client system fosters a highly linear and mechanistic model of communication. According to Rogers and Shoemaker (1971: 23-24) "Communication is the process by which messages are transmitted from a source to a receiver. In other words communication is the transfer of ideas from a source with the viewpoint of modifying the behaviors of receivers. A communication channel is the means by which the message gets from the source to the receiver."

The diffusion process is correspondingly linear and mechanistic. Viewed fundamentally, "the diffusion process consists of (1) a new idea, (2) individual A who has knowledge of the innovation, (3) individual B who is not yet aware of the new idea and (4) some sort of communication channel connecting the two individuals."(Rogers and Shoemaker, 1971: 24)

Prevailing theory also posits a structural notion of the diffusion process. One of the basic units of analysis is the individual person within the social system, a person endowed with status, roles, personality traits and other characteristics which exist in space and over extended periods of time. In fact, the individual is a composite of "system effects" which influence his behavior and distinguishing traits that explain his attitudes toward innovation. As Rogers and Shoemaker (1971: 29-30) elaborate, "The basic notion of system effects is that the norms, social statuses, hierarchy, and so on, of social systems influence the behavior of individual members of that system. System effects are the influences of the system's social structure on the behavior of the individual members of the social system . . . . System effects . . .. may be as important in explaining individual innovativeness as such individual characteristics as education, cosmopoliteness and so on."

System effects and individual characteristics culminate in adopter categories. The criterion Rogers and Shoemaker use for adopter categorization is "innovativeness, the degree to which an individual is relatively earlier in adopting new ideas than other members of his social system." (1971: 27) The authors note that "research findings on the characteristics of adopter categories are summarized as generalizations under the headings (1) socio-economic status, (2) personality variables, and (3) communication behaviors." (1971: 185)

The remaining concern of diffusion process research lies in the time dimension. Rogers and Shoemaker (1971: 24-25) explain, "Time is an important consideration in the process of diffusion. The time dimension is involved (1) in the innovation-decision process by which an individual passes from first knowledge of the innovation through its adoption or rejection; (2) in the innovativeness of the individual, that is, the relative earlinesslateness with which he adopts an innovation when compared with other members of his social system; and (3) in the innovation's rate of adoption in a social system, usually measured as the number of members of the system that adopt the innovation in a given time period."

The rate of adoption varies in different parts of the social system. Rogers and Shoemaker (1971: 161) attribute this phenomenon to the "diffusion effect" which 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 . . . In other words the norms of the system toward the innovation change over time as the diffusion process proceeds, and the new idea is incorporated into the life stream of the system."

The diffusion effect and, therefore, the rate of adoption depends upon the degree to which individual members of the social system form communicative ties. Rogers and Shoemaker reason that "communication integration → diffusion effect → rate of adoption." The conclusion is that "the degree of communication integration in a social system is positively related to the rate of adoption of innovations." (1971: 164)

The preceding paragraphs reveal a pro-innovation bias on the part of diffusion process researchers. Rogers and Shoemaker (1971: 164) readily admit that "many past researchers implicitly assumed that adoption of innovations by their respondents is desirable behavior and that rejection of innovations is less desirable."

While the authors do not share this bias completely, the only qualification they make is for "overadoption, defined as the adoption of an innovation by an individual when experts feel he should reject." (1971: 164) In this case and all others, "objective rationality" weighs more heavily than "subjective rationality as perceived by the individual." (1971: 165)

A pro-innovation prejudice on the part of diffusion process researchers is not surprising. These researchers examine social systems which they perceive as change-starved and desperately in need of external influence. The client system is essential since it represents the only way that low innovation societies avert disaster.

How, then, do high innovation societies avert disaster? That is a question to which diffusion researchers do not address themselves. For tentative answers, it is necessary to fuse past research with selected principles of modern systems theory.

SELECTED PRINCIPLES FOR A SYSTEMS PARADIGM OF THE DIFFUSION PROCESS

The first of the selected principles of modern systems theory is equifinality which explains the activities of open systems. Bertalanffy (1968: 18) notes, "The steady state of open systems is characterized by the principle of equifinality; that is, in contrast to equilibrium states in closed systems which are determined by initial conditions, the open system may attain a time-independent state independent of initial conditions and determined only by the system parameters."

