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DIFFUSION OF INNOVATIONS

Theoretical Extensions

◆ Ronald E. Rice

◆ *Brief Overview and History of Diffusion of Innovations Theory*

Diffusions of innovations (DOI) theory (Rogers, 2003) is probably the most cited, summarized, and applied of all communication theories. By 2003, there were already over 5,000 publications in this area (Rogers, 2004), and a search for "diffusion of innovations" in June 2008 found 29,000 citations in Google Scholar. *Diffusion* is the process through which an innovation (an idea, product, technology, process, or service) spreads (more or less rapidly, in more or less the same form) through mass and digital media, interpersonal and network communication, over time, through a social system, with a wide variety of consequences. Underlying the components of the diffusion process is the extent to which various actions, perceptions, communication processes and sources, and social norms and structures sufficiently reduce the potential adopter's *uncertainty* regarding the innovation. Figure 32.1 organizes the main components and their relationships in DOI theory.

Media and interpersonal *communication* and the wider *social system* both affect all aspects of these components. An individual in a social system may become aware of an innovation through mass or digital

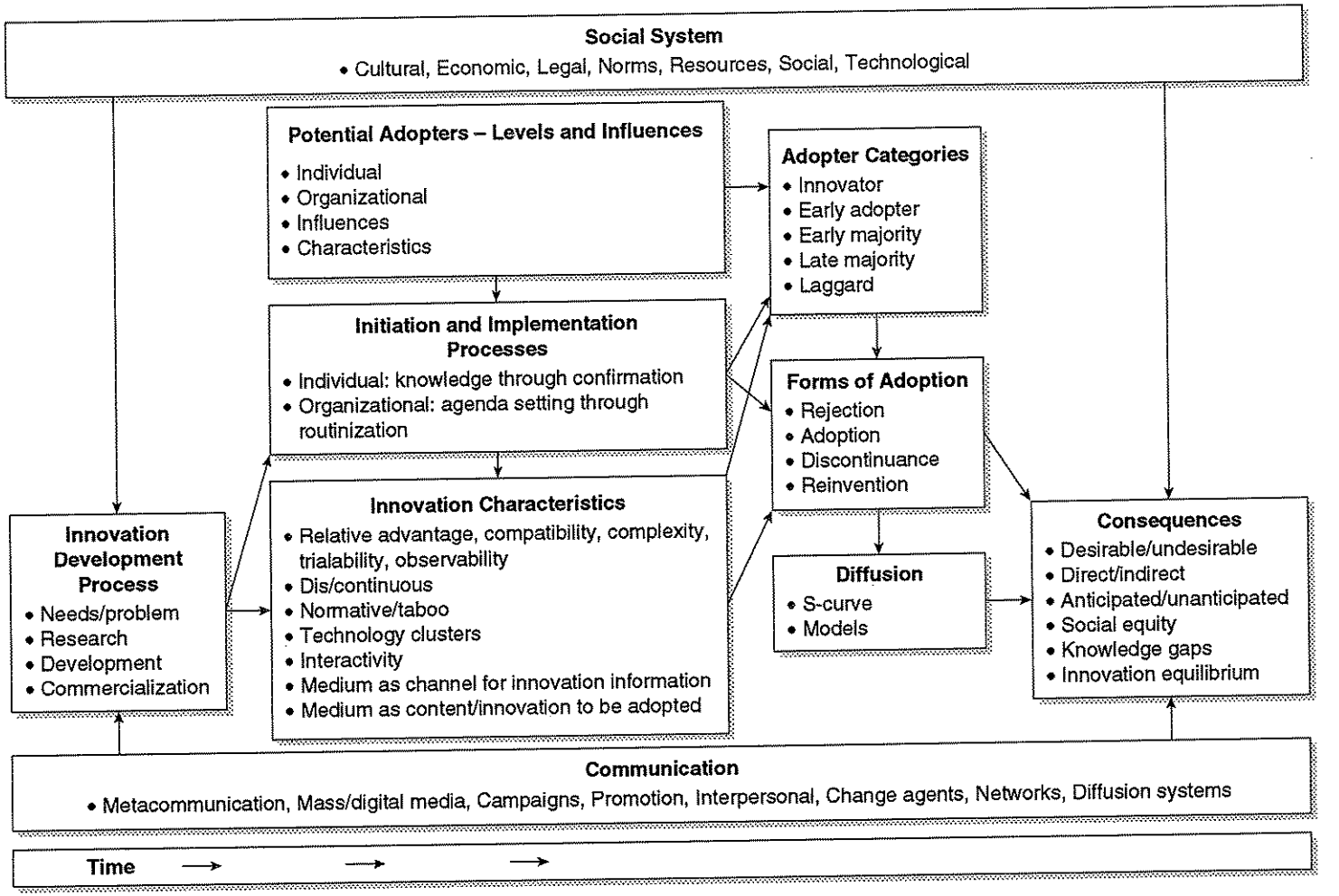

Figure 32.1 Main Components of Diffusion of Innovations Theory

media and individually choose to adopt it, or may be persuaded through interpersonal communication by influential peers. Unequal social structures, regulatory policies, and industry trends highly constrain what kinds of innovations are available and to whom.

During the *innovation development process,* actors ranging from individual entrepreneurs and collaborative users through governmental agencies and corporations attempt to identify needs and/or problems, conduct research on the ways to solve those problems, develop the innovation, and commercialize or otherwise promote it. *Potential adopters* may be individuals, groups, communities, organizations, governments, and so on, and may be affected by higher-level prior adoption decisions. The characteristics of and influences on these potential adopters affect their adoption perceptions and behaviors. These potential adopters must go through an *innovation-decision process,* consisting of first *initiation* and then *implementation* subprocesses.

