
Reinvention in the Innovation Process

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The purpose of this article is to discuss the concept of reinvention in the innovation process. We argue for its inclusion in research on the diffusion of innovations, and we suggest some possible typologies and implications of reinvention.

There are over 3,000 titles in the literature on the diffusion of innovations (Rogers et al., 1977 and 1978), beginning with Ryan and Gross's analysis (1943) of farmers who adopted the use of hybrid corn. This tremendous diffusion of diffusion studies has received attention by authors such as Downs and Mohr (1976) who attempt to explain the phenomenon. They suggest that reference to change as a product of diffusion allows generalizability of the discussion from a particular case to a common process. And, they argue, association with the wide body of diffusion studies and theory also adds a touch of class to a study of change. This generality, and status by association, may often be a strength, improving the diffusion of the research results; but it may also be a weakness, increasing the possibility of more contradictions in the diffusion literature.

One model of the innovation process has been developed as a tool for the analysis of technology transfer decisions (Eveland et al., 1977). The process of adopting (and, at some stages, rejecting) an innovation is

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conceptualized as a sequence of subprocesses in which the innovation moves from a general concept to its expression as a specific set of organizational behaviors:

- (1) *Agenda-setting*: the stage at which the general problems of an organization are defined (or imposed by regulation) and commonly recognized by its members.
- (2) *Matching*: the stage at which a general problem from the agenda and a possible solution are brought together (within an organization or through intergovernmental programs).
- (3) *Redefining*: the stage at which the main attributes of the innovation are defined in terms relevant to members and goals of the organization.
- (4) *Structuring*: the stage at which organization members establish the innovation within the structure of the organization.
- (5) *Interconnecting*: the stage at which the innovation-organization structure defines its relationships with the rest of the organization and external forces. The conclusion to the innovation process occurs when the innovation becomes a normal, routine part of the system.

This five-staged model of the innovation process in organizations is rooted (1) in the stages in the individual innovation process proposed by Ryan and Gross (1943), Rogers (1962), and Rogers with Shoemaker (1971), and (2) in the stages postulated for the innovation process in organizations by Zaltman et al. (1973), Berman and McLaughlin (1978), Zand and Sorensen (1975), and Yin (1976). The latter scholars recognized the stage (or several substages) of implementation of the innovation, while the former scholars generally conceived of the process as ending with the decision to adopt. Our present five-staged process model differs most notably from prior models in recognizing the innovation process as a matching of the adopter's perceived problem with the technological innovation, thus identifying the possibility that reinvention can occur.

The addition or reinvention to the innovation process may shed some light on contradictory research findings and has clear implications for technology transfer policy.

Defining Reinvention

Reinvention is the degree to which an innovation is changed by the

adopter in the process of adoption and implementation after its original development (Rogers, 1978). Reinvention may involve both the innovation as a *tool* and in its *use* (Eveland et al., 1977). Thus, the same technological innovation may be put to a different use than originally intended; alternatively, a different innovation may be used to solve the same problem. In addition, the intended or potential consequences of an innovation may be changed through reinvention.

The concept of reinvention also recognizes that an innovation is often really a bundle of components; it is possible to adopt some components and change or reject others. Typically, diffusion studies assume the existence of technical experts who ultimately make the decision to adopt or reject a monolithic, prepackaged innovation. In fact, there may be a fair amount of groping for a solution by concerned individuals, leading to alterations of and later corrections to, the original innovation.

Berman and McLaughlin (1978) recognized the frequency of reinvention and its appropriateness:

We found that the *same* innovation typically was implemented differently in different school districts, in different classrooms within the same school. Moreover, "packaged" projects, which prescribed procedures for teachers and project directors in ways that precluded the innovation's adaptation to the local setting, typically could not be implemented effectively [p.37].

Factors Influencing Reinvention

A variety of factors may determine the degree of reinvention with which an innovation is implemented. Reinvention is more likely to occur in cases where the innovation is more complex, is irreversible, and when an external consultant does not take an active role in the innovation process (Larsen and Agarwala-Rogers, 1977). Problems with operational implementation of an innovation may be one impetus for reinvention: The innovation as originally introduced to a system may not match with that system's problem. Reinvention may also be a response to a threat to the political survival of an innovation; or it may be due to practitioner resentment against an earlier form of the innovation (Yin, 1978). Pride of ownership and reasons of status may also encourage adopters to alter an innovation cosmetically or more

fundamentally (SRI International, 1977). Reinvention may simply occur because of a user's lack of detailed knowledge about the innovation (Rogers, 1978). Of course, organizational budget constraints will also influence reinvention (in some cases stimulating reinvention as a solution to innovation pressures upon a limited budget).