The principle of equifinality in open systems permits the researcher to view society as self regulating, evolving and independent of initial conditions. This conception is important to the researcher since it enables him to treat the diffusion process in terms other than the client system. The client system is no longer necessary nor even relevant since the system intakes information from the environment and generates innovation through deviant behaviors on the part of its members.

The assumption of equifinality also implies the inevitability of systemic flux. Unlike the societies described by Rogers and Shoemaker, the open system does not lie dormant until it is acted upon by external forces. It changes of its own accord and even alters the rate at which it changes and restructures itself.

The second principle of concern is mutual causation. According to Maruyama (1968: 304); mutual causal processes are those in which the elements influence each other either simultaneously or alternatingly. These processes entail positive feedback if they amplify deviance within the system and negative feedback if they counteract deviance.

In explaining positive and negative feedback cycles, Maruyama (1968: 311) points out "that the presence of influences in both directions between two or more elements does not necessarily imply mutual causation. If the size of influence in one direction is independent of the size of influence in the other direction, or if their apparent correlation is caused by a third element, there is no mutual causation." Feedback networks form a loop in which "each element has an influence on all other elements either directly or indirectly, and each element influences itself through other elements. There is no hierarchical causal priority in any of the elements." (Maruyama, 1968: 312) Negative feedback loops are deviation-counteracting while positive feedback loops are deviation-amplifying. Whether a "system as a whole is deviation-amplifying or deviation-counteracting depends on the strength of each loop." (Maruyama, 1968: 312)

In contrast, Rogers and Shoemaker base their picture of deviation-amplifying and deviation-counteracting processes on a linear notion of causality. To review, they posit a straight causal link consisting of communication integration → diffusion effect (which refers to diffusion of innovations, inherently a deviation-amplifying process) → rate of adoption. This linear scheme is far too simplistic to account for communication behaviors in an open system. Some of the elements in the scheme are helpful but only if they take the form of components in a system characterized by mutual causal processes.

A SYSTEMS PARADIGM OF THE DIFFUSION PROCESS

The components of the proposed systems analysis include:

1. Communication integration of technological innovators. This component refers to the degree to which scientists and other producers of technological innovation link together through communication ties or networks.

2. Communication integration of the general population. This component refers to the degree to which all members of a society link together through communication ties or networks.

3. Diffusion effect among technological innovators. This component refers to the cumulatively increasing degree of influence upon a technological innovator to accept an innovation, resulting from an increasing rate of knowledge and approval of the innovation in the specialized community of technological innovators.

4. Diffusion effect in the general population. This component refers to the cumulatively increasing degree of influence upon all members of a society to adopt an innovation, resulting from an increasing rate of knowledge and adoption of the innovation within the general population.

5. Rate of adoption by technological innovators. This component refers to the number of technological innovators within a system who accept, develop or improve an innovation in a given time period.

6. Rate of adoption in the general population. This component refers to the number of people within a society who adopt an innovation in a given time period.

7. Rate of technological change. This component refers to the number of technological innovations developed and introduced into a society in a given time period.

Relationships among these seven components form two mutual causal processes. Both of the processes are deviation-amplifying and both rely on an integration of traditional diffusion research and data extracted from Toffler's (1971) analysis of future shock.

The first of the two processes comes from Toffler's explanation of technology and communication in the scientific community. The central point of Toffler's analysis is that the development and use of technology by technological innovators increases the level of communication integration in that specialized community. Toffler notes, for example, that the accelerative curve in book publication crudely parallels the rate at which man discovers new knowledge. Today, "the number of scientific journals and articles is doubling, like industrial production in the advanced countries, about every fifteen years." (1971: 31) In addition, the computer's "unprecedented power for analysis and dissemination of extremely varied kinds of data in unbelievable quantities and at mind-staggering speeds" is a "major force behind the latest acceleration in knowledge acquisition." (Toffler, 1971: 31)

Toffler's relationship between technological innovation and communication integration in the scientific community permits a recasting of the linear process: communication integration → diffusion effect → rate of adoption. The process becomes mutual causal and deviation-amplifying as Diagram 1 demonstrates. In the diagram, the arrows indicate the direction of influences. Plus signs indicate that changes occur in the same direction, but not necessarily positively. For example, the plus sign between the diffusion effect among technological innovators and the rate of adoption by technological innovators indicates that an increase in the former causes an increase in the latter. But, at the same time, it indicates that a decrease in the former causes a decrease in the latter. Minus signs indicate that changes occur in opposing directions and that the connected components are inversely variant.