During these processes, potential adopters develop perceptions of the *innovation characteristics,* which are influenced by peers, change agents, mass media portrayals, social norms, the kinds of innovation information needed, initial experiences, and, in some cases, the adoption by others. A particularly intriguing aspect of this theory relevant to media effects is that a medium can be a channel for communication about an innovation, but also an innovation itself (Rice, 1987).

The characteristics and social contexts of the potential adopters, the stage and outcomes of the initiation and implementation processes, and the perceived innovation characteristics influence one's *adoption category* (innovators, early adopters, early majority, late majority, and laggards). The initiation and implementation processes, the innovation characteristics, and one's adoption category all influence the timing, extent, and *form of the adoption.*

The timing and form of adoption in turn affect and constitute the rate of *diffusion of the innovation* throughout the social system. To the extent that the adoption times are normally distributed (the basis for the five adopter categories), the cumulative number of adopters over time is the well-known *S-shaped diffusion curve. Adoption* is an individual or organizational action (emphasizing the adopter's perspective), while *diffusion* is the spread over time of the innovation (emphasizing the supplier's, market's, and society's perspective). The innovation's diffusion through the social system generates various individual and social *consequences.*

Many of the foundations of DOI theory were developed at the beginning of the 20th century. Gabriel Tarde argued that what he called "imitation" was the basic source of social change, and he developed now-familiar concepts such as the diffusion S-curve, opinion leaders, and compatibility. Georg Simmel emphasized social influence on innovation through the role of the "stranger" who brings new ideas into a social system, heterophily, cosmopoliteness, and social networks. Early on, Rogers (1962) synthesized what had been separate, though converging, disciplinary approaches to diffusion in his *Diffusion of Innovations.* He particularly emphasized the role of the classic Ryan and Gross (1943) hybrid seed corn study through Iowa State University, which integrated and clarified many of the concepts within a primarily quantitative framework that established the DOI paradigm (Rogers, 2003, 2004).

