Diffusion of Innovation

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The theory of diffusion of innovations (DOI) is the seminal work of communication scholar and sociologist Everette M. Rogers (1931–2004). The DOI theory did not originate by researching any high-end technological product; rather its origin can be traced from agriculture. In 1928 researchers started to study the adoption patterns of farmers using hybrid corn produced by the Iowa State Agricultural Experiment Station. Between 1933 and 1939, the number of acres planted to hybrid corn increased from hundreds to thousands. By 1940, it had been adopted by most Iowa corn growers. Ryan and Gross (1943) introduced the categorization of the adopters, in this case the farmers. Rogers continued this investigation and in 1962 published his seminal work *Diffusion of Innovations*, with new editions in 1971, 1983, 1995, and 2003.

DOI research draws upon rational theories of organizational life adopted from sociology, management, and communication theory. It develops predictive accounts of the diffusion phenomenon that supposedly helps technology implementors advance the dissemination of selected technologies. Overall, the DOI tradition has sought to explain individual adoption decisions or intentions to adopt, which concern well-defined innovations and relatively homogeneous populations.

According to Rogers (2003, p. 5), diffusion is "the process by which an innovation is communicated through certain channels over time among the members of a social system." Thus, diffusion is regarded as a special type of communication in which participants create and share information with one another in order to reach a mutual understanding. The newness of the idea in the message gives diffusion its special character, as some level of uncertainty is thus involved. Rogers (2003, p. 9) defines uncertainty as "the degree to which several alternatives are perceived with respect to the occurrence of an event and the relative probabilities of these alternatives." He described the DOI as "an uncertainty reduction process" (p. 232) and proposed attributes of innovations that help to decrease uncertainty by obtaining more information.

An innovation is "an idea, practice, or object perceived as new by an individual or other unit of adoption" (Rogers, 2003, p. 12). Most of the new ideas discussed in his book are technological innovations. Rogers defines a technology as "a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome" (p. 13). But, as he argues, a technological innovation "also creates another kind of uncertainty because of its newness to the individual and motivates him or her to seek information by means of which the new idea can be evaluated" (p. 13).

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Researchers, theorists, and practitioners from many fields have been interested in DOI within and across organizations, including organization theory, management, education, health care and public health, information technology, and sociology. A review of the literature on the diffusion and sustainability of innovations (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004) identified 13 major research traditions. Four of these were labeled as "early diffusion research": rural sociology, where Rogers first originated his influential theory; medical sociology, in which similar theoretical explanations were applied to the clinical behavior of doctors; communication studies, which analyze the speed and quality of transmission of news and improving key variables such as the style of message and the nature of the exposure of intended adopters to messages; and marketing and economics, where innovations were usually products or services and the adoption decision was conceptualized as a rational analysis of costs and benefits by the intended adopter.

The focus of DOI theory

The DOI theory has mainly focused on the perceived features of technologies and the innovativeness of the organizations adopting them. Rogers (2003) mentions five attributes of an innovation that influence its adoption: relative advantage in comparison to existing technologies, compatibility with the organization workflows and knowledge, complexity to implement, trialability, and observability of the development of the innovation both inside the organization and in competitors. The individuals' perceptions of these five characteristics predict the rate of adoption of innovations.

Rogers (2003) proposed an innovation-decision process model for studying the stages of adoption, which is essentially an information seeking and information processing activity in which the individual is motivated to reduce uncertainty about the advantages and disadvantages of a specific innovation. Through the innovation-decision process, an individual or another decision-making unit passes from first knowledge of an innovation to forming an attitude toward it, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision. Rogers conceptualizes five steps in this process: knowledge, persuasion, decision, implementation, and confirmation. At the knowledge stage, an individual wants to know what the innovation is and how it works. At the persuasion and decision stages, an individual seeks innovation-evaluation information in order to reduce uncertainty about an innovation's expected consequences. The decision stage leads to adoption, to make full use of an innovation as the best course of action available, or to rejection. Reinvention is the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation, according to Rogers.

Most individuals evaluate an innovation not based on scientific research by experts, but through the subjective evaluations of peers who have adopted the innovation; they serve as social models, whose innovation behavior tends to be imitated by others in

their system. Rogers argues (2003) that "mass-media channels are more effective in creating knowledge of innovations, whereas interpersonal channels are more effective in forming and changing attitudes toward the new idea, and thus in influencing the decision to adopt or reject it" (p. 36).

According to Rogers (2003, p. 22), innovativeness is "the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a social system." Rate of adoption is the relative speed with which an innovation is adopted by members of a social system. The social and communication structure of a system facilitates or hinders the diffusion of innovations in the system. He distinguishes three main types of innovation-decisions: (i) *optional innovation-decisions*, choices to adopt or reject an innovation that are made by an individual independent of the decisions of other members of the system; (ii) *collective innovation-decisions*, choices to adopt or reject an innovation that are made by consensus among the members of a system; and (iii) *authority innovation-decisions*, choices to adopt or reject an innovation that are made by relatively few individuals in a system who possess power, status, or technical expertise.