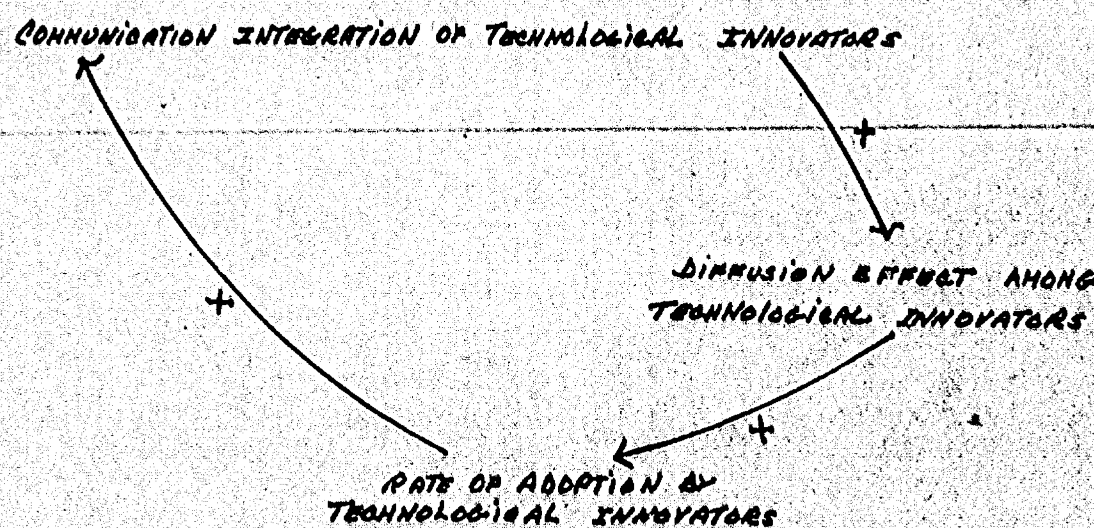

DIAGRAM I

This feedback cycle generates another by producing an accelerating rate of technological change. The premise is that an increased rate of adoption by technological innovators spawns a commensurate increase in the development of technological innovations as well as their rate of introduction into the general population of our society. As Toffler suggests (1971: 26) "Technology feeds on itself. Technology makes more technology possible. . . ."

To follow Toffler further, an accelerating rate of teonological change decreases communication integration in the general population of our society. He explains "This is why it often seems to us that our society is cracking at the seams. It is. Where once there stood 1,000 organizational entities, there now stand 10,000 - interconnect d by increasingly transient links. Where once there were a few relatively permanent subcults with which a person might identify, there now are thousands of temporary subcults milling about, colliding and multiplying. The powerful bonds that integrated industrial society . . . are breaking down." (1971: 300-301)

As communication integration decreases in the general population, so do the diffusion effect (although the rate of introduction of innovations continues to accelerate) and the rate of adoption. A lowered rate of adoption leads to a still lowered level of communication integration through decreased acceptance of social control and the dangers of overindividualization. The complete system appears in Diagram II.