The two-step flow model (Katz & Lazarsfeld, 2005/1955) highlighted the role of opinion leaders in filtering, interpreting, and diffusing mass media messages. Also influential was Coleman, Katz, and Menzel's (1966) analysis of physicians' adoption of prescribing the antibiotic tetracycline. By analyzing data about the doctors' individual backgrounds, their communication networks with the other

doctors, and the local pharmacies' records of when the doctors first prescribed the new drug for their patients, they established the importance of communication networks in influencing individual adoption and thus the rate of diffusion throughout the social system.

The following sections briefly discuss some central issues and theoretical extensions of each of the DOI model's components, ending with some critiques of DOI.

◆ *Communication and the Diffusion Process*

All components of the diffusion model are potentially influenced by communication activities, from mass, digital, and local media, to interpersonal and change agent interactions (Kotler & Roberto, 1989, p. 127).

MASS AND DIGITAL MEDIA

The mass media play a central role in diffusing new ideas throughout a social system, especially in generating awareness of the innovation and providing information for opinion leaders to filter and discuss with their social system members. We may consider several mass media theories, alternate conceptualizations of mass media, and the growing importance of digital media as relevant to DOI theory.

News diffusion and agenda setting. The diffusion of news (e.g., about explosions, assassinations, celebrity gossip) was a central and early focus of mass media (DeFleur, 1987) and communication-oriented diffusion research (Rogers, 2003), and this persists as a central topic of media effects research (Lim & Kim, 2007; Perse, 2001; see also Allport & Postman, 1947). More specifically, agenda-setting research (see Shah et al., this volume) may be conceptualized as a special case of the study of news diffusion, as it analyzes how social issues that become part of the mass media agenda, through frequent and highlighted coverage, in turn, are raised higher on the public's agenda (McCombs & Shaw, 1972). *Bandwagon* and *underdog* effects of media coverage of opinion polls on voting are other forms of agenda-setting diffusion effects, especially for political nonelites (Perse, 2001).

Communication campaigns. A second major area of media effects research is the study and implementation of programs intended to change knowledge, attitudes, and behaviors at both the individual and social level through well-designed and evaluated communication-based interventions, or communication campaigns (Rice & Atkin, 2001). This research field overlaps with DOI in that campaign goals include diffusing information and practices throughout a social system over time, through mass, interpersonal, and social network communication. Rogers (2003) particularly highlights the successes of using mass media in edu-entertainment campaigns in fostering improved health, agricultural productivity, economic development, and prosocial norms in less developed countries.

Local media. Traditional definitions of "mass media" may unnecessarily limit our understanding of how media influence diffusion processes. Lin and Burt (1975) found that in underdeveloped areas, mass media and local media (announcers, leaflets, educational and government offices) are predicted by different demographic factors and have different influences on participation in adoption. For example, people who used local media more tended not to own radios and were well integrated into the local communication network.

Digital media. Digital media (e-mail, Internet, mobile phones, etc.) have also been considered for how they affect DOI, as well as how they themselves are diffused and adopted. Initially, because of their asynchronous and text-based nature, new media were not considered to be successful channels for innovative ideas, which supposedly require contextualization and

interpretation through face-to-face communication. However, it quickly became clear that given their ability to overcome the traditional communication and mass media barriers of time and location via asynchronous sending and receiving, Internet and mobile communication allow for message tailoring, two-way interaction, searching, and sharing of knowledge among unknown others, greatly expanding the opportunities for the diffusion of new ideas (Rice, 1987; Rice & Webster, 2002). Communication research about information diffusion is especially relevant in the Internet era, where rumors and inaccurate or dangerous political or health information can spread nearly instantaneously, and be both reinforced and challenged in blogs, discussion lists, personal Web pages, etc. (Bordia & DiFonzo, 2004; Rice, 2001; Walker & Gibbons, 2006).