A fourth category, according to Rogers, consists of a sequential combination of two or more of these types of innovation-decisions: contingent innovation-decisions are choices to adopt or reject that can be made only after a prior innovation-decision. A social system may also function as an element in diffusion concerning consequences: the changes that occur as a result of the adoption or rejection of an innovation. Rogers (2003) identifies "opinion leaders" as key actors in the process, as their attitude will have a greater effect on others' attitudes. In the case of innovations that are expensive, visible, and radical, empirical data collected by Rogers suggest that there needs to be an "innovation champion" to push forward the diffusion of the technology.

The theory explains diffusion rates by the characteristics of the innovation and its surrounding social system (Wolfe, 1994). DOI models are not very specific about the items of diffusion and seldom question whether the studied technology makes a difference (Wolfe, 1994). Variations in research constructs are usually restricted to the choice of adopting units and to the number of variables included in the model.

Rogers classifies the members of a social system based on the degree to which an individual is relatively earlier in adopting new ideas than other members of a system. The continuum of innovativeness is divided into five adopter categories: innovators, who introduce the innovations; early adopters, who are the first to implement them; early majority, a large number of individuals who adopt the innovations soon enough; late majority, who adopt them far on time; and laggards, who fall behind the rest. These categories are ideal types based on observations of reality and designed to make comparisons possible. Adopter distributions tend to follow an S-shaped curve over time and to approach normality. One reason is because of the diffusion effect, defined as the cumulatively increasing degree of influence upon an individual to adopt or reject an innovation resulting from the activation of peer networks about the innovation in the social system.

Current developments in DOI research

The strength of DOI theory lies in its utility and its practical implications, which can be adapted to a wide variety of scenarios. Regardless of the culture, the social system, or the characteristics of the population, the diffusion process in the model captures the activity that must occur for an innovation to move from its inception to a larger population (Atkin, Hunt, & Lin, 2015).

A systematic review of the literature followed by a meta-analysis of articles on Rogers's innovation attributes (Kapoor, Dwivedi, & Williams, 2014) found that most of the studies are retrospective, concentrating on the adoption of an innovation, with hardly any focus on implementation or the postadoption behavior. DOI research is mainly based on quantitative data from surveys and questionnaires, where users are invited to rate the effects and influences of the alleged innovation attributes. Almost all studies explore multiple attributes, with a high proportion considering only one innovation, mostly in an organizational context (Kapoor et al., 2014).

The accumulated body of DOI research shows differences between earlier and later adopters of innovations in socioeconomic status, personality variables, and communication behavior (Rogers, 2003). Earlier adopters are more likely to be literate, have higher social status, a greater degree of upward social mobility, and a commercial rather than a subsistence economic orientation. Earlier adopters also differ from later adopters in personality variables. According to Rogers, earlier adopters have greater empathy, less dogmatism, a more favorable attitude toward change, a greater ability to cope with uncertainty and risk, a more favorable attitude toward education and science, and higher achievement motivation. The adopter categories also display different communication behavior. Earlier adopters have more social participation, have greater exposure to mass media and interpersonal communication channels, engage in more active information seeking, exhibit greater knowledge of innovations, and are more likely to belong to highly interconnected systems.

DOI theory in media research is conceptualized as a process that includes structural and practical factors derived from professionals' inputs in different areas of news production (Lund, 2008; Micó, Masip, & Domingo, 2013). Lawson-Borders (2003) uses DOI theory along with case study results from pioneering media groups to identify the best management practices for integrating old and new media. In the era of digitally converged multiplatform environments, it is necessary to balance the tension between simplicity and complexity. Innovations emerge not only as a response to the threats from the instability of the media market, increasing industry competition and technological disruption, but also interactive audiences and social media are playing a decisive role in helping reduce uncertainty and fostering early adoption (Atkin et al., 2015; Lievrouw, 2006).

Many factors, including the availability of information concerning technology (like relative advantage and compatibility), adopters' properties (such as past experiences), characteristics of the social system (such as management support and availability of change agents), and the communication process, explain the adoption decisions in news organizations. In this context, García-Avilés, Carvajal-Prieto, Arias, and De Lara-González's (2019) model of DOI in news organizations considers specific factors

which might help advance or hinder innovative practices and processes within media companies, focusing on how innovations are embraced by early adopters in digital newsrooms.

Criticism of DOI theory

The foremost criticism that the DOI theory faced was that it was more agrarian in approach and would not hold good for innovations in more technological sectors (MacVaugh & Schiavone, 2010). Not only the adoption pattern varied, and the rate of adoption differed, but often adopters developed negative attitudes about cutting-edge innovations. The business community also raised its voice against the theory, questioning the static nature of the categories of adopters and that anyone could be an innovator if innovations are matched with those organizations targeted for adoption (Downs & Mohr, 1976).