The *width of problem-definition* associated with an innovation is also a factor in its possible reinvention. This is the degree to which the scope of the original problem leading to use of the innovation is defined by an adopter, and ranges from general/abstract/ambiguous to specific/explicit. For example, adoption of a transportation system for an elderly and handicapped ridership is more narrowly defined than adoption in order to clear the way for alternatives to the car. Generally, a wider problem-definition will facilitate or necessitate reinvention because the innovation can be, or needs to be, fitted to a wider variety of local conditions.

An innovation may be considered a tight or a loose bundle of subinnovations (Kooztz, 1976). A *tight-bundle* innovation is a collection of highly interdependent components which constitute a narrowly defined mainline innovation which has achieved a stable and commonly shared conceptualization. Reinvention of a tight bundle may be considered a deviation from the mainline innovation (Lambright and Flynn, 1977) that is relatively difficult. This is because it is difficult to adopt one component of a tight-bundle innovation without adopting other components. An innovation consisting of a *loose bundle* of components, on the other hand, implies a developmental process in adoption, and allows more flexibility in designing locally suitable versions of the innovation. Adopters can "mix and match" components.

Reinvention (particularly in loose-bundle innovations) can occur at any of the four stages following the agenda-setting stage in the innovation process. (If the general organizational problems change, then a new agenda or innovation is considered.)

Matching the different abilities, resources, needs, and pressures of a particular system may necessitate adaptation of the innovation. An adoption which seeks to solve a local problem results from information searches which match a possible technological solution to the local situation, and often immediately entails reinventions. An adoption motivated by the prior existence of an innovation and which then seeks an accessible application often requires the bending of the innovation to

more appropriately match the problem. The planning, deciding, and implementing of an innovation may even require a different way of looking at the problem, thus necessitating a solution process which is innovative in itself (Pott, 1976).

Redefining the innovation implies its adaptation and reinvention in ways relevant to local conditions. *Structuring* requires that similar organizational structures should be available for similar applications of an innovation to occur; some components of an innovation may be prohibited by, or be competitive with, local or preexisting organizational components, necessitating reinvention of these components. *Interconnecting* affects the final form of an innovation as it fits into the entire organization and its environment; reinvention may often be an accommodation between opposing forces.

Reinvention Has Been Overlooked

For most of the past four decades of research on the diffusion of innovations, *scholars* (not all; for example, see Havelock, 1974) have usually ignored the concept of reinvention, considered it troublesome, or recategorized it so as to make it disappear, thus treating it as "noise" (often ignoring adopters' claims of their distinctive utilization of an innovation). As Rogers (1978) writes,

Past research on innovation in organizations has assumed that a new technological idea enters the system from external sources, and then is adopted (with relatively little adaptation of the innovation) and implemented as part of the organization's ongoing operations. The assumption is that adoption of an innovation in organization A will look much like adoption of this same innovation in organization B.

The research on which our discussion is based (Eveland et al., 1977; Rogers et al., 1979) calls this assumption into serious question. In fact, "Organizations often adopt not a specific blueprint for an innovative activity, but a general concept whose operational meaning gradually unfolds in the specification process of adopting and implementing the new idea" (Rogers, 1978).

Reinvention has not received much favorable attention from *R&D agencies*, who may consider it as a distortion of their research project. Diffusion agencies may be unfavorable toward reinvention, feeling that

they know better than the users what form of the innovation the users should adopt. Also, diffusion agencies find it difficult to measure their performance if a specific innovation's components change over time and across different adopters.

Adopters, on the other hand, generally think that reinvention is good (when they are aware that reinvention has taken place). They place emphasis on the innovation's elements that they have reinvented, while minimizing the amount of reinvention introduced by other adopters. Some reinvention, however, may not even be recognized by adopters, who frequently perceive modification of an innovation as a natural part of its implementation.

Reinvention Is Not Necessarily Bad

Past writings have seldom recognized that reinvention is not necessarily bad. Baer et al.'s (1976) definition of diffusion, for example, considers adoption beyond the demonstration period as the criterion. The implicit shortcoming of this view of diffusion is that it fails to suggest that most innovations are reinventable. The choices available to a potential adopter are not just adoption or rejection; modification of the innovation or selective rejection of some components of the innovation may also be options. Some implementation problems in an organization are unpredictable by nature, so changes in the originally planned innovation often occur (House and Jones, 1978).