INTERPERSONAL COMMUNICATION AND SOCIAL NETWORKS

Interpersonal communication is particularly important in reducing uncertainty about an innovation as potential adopters turn to similar, trusted, or close—that is, *homophilous*—others for insights, interpretations, attitudes, and experiences, especially during the persuasion and decision-making phases (Rogers, 2003). A major influence on normative acceptance of an innovation is the social system's *opinion leaders* and the extent to which potential adopters communicate with them (Coleman, Katz, & Menzel, 1966). Similar to the *change agent,* who represents the organization or agency sponsoring the innovation and who works with opinion leaders and other clients to develop an understanding of the costs and benefits of the innovation, the *technology champion* in organizational contexts plays a significant interpersonal role in influencing the adoption of new organizational media (Howell & Higgins, 1990).

More specifically, one's location in a social system's *communication network* strongly affects the speed and extent of information/adoption diffusion (Valente, 2005). Weak ties—infrequent communication with those who are not close—provide exposure to new ideas and information (Granovetter, 1973). Frequent social or physical exposure to salient others is then crucial for reducing uncertainty about the innovation, fostering supportive social norms, and persuading potential adopters (Rice, 1993a). Now, social networking Web sites enable rapid diffusion of information and norms (Wang, Carley, Zeng, & Mao, 2007). The importance of interpersonal communication networks in combination with targeted media messages on DOI has been popularized through concepts such as the tipping point (Gladwell, 2000; related to a *critical mass* of adopters, Markus, 1987) and new product "buzz" (Rosen, 2000).

Network influences also provide explanations for how initial minority views about innovations generate widespread diffusion. Once innovators and those who may have more resources or can obtain early benefits adopt, then those with higher *network adoption* thresholds will be more open to adoption (Valente, 2005). *Bounded normative influence* explains how a minority, through network centrality, persuasiveness, consistency, confidence, commitment, and difficulty of expelling deviants, may succeed in establishing their norm as a majority norm, especially if the majority is not well articulated, is ambiguous, misperceives the situation, or has low commitment (Kincaid, 2004).

♦ *Social System(s) and the Diffusion Process*

Social system conditions include economics, network cooperation, power relations, governmental policies, competition/cooperation, and standardization (Andriessen,

1994). O'Callaghan (1998) emphasized that individual organizations rarely adopt an innovation in isolation from the surrounding industry. Diffusion of a technology throughout an industry can change organizational and industry perceptions of the innovation through increased knowledge of the technology, applications, benefits, and reduced risk, as well as develop positive network externalities of supporting innovations, which in turn influence later adaptations and likelihood of adoption by other organizations. Historical analyses of technological innovations clearly reveal the wide range of prior developments, path dependencies, and actor networks fostering or constraining an innovation (e.g., Aikat, 2001; Sedman, 1998; Streeter, 1996).

A theoretical approach to understanding the complex social, technological, and economic context of DOI is *mediamorphosis*, or "the transformation of communication media, usually brought about by the complex interplay of perceived needs, competitive and political pressures, and social and technological innovations" (Fidler, 1997, p. xv). In the case of media innovations, these include, for example (Fidler, 1997; Winston 1998), (1) competition (e.g., between radio and TV); (2) new opportunities and needs fostered by other innovations (e.g., the development of stereo audio recordings stimulating the advantage of FM over AM radio); (3) regulation and technical standards (e.g., changes in copyright and cross-ownership criteria; Rice, 2008a); and (4) economic factors (e.g., microprocessor chip costs). More general theoretical approaches to the evolution, diffusion, shaping, and application of technological innovations include social construction of technology, co-construction of technology, sociotechnical systems theory, and path dependence.

◆ *The Innovation Development Process*

Many of the social systems approaches may be seen as explaining general contexts for, as well as specific aspects of, the innovation development process. Understanding this process is the goal of a vast realm of studies on research and development, technology and innovation management, technology transfer, entrepreneurship, marketing/promotion, financing, licensing/patents/copyrights, and so on. However, Rogers (2003) recommends greater attention to how the social system fosters and constrains both the initial development of innovations and their form and features before adopters even become aware of the innovation.

