Diffusion of Innovations:

A Theoretical Framework for Understanding how Scientific Knowledge and Technology are Adopted by Managers.

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Theory Overview

New ideas and approaches (innovations) are constantly being developed, and whether or not they are effectively incorporated into management depends on a number of factors that have been outlined within a framework known as diffusion of innovations theory. The theory emerged from explanations of how farmers adopted new technologies and practices (Rogers 1958), and has evolved into a field of research that has broad application for a wide variety of disciplines. This research is focused on understanding the process of diffusion, defined as the process by which innovations are communicated among members of a social system (e.g., the management community), and are ultimately adopted or rejected by that audience. There are several component parts of this field of research including the process of adopting or rejecting innovations, the rates of adoption and factors that influence those rates, and the communication channels through which diffusion occurs.

Wolfe (1994) identified 6,240 papers on this topic during a 5 year-period leading up to 1994. Similarly, Nutley et al. (2002) found 14,600 papers in a follow-up search from 1990-2002, indicating that interest in this topic has remained high and constant over the past two decades. As you might expect, this field of research has strong implications for marketing, but its application to natural resource management will hopefully become apparent. Although some of the terminology and formal structure may be unfamiliar to natural resource scientists and managers, many of the concepts will likely be familiar and intuitive.

The Process of Adopting or Rejecting Innovations

It is widely recognized that an individual’s decision about a given innovation is not an instantaneous act; rather, it is a process consisting of several stages which affect a manager’s willingness and ability to adopt an innovation. Although different from the stages originally proposed by Ryan and Gross (1943), most scholars today recognize a similar set of stages that begin with awareness of the innovation and ultimately result in its adoption or rejection (Rogers 2003) (Figure 1). Although there are slight variations in how different researchers describe and categorize the stages, they generally follow a progression something like those described below:

Awareness / Knowledge- Obviously, an innovation will not be adopted if nobody is aware of its existence. Thus, awareness, or knowledge of the innovation, is the first stage.
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of the adoption process. From a strategic perspective, if there is a desire in seeing a given innovation adopted by management, then consideration should be given to the communication channels by which it is communicated to the target audience.

Interest-Understanding- Hassinger (1959) argues that even if an individual is exposed to an innovation, it will have little effect unless the innovation is perceived to be relevant to the needs of that individual. If there is interest in the innovation, an individual will generally work towards understanding how an innovation works. Similarly, if an individual does not understand an innovation, then it is less likely that they will further explore that innovation unless there is already interest in its use. From a strategic standpoint, this implies that promoters of a given innovation should pay careful attention to ensure that it is communicated in a way that will be understood by the target audience (see also concept paper on Principles of Scientific Communication in this series).

Attitude Formation- Once an individual has become aware of an innovation, and has a basic understanding of how it works, they will begin to weigh the relative advantages and disadvantages of using the innovation in their context (see also Attributes of the Innovation below), and begin to develop either a favorable or unfavorable attitude toward it. This attitude formation may consist of thinking hypothetically about what would happen if the innovation were applied to their situation. It also often entails seeking the opinions of one’s peers.

Initial Decision- The attitude formation stage eventually leads to an initial decision about whether to adopt, or at least try the innovation. Most individuals do not adopt an innovation without first trying it on a limited basis (Rogers 2003). This trial is often an important part of the ultimate decision to adopt or reject an innovation. Although some innovations are not conducive to a trial basis, those that tend to be adopted more readily. A decision not to adopt an innovation need not be a conscience decision; rather, it may just be a subsidence in further pursuit of the innovation as interest wanes.

Implementation- This stage is when the innovation is actually put into use. Researchers of diffusion of innovations also now recognize that there can be considerable “re-invention” at this stage, as individuals or organizations adapt a given innovation to their particular set of circumstances. Sometimes a given innovation may go through a substantial evolution and divergence as it is implemented in different contexts. It is even thought that a high degree of such re-invention leads to faster adoption and greater sustainability of the innovation, because it indicated a high degree of flexibility for the innovation to be adapted to different circumstances (Rogers 2003).

Confirmation- At this stage, empirical evidence is accumulated that reinforces or counters the decision to implement an innovation. Decisions to discontinue use of an innovation after initially deciding to implement it is not uncommon. Leuthold (1967) found in the farming context that discontinuing innovations was just as frequent as adopting new innovations during any given year. Discontinuance of an innovation can occur when an individual or organization becomes disenchanted with the results of implementation, or it can occur as a replacement in order to adopt a better idea that supersedes it.

Communication Channels

Communication channels are the means by which information travels from a source to a receiver. Different communication channels tend to play different roles at each stage of the diffusion process. In the early stages of awareness and knowledge, mass media channels (e.g., radio, television, etc) that reach large audiences very quickly probably play a greater role. The internet is an example of a mass media channel that is probably playing a much greater role than it has in the past. In contrast, interpersonal channels that involve face to face meetings between two or more individuals probably plays a greater role during the attitude formation stage. These conclusions are supported by a forecasting model, developed by Bass (1969), based on extensive diffusion research. The Bass model indicates that mass media channels influence the number of adoption continually throughout the diffusion process, but its influence is concentrated in the early stages (Figure 2). In contrast, interpersonal communication channels have a peak of influence that coincides with the attitude formation stage.