Reinvention can be beneficial. Flexibility in the process of adopting an innovation may reduce mistakes and encourage experimentation with, and customization of, the innovation to fit more appropriately local and/or changing conditions (SRI International, 1977). The typical shifting of local priorities and contexts may occur especially during a large-scale innovation with a long start-up time, because the problems (and even the local organization's leadership) may change before the innovation is fully implemented. Further, once implemented, an innovation may generate previously unanticipated difficulties, and thus create a need for additional and alternative solutions (Aberg et al., 1976). So, as a result of reinvention, an innovation may be more appropriate in matching the system's preexisting problems and more responsive to new problems.

In general, it appears likely that the more comprehensive or generalized an innovation is (especially a large-investment, institutionally sponsored innovation designed for a variety of ills in different locations), the less applicable it is to any one *particular* situation (SRI International, 1977). Yet, as Meyer and Rowan (1977: 356) point out, "organizations in search of external support and stability [will agree to] incorporate all sorts of incompatible structural elements." The structure and connections of the generalized innovation may then have to be reinvented to allow for integration within the local context. In turn, reinvention can help localize an externally provided innovation in the minds of organization members as well as of their constituents.

Dial-A-Ride: A Case Study in Reinvention

During the 1970s, several scholars have mounted diffusion researches in which the concept of reinvention has received attention: Havelock (1974), Berman and McLaughlin (1978), Eveland et al. (1977), and Larsen and Agarwala-Rogers (1977). Here we detail an investigation of reinvention for Dial-A-Ride, a mass transportation innovation (Rogers et al., 1979). The objectives of this research were:

- (1) To determine the nature of the innovation process on the part of adopters of an urban mass transportation innovation (specifically, Dial-A-Ride).
- (2) To determine the role of demonstrations and other federally sponsored interventions in the diffusion of such innovations.
- (3) To identify and evaluate alternative methods of disseminating information on such innovations.

Dial-A-Ride (DAR) is a form of demand-responsive transportation characterized by the traveler's telephoning for a bus, van, or cab to request a reservation of one or a series of rides or to request immediate service. The vehicle can pick up and deliver at individual addresses or at system exchange points, and usually uses a flexible route determined by rider demand.

In this DAR research, and in an investigation of a federally sponsored computerized census system (Eveland et al., 1977), the *uses* of an innovation as well as the *decision* to adopt were studied. In addition,

the focus in both studies was primarily on one innovation. For these reasons, reinvention of one innovation could be investigated in detail and considered conceptually rather than overlooked or treated as "noise."

DAR has, in fact, proven to be exceptionally fertile ground for the study of reinvention. DAR diffused more widely during the 1970s than any other urban mass transportation innovation. It is distinctive in that the nature of the innovation was changing under different regulatory, financial, operational and conceptual influences while it was diffusing among U.S. cities. Thus, many of the adoptions, while all called "Dial-A-Ride" (or some variant), actually represent a variety of different versions of this innovation. In addition, DAR is adopted by organizations, rather than by individual actors. In general, much diffusion research is concerned with organization innovativeness, and indeed one of the main goals of the present research is to explore the usefulness of a model of the innovation process in organizations. Promoted by the Urban Mass Transportation Administration (UMTA), DAR represents an interface between federal and local public organizations as they collaborate in the diffusion of a technological innovation to solve an important set of social problems.

DAR is an innovation consisting of a loose bundle of components. The total twenty-four innovation components exist in various combinations in the ten case study sites (of which two are presented in Table 1), from a relatively straightforward system with four main innovation components to the more complex systems with fifteen or sixteen components.

One effect of the presence of UMTA demonstration funds (and accompanying requirements) in some of the case sites is that more innovation components are included in those systems than in non-demonstration systems. Almost all of these extra innovation components were explicitly or implicitly part of UMTA's suggestions or requirements (examples are automated fare collection and private sector service providers such as taxis). A few additional components, however, were developed independently of federal involvement by these demonstration sites (such as coordination of several kinds of transportation service among users and some aspects of data management).