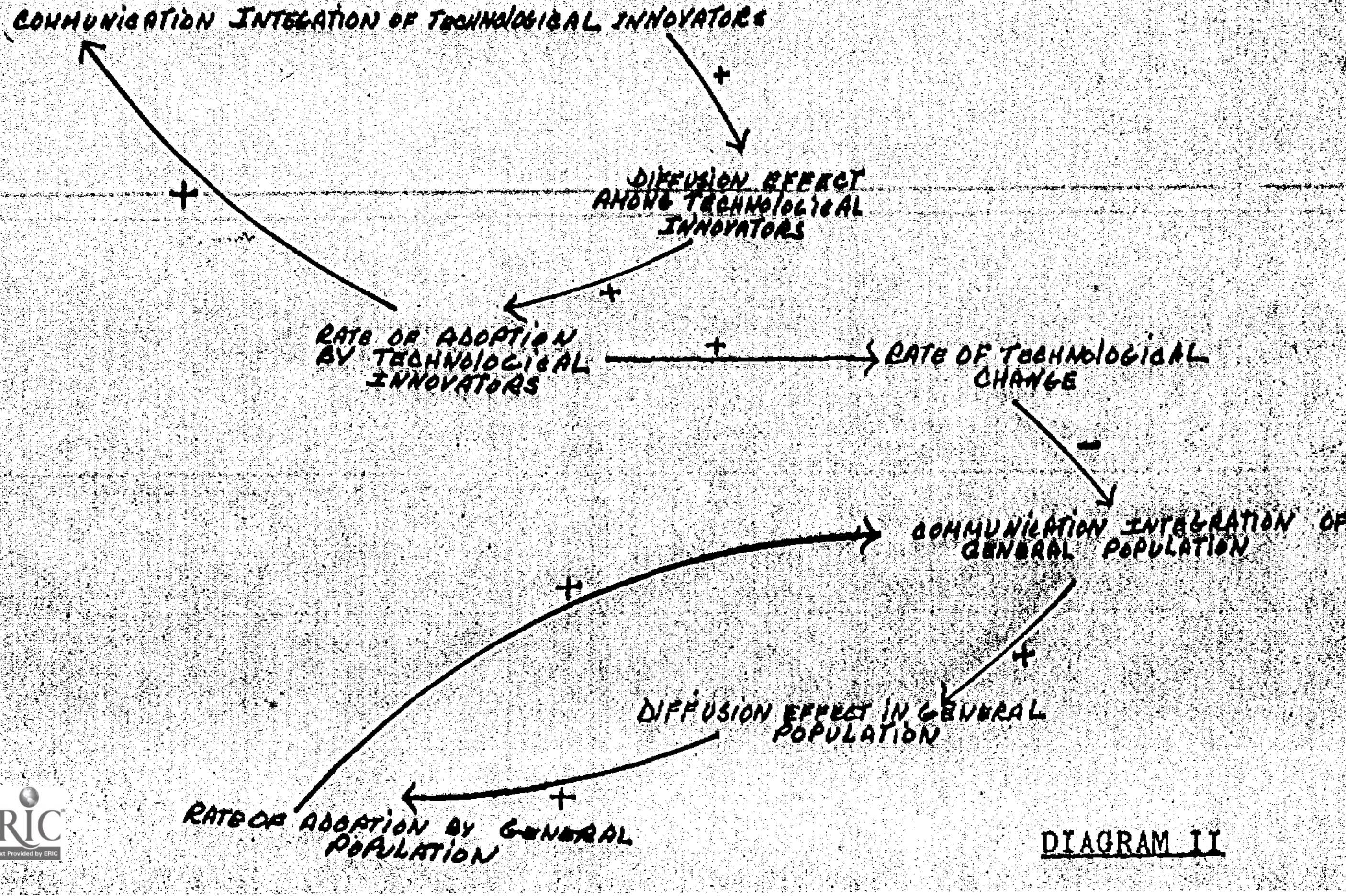

DIAGRAM II

The final concept of relevance is modern systems theory's interpretation of purpose. Churchman and Ackoff (1968: 245) postulate that "a purposive object is always taken to exhibit choice; that is, a purposive object displays a selection-process in its behavior. As the cyberneticians point out, "The basis of the concept of purpose is the awareness of 'voluntary action.'" Conditions for studying objects from the point of view of their choices is made possible by the teleologists' method of considering objects and environments."

Since an open system is self guiding and self regulating, its behaviors are purposive. It chooses to adapt or not to adapt to its environment and, through information processing, enacts the environment in the first place.(Weick, 1969)

The potential for purposive behavior permits a social system to choose among deviation-amplification, deviation-counteraction or a balance between the two. This potential is crucial to the survival of the system as the following statement from Fisher (1972: 13) testifies:

> A system responding to positive feedback is a system in a period of change. When deviation in the system is amplified, the system suffers a decrease in structural order and, for the time being at least, is not adequately self-regulated. Of course, if deviation continues indefinitely unchecked, complexity increases to a point of virtual random patterning--systemic destruction. An evolving and

> healthy system, however, will experience periods of increased complexity and decreased order, but those periods will be temporary as negative feedback loops are reasserted.