In natural resource science and management, conferences and workshops are an important source of information, and channels that reach a relatively large audience (e.g., presentations) are often followed up by more interpersonal exchanges in the hallways between sessions. The rise in
internet “blogs” are likely to be an important channel in the future which combine the ability to reach large audiences, with more interpersonal types of information exchange. From a strategic standpoint, researchers have suggested that a sequence of channels starting with mass media and progressing to more interpersonal channels helps to maximize the probability of an innovation being adopted (Sill 1958, Rogers 2003). Mass media channels are also an important channel that reaches park visitors which may indirectly influence decisions to adopt an innovation via outside pressures.

### Factors Influencing the Probability and Rate of Adopting New Innovations

#### Attributes of the Target Audience

An additional component of the theoretic framework of diffusion of innovation has to do with the attributes of the individuals that adopt (or reject) innovations. This focus helps us understand the process by which the information is transferred among individuals to permeating the management community. To understand this aspect, researchers studying the diffusion process have categorized individuals of the target audience as belonging to one of several categories. The details of specific categories vary among researchers, and are probably beyond the scope of this discussion; however, the categories generally range from individuals that tend to readily adopt new innovations with much enthusiasm, and perhaps even a bit of recklessness (innovators) to those that are very sceptical and reluctant to adopt innovations until after they are well established (sceptics). The take home message from this line of research is that the most effective individuals to target in order to introduce a new innovation is a group called the “early adopters”. Individuals of this group are not the first to adopt new innovations (innovators); rather they are open to new ideas, but that pay closer attention to the effectiveness of the innovations. These individuals tend to be respected by their peers and are readily sought out as the “individual to check with before adopting a new idea” (Rogers 1995, 2003).

#### Attributes of the Innovation

A marketing strategy for a given innovation will unlikely be successful if the innovation does not have qualities that warrant its adoption. Thus, In addition to the characteristics of the target audience, the rate, and/or likelihood of widespread adoption also depend greatly on the qualities of the innovation, itself. Rogers (1995, 2003) suggested, based on existing research, that most of the variance in the rate of adoption of innovations can be attributed to five attributes of the innovations (defined in Text Box 1 and discussed below): (1) the relative advantage of the innovation over alternative ideas, (2) the compatibility of the innovation with existing experience and perceived needs, (3) the simplicity or ease of use of the innovation, (4) the trialability, or ease with which the innovation can be tested in a limited capacity, and (5) the observability of effective results when applied.

#### Relative Advantage

The perceived relative advantage is typically one of the best predictors of the rate of adoption of an innovation. It is also one of the first things that potential users of a given innovation will want to know. For this reason, proponents of a given innovation would be well advised to include information about the relative advantage when communicating about the innovation (provided there is a relative advantage). It is also for this reason that a
common marketing strategy in commercial enterprises is to provide incentives for an innovation as a means of increasing its relative advantage, thus its rate of adoption (Rogers 2003).

**Compatibility** - The rate of adoption of an innovation will generally be more rapid if the innovation is consistent with the existing values, past experience and perceived needs of the client (in this case managers). How well the innovation meets the perceived needs of managers is particularly important in natural resource management. In commercial enterprises marketers go to great lengths to understand the needs of their clients. In some cases, they even go so far as to try to convince clients that they have a need for the innovations that they are trying to market. One of the goals for this series is to encourage scientists in the Inventory and Monitoring Program to seek a better understanding of the needs of managers.

**Complexity** - This quality is a major factor in natural resource management, as many of the innovations of natural resource science entail complex theoretical ideas that are often difficult to understand, often controversial, and often with a high degree of uncertainty. Thus simplistic applications can be likewise be difficult and may incur a high political cost. For example, the idea of threshold responses to ecosystem stressors is now widely accepted among ecologists, but their has been extremely little in the way of this innovation having been adopted into management practices, largely because it lacks simplicity. The factors that influence threshold responses can be quite complex; thus being able to predict at what point they would occur is extremely difficult. When weighed against completing demands on the resource, it becomes hard to justify managing for threshold responses.

**Trialability** - The ability for a potential user to experiment with an innovation can greatly enhance its rate of adoption. This is not mutually exclusive of its relative advantage, for an innovation that is not testable on a small scale can incur large costs to implement with greater uncertainty of the outcome. This will certainly be perceived as a reduction in its relative advantage.

**Observability** - The ability to readily observe the results of a given innovation will have a positive effect on its rate of adoption, assuming of course that the results are favorable. In natural resource management, this may have a substantial effect because many innovations influencing our natural resources require long time periods to see the effect. Individuals are generally more reluctant to adopt an innovation prior to visible results.

**References**


Wright, V. 2004. How do land managers adopt scientific
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