Most of the high-technology components of DAR are at the three UMTA demonstration sites. One exception is the use by a nondemonstrator of digital communication with DAR vehicles and of computer-

TABLE 1
Dial-A-Ride Innovation Components Implemented
at Case Study Sites

Dial-A-Ride Innovation Components	Site A	Site B	Dial-A-Ride Innovation Components	Site A	Site B
Prepayment passes	-	✓	Radio-voice communication	✓	-
Third-party billing	-	-	Manual dispatching	✓	-
Direct user subsidy	-	-	Computer-aided dispatching	-	✓
Contracts with, or subsidy of, private operators	✓	✓	Computer-aided data management	-	✓
Special class rates	✓	✓	Incentives for vehicle drivers	-	-
Reader routes with integrated service	✓	✓	Automatic fare collection credit card	-	-
Guaranteed transfer points	✓	✓	Service on demand	✓	✓
Zonal routes	✓	✓	Charter reservation service	-	✓
Some busses or vans with special equipment for elderly and handicapped	No, but soon	✓	Subscription service	-	✓
Private taxi operators	-	-	Local transportation broker	-	-
Goods delivery	-	-	Offers elderly and handicapped priority	✓	-
Digital communication	-	✓	Eligibility prioritization	-	-
			Total number of components	9	12

NOTE: Only two of ten case study sites are represented here.

assisted routing. Some of these high-technology components have not proven very effective; reinvention of these components is occurring in the form of developing information systems (out of computer dispatching and automated fare collection equipment) for data management, evaluation, billing, and report-generation. Reinvention of this kind is an example of a tool's being used differently from its original

invention may prevent a particular problem from occurring in the re-inventing system. For example, several sites implemented their DAR system incrementally because of the notorious failure of one site which attempted to activate a countywide system overnight.

(2) *Reactive*: reinvention required by unexpected and unsatisfactory consequences of the original innovation (for some component). For example, several sites had to reinvent the original service access mode due to litigation stemming from its use.

(2a) *Secondary*: a result of a previous reinvention's causing problems affecting some other aspect of the innovation bundle. For example, one site chose a vehicle designed to test improved physical accessibility, but the vehicles' reliability was so poor one winter that the site had to hire private transportation providers; but these did not have the automated fare collection system, resulting in the switch to different collection methods.

Table 2 summarizes the nature and type of DAR reinvention in ten case sites. What might we conclude?

- (1) The nature of DAR reinvention is mainly technical (especially reactive reinventions), with operational and managerial reinvention about equal in frequency.
- (2) Planned and reactive reinventions are about equal in number indicating that reinvention may be as much a designed developmental aspect of the innovation process as it is a response to unexpected difficulties in implementation.
- (3) Management reinventions tend to be planned, while technical reinventions tend to be reactive. Operational reinventions tend to be equally distributed between the two types.
- (4) Management reinventions do not involve vicarious reinventions derived from other similar innovations, perhaps because changes in management policy are closely related to the particular organization's existing structure. Perhaps the heavy emphasis on *planning* management reinventions limits perceived borrowing from other situations.

Summary and Implications for Policy and Research

Reinvention exists, is not necessarily bad, and is a natural part of the innovation process. Some innovations which are loose bundles or subinnovations are particularly conducive to reinvention by local sites.

application, and is facilitated by the component flexibility in a loose-bundle innovation.

Although DAR was originally typically perceived as a kind of public taxi system, other forms of access (such as subscription and chartering) are becoming equally (or more) likely to be DAR components. This shift is part of the ongoing reinvention of the *concept* of a particular innovation in order to provide more flexible and more efficient service.

Type and Nature of Reinvention in Dial-A-Ride

One of the difficulties in considering a new variable in any research is the development of appropriate measures. Reinvention is no exception, and may, in fact, be particularly troublesome to measure. In order to bring the variable of reinvention into diffusion research, we present a tentative typology of reinventions which provide public service. There are certainly alternative approaches to measuring reinvention, and this section is necessarily derived primarily from our Dial-A-Ride investigations. We suggest the following typology as a first step, however.

The nature of a reinvention might be categorized as follows:

- (1) *Operation/service*: concerns the operational components apparent to the user (routing, service, fares, access, etc.). This category would include the change from a reservation to an on-demand system.
- (2) *Technical*: concerns specific techniques and hardware, mostly invisible to the public user, performed and modified within the DAR system. For example, one site decided to interface fixed route service with DAR by means of computerized dispatching.
- (3) *Management/organizational*: concerns conceptual approaches of the DAR system and organizational restructuring. One example is the addition of driver and dispatcher unit incentives for safety and productivity.

Additionally, the *type* of reinvention can be categorized as follows:

- (1) *Planned*: the changes from the original innovation bundle are an expected part of the innovation process. For example, the computer interfacing mentioned above had been included in the long-range planning.
- (1a) *Vicarious*: a planned reinvention which occurs as a preventive reaction to a problem experienced by some other adopting system. Such re-

TABLE 2
Number of Occurrences of Reinvention of Dial-A-Ride
by Nature and by Type, at Ten Case Study Sites

Nature of Reinvention	Type of Reinvention					Totals
	Planned	Vicarious	Reactive	Secondary	Totals	
Operation	7	2	9	2	20	
Technical	11	3	18	2	34	
Management	16	0	6	1	23	
Totals	34	5	33	5	77	

A wider initial problem-definition can also facilitate (or necessitate) reinvention as the innovation can (or must) be fitted to a wider variety of local conditions. Reinvention can occur at any stage in the innovation process after the original agenda has been set, as the innovation moves from the awareness stage to the interconnecting stage.