Fisher's point is particularly cogent in light of Toffler's characterization of our social system. If we accept the latter's description, our system clearly is out of control and governed entirely by deviation-amplifying processes. Toffler even denies our systemic capacity to counteract deviation since our problem is not "to suppress change, which cannot be done, but to manage it." (1971: 379)

Ironically, the management of change requires even more deviation in the system. Toffler (1971: 373) explains:

> . . . there is danger that those who treasure the status quo may sieze upon the concept of future shock as an excuse to argue for a moratorium on change. Not only would any such attempt to suppress change fail, triggering even bigger, bloodier and more unmanageable changes than we have ever seen, it would be moral lunacy as well. . . .
>
> The only way to maintain any semblance of equilibrium during the superindustrial revolution will be to meet invention with invention - to design new personal and social change regulators. . . . The individual needs new principles for pacing and planning his life along with a dramatically new kind of education. He may also need

> specific new technological aids to increase his adaptivity. The society, meanwhile, needs new institutions and organizational forms, new buffers and balance wheels.

Unfortunately, Toffler continually escalates the adaptation requirements of the individual. Now the individual not only adapts to rapidly accelerating technological change, he adapts to new coping mechanisms as well. Suddenly, his education is different, his organizations are different and he must accustom himself to new "technological aids." If that is not enough, new organizational and educational forms inevitably generate new technological innovations in still another, never ending, deviation-amplifying mutual causal process.

The totality of the process holds profound implications for the communication integration of our society. If rapidly accelerating change produces withdrawal behaviors and non-participation in the communication structures of the society, then Toffler's analysis culminates in total communication disintegration and, ultimately, systemic destruction.

The salvation, of course, lies in the system's capacity for purposive behavior and negative feedback. The fatalistic notion that we cannot suppress technological change ignores a number of successful efforts to do precisely that, particularly those of the environmentalists. As time passes, the system is increasingly likely to check itself, counteract deviation and bring itself under control.

VALUE AND IMPLICATIONS FOR FUTURE RESEARCH

Selected principles of modern systems theory provide the basis for a balanced view of the diffusion process. The concepts of equifinality and mutual causation free the researcher from the strictures of closed systems, exclusively structural categories and linear processes. At the same time, the potential for purposive behavior reminds the researcher that highly innovative social systems are self guiding and able to counteract deviation as well as amplify it. In this way, the system evolves and moves through necessary periods of change without endangering its survival or critically damaging the communication integration of its general population.

A modern systems approach also permits an examination of interdependent sets of communication behaviors in rapidly innovating social systems. Specifically, a systems paradigm is useful in explaining mutual causal relationships between diffusion behaviors and integrative, structure reinforcing communication behaviors within a social system. By contrast, previous paradigms of the diffusion process examine the process in isolation and ignore the cycles of communication behaviors which the diffusion of innovations inevitably generates in a rapidly changing society.

Along the same lines, the suggested paradigm demonstrates the varying impact of the diffusion process on communication behaviors in different parts of the social system. This paper posits, for example, that rapid diffusion causes an increase in the communication integration of the technological community but a decrease in the communication integration of the general population of our society. The systems approach encourages the researcher to carefully differentiate among the communication elements of a social system, identify their interdependent relationships and pinpoint varying effects of specific influences upon them.

An area which requires further research is the formation of negative feedback cycles or deviation-counteracting processes within our social system. As the example of the environmentalist movement demonstrates, a rapid increase in technological change causes the formation of social action groups and presumedly enhances the communication integration of that portion of society which desires a slowdown of technological growth. In a broader sense, Schmidt (1970) suggests that our society is entering into a post-industrial age in which the supreme value lies in the "process" domain rather than the "product" domain. If Schmidt's analysis is correct, our society is less and less likely to generate new products and innovations simply because it has the ability to do so. The entire process implies an interdependence between goal seeking behavior and the formation of social groups within the system. For the diffusion researcher, it allows an analysis of negative feedback cycles within a rapidly innovating society.

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