In the field of organizational management, the decision process is more complex than at the individual level. Organizations have goals, regulations, and informal practices that shape the processes. As Lyytinen and Damsgaard (2001) argue, an innovation needs not necessarily pass through various stages of adoption for an individual to adopt to it: sometimes adoptions take place in dyadic relationships so that it becomes difficult to identify the stages of adoption. Further, they found some of the laggards being more visionary than the innovators defined in DOI theory.

Another main factor surveyed in DOI studies was the innovativeness of the organization, which included individual leader characteristics and organizational structure. On the organizational level, positive factors for innovativeness are large company size, decentralization, high complexity, low formalization, dense interpersonal networks, and uncommitted resources. However, in the implementation phase more centralization and less complexity may help in the process of diffusion.

Rogers admitted that over the years his model had been oversimplified and he criticized the "stereotyped and limited ways in which many diffusion scholars have defined the scope and method of their field of study" (2003, p. xix). He blamed DOI researchers for being more oriented to the dependent variable of adoption, than to actual implementation itself or to studying the consequences of innovation. Rogers suggested also researching cases of nonadoption, delayed adoption, or radical changes in the usage of technology: "The problem is that we know too much about innovation successes and not enough about innovation failures" (2003, p. 111). He conceded that anthropological methods and longitudinal studies could offer better assessments of the process of innovation than the quantitative surveys that are usually the trademark of many DOI studies.

DOI theory has been criticized for being techno-deterministic because a crucial aspect of his adoption model is related to the perceived characteristics of the technology. However, he argued that his model understands innovation as a process of communication through which members of a social system share information to achieve a mutual understanding of the technology: "The meaning of an innovation is thus gradually worked out through a process of social construction" (2003,

p. xxi). Rogers proposed understanding the social structure of an organization as a communication network and shifting the unit of analysis from the individuals to their relationships.

Several basic premises of DOI theory need a careful reconsideration in the context of the networked and complex technologies because they do not offer adequate constructs to deal with collective adoption behaviors (including the critical role of standards, critical mass, network externalities, sunk costs, path dependence, etc.). DOI researchers should be careful in analyzing the impact of the nature and meaning of technology, the role of institutional policies and regimes, the impact of industrial policies and strategies, and the importance of the installed base and learning inertia. In many cases, DOI models are not able to explain the adoptions of new technologies. Instead, the diffusion "factors" had to be changed radically due to the complex and networked nature of the technology, that is, by expanding the scope and timescale of the diffusion study.

A lack of consistency in operationalizing innovativeness, resulting in the interchangeable use of the constructs "innovation" and "innovativeness" to define innovation types, was also reported (Garcia & Calantone, 2002). This led to incongruent categorizations of innovation typology and widespread confusion as to what empirical studies were finding. For example, an innovation that one researcher may term "really new" is labeled "radical" or "discontinuous" by another researcher.

The dominant perspective in the DOI literature contains pro-innovation biases which suggest that the DOI will benefit adopters (Abrahamson, 1991). As a result, it is difficult to address questions such as when and how do technically inefficient innovations diffuse or when and how are technically efficient innovations rejected. Abrahamson (1991) recommends developing more encompassing theories of innovation diffusion and rejection by using the theoretical tensions that exist between the dominant perspective, and he argues that processes which prompt the adoption of efficient innovations may coexist with processes that prompt the adoption of inefficient ones.

Issues for further research

There is a need to fully describe the interaction between the innovation, the adopter, the social system, and the other influencers of adoption, exploring how these units of the theory relate to DOI within organizations (Lundblad, 2003). New technologies may also foster exploring innovation opportunities, but innovations create uncertainty in technical, financial, and social aspects of the organization; therefore, the process of diffusion is based on reducing uncertainty through information. While the body of research related to innovations within organizations grows, little is said about diffusion across organizations in Rogers's theory, leaving a real gap in such fields as public health and education (Lundblad, 2003). More empirically tested propositions, stemming from current DOI theory, could advance its application.

Research examining the determinants of successful innovation diffusion is both relatively common and, for the most part, internally consistent (MacVaugh & Schiavone, 2010). Innovation diffusion is affected by technological, social and learning conditions while operating in the contextual domain of the individual, the community or the

industry. Accepting that diffusion of innovations is neither uniform nor inevitable, MacVaugh and Schiavone (2010) investigate limits to adoption that new technological innovations are likely to find from competition with nonuse of technology and/or more traditional technologies.

As the communication revolution continues to unfold, there is an opportunity for theory building on diffusion within and across organizations, and to better link DOI research to Rogers's core theoretical base. By pursuing integrative perspectives, scholars can strive for new theoretical thinking that expands diffusion theory to consider the challenges associated with interactive digital technologies as well as the changing policy environment in contemporary societies. A key challenge is to move beyond the models of the past and to keep broadening the conceptions of DOI theory in the network society.

SEE ALSO: Case Study Research; Digital Inclusion: Factors Related to Internet Adoption; Information Seeking; Measurement of Attitudes; Stages of Change

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