Problem-initiated adoptions (intended to solve a perceived problem) result from information searches which match a possible technological solution to the local recognized needs, and often immediately entail reinvention. Many of the necessary changes to the sought innovation are already known. Technology-initiated adoptions (occurring as a result of an organization finding a use for an alluring, or funded, innovation), on the other hand, often require a slower process of reinventing as the innovation's inappropriateness is discovered. This is a likely reason for the tendency of technology-initiated adoptions to require more reinvention, particularly the reactive type.

Such conditions may be particularly true for federally sponsored (or other large-scale, generalized) innovations. Demonstration systems may be more complex, more technical, and include more components than do nondemonstration systems, and thus tend to require a greater degree of reinvention. In particular, operational reinventions, more likely than technical or managerial reinventions to require secondary reinvention, should be considered carefully because of their potential for systemwide repercussions.

Insofar as national, generalized problem agendas may differ from local problem agendas, a local adoption may represent the intersection of these sets of agendas, requiring reinvention of a federally sponsored

innovation intended to diffuse to local sites. Reinvention by adopters should not be rejected or overlooked, or interpreted by the sponsoring agency as meddling with a good idea. The potential for reinvention should rather be encouraged; sponsoring agencies could offer local sites a variety of solutions or innovation components to perceived problems, and could then monitor the results of particular reinventions. A federal agency might actually wish to build reinvention activities into the original innovation: the results could be filtered back into the innovation's R&D and documentation. One DAR site's solutions to its vehicle problems, for example, are quite useful as reinventions and should be disseminated and recycled into the technological warehouse of UMTA information.

Future analysis of reinvention awaits a more satisfactory measurement of the degree of reinvention as a conceptual variable as well as a more precise delineation of the degree to which an innovation-decision is problem-initiated or technology-initiated, and how that affects reinvention. The general philosophy of an adopting organization may also affect reinvention. For example, one site's DAR is quite simplistic technologically, but highly reactive in nature because the managing system does not believe in the concept of planning (which they feel simply reflects the availability of funds). Another site's DAR is highly technical in nature but has had very few reactive technological reinventions, due to its explicit planning-oriented philosophy.

In order to investigate further the nature of reinvention by adoption stage (from agenda-setting through interconnection) in the innovation process, more complete data on this process in specific adopting organization are needed. The factors affecting routinization (Yin, 1978) in general (the inherent characteristics of the innovation, service applications and outcomes, and the external and internal environments) also may affect reinvention. We should find out.

Future research could investigate more fully the hypothesis derived from the GBF/DIME research (Eveland et al., 1977), that the degree of reinvention is negatively related to the directness and frequency of the communication relationship between the user agency and the innovation support organization. We already have indications that the DAR demonstration sites, which have more direct and more frequent communication with the innovation support organization (UMTA), are more likely to have more complex and numerous innovation components in their adopted innovation. In addition, Downs and Mohr (1977) defined innovation as the use of a new idea when there is

uncertainty and risk attached to its application. Therefore, the degree of uncertainty about an innovation component may be a useful element in analyses of reinvention.

There are two final research implications which have great potential for resolving some of the contradictions of past diffusion research, as well as for creating new questions. Past studies have usually been concerned with *sets* of innovations, obscuring the detail of particular innovation processes, particularly because the innovations are seldom interconnected. Our recent investigations reveal the richness and insight inherent in a focused approach to diffusion. And, finally, what does the familiar cumulative S-curve of adopters of an innovation, or a measure of the rate of adoption of an innovation, really mean if a high degree of reinvention occurs? If each innovation adoption is different in certain important respects, a crucial (but previously unrecognized) source of variation is present in the diffusion process, casting some doubts about previous research findings. We suggest the need both for recasting some previous results in the light of the variable nature of each innovation adoption, and the inclusion of the variable of reinvention in future diffusion research.

Recognition of the existence of reinvention brings into focus a different view of adoption behavior: instead of simply accepting or rejecting an innovation, potential adopters are active participants in the adoption and diffusion process, struggling to give meaning to the new information as the innovation is applied to the local context. This conception of adoption behavior, involving reinvention, is more in line with what respondents in diffusion research have been trying to tell researchers for many years.

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