Scientific and technical communication among researchers, both within and across organizations, through media (such as specialist journals and online discussion lists) and interpersonal networks (gatekeepers, conferences, local professional networks) is a central topic of R&D and organizational innovation research (e.g., Rice, 1987). Diffusing the innovation beyond the initial innovators and early adopters is a particularly risky and difficult process, especially for discontinuous technology innovations, as discussed later in this chapter.

◆ *Potential Adopters–Levels and Influences*

INDIVIDUAL CHARACTERISTICS AND INFLUENCES

Innovativeness is conceptualized as relative earliness in adopting an innovation and being receptive to new ideas independent of others' influence (Lin, 1998), and can be categorized into two types: *inherent* innovativeness (tendencies or drives) and *actualized* innovativeness (behaviors). Innovativeness is positively related to other individual characteristics such as SES, and to earlier adoption (Rogers, 2003), and has been shown to moderate the relationship between perceived innovation attributes and adoption decisions (Agarwal & Prasad, 1998).

Adoption may also be influenced by other individual factors, such as media

use (though research is not consistent), technology ownership/experience/expertise, demographics (age), personality (such as dogmatism), obstacles to innovation (access), and needs and expected gratifications (entertainment). Other factors include task characteristics (interdependency, equivocality), contexts (other users, situational constraints), technical (standards, technological literacy), social influences (peers, status), communication competence, mental models (blogs as journalism or opinion), and user attitudes (expected benefits, costs; Andriessen, 1994; James, Wotring, & Forrest, 1995; Jeffres & Atkin, 1996; Lin, 2002; Rice, 1987; Rice & Webster, 2002). Indeed, individual demographic and access factors capture most of the factors representing the *digital divide* (markedly differential adoption of the Internet) in the United States (Katz & Rice, 2002), although these factors combine somewhat differently to explain adoption patterns for the Internet and mobile phones (Rice & Katz, 2003). Recently, there have also been some notable attempts to integrate individual characteristics within a range of theoretical perspectives to better understand their role in the adoption, use, and diffusion of communication/information technologies (see Rice & Webster, 2002; Van den Hooff, Groot, & de Jonge, 2005).

ORGANIZATIONAL CHARACTERISTICS AND INFLUENCES

In many cases, organizations (in the DOI model, broadly meaning any collectivity of people, including departments, organizations, communities, states, etc.) must adopt an innovation (which may include technical standards or underlying infrastructure) before individual members have the possibility (whether by choice or requirement) of also adopting the innovation (what is called a *contingent* adoption decision).

Organizational characteristics, such as size, formality, complexity, centralization, and slack resources, also influence innovation adoption. In the media industry, because digital information can be easily distributed, repackaged, and cross-promoted, organizational characteristics, such as vertical and horizontal integration, can both foster innovation (multiplatform programming) and stifle it (excessive copyrights, suppressed independent production; Rice, 2008a). An *innovative organizational culture* is characterized by the ability to manage its environments, a proactive support of appropriate human activity, pragmatic assessments of truth, medium-length time horizons, an assumption that people are generally good and capable of improvement, a positive view of individualism and diversity, support for participation appropriate to the type of innovation, and diverse but connected subcultures (Schein, 1994).

◆ *Initiation and Implementation Processes at the Individual and Organizational Level*

Because of the need to reduce their uncertainty about an innovation, both individuals and organizations must go through several phases before making the decision and then integrating the innovation into regular use. For individuals, these phases include knowledge/awareness, persuasion decision, implementation, and confirmation. For organizations, they include agenda setting, matching, redefining, clarifying, and routinization. The first three individual phases and the first two organizational phases are more generally considered *initiation* processes (and are arguably the foci of some media effects research), whereas the latter individual and organizational phases are considered *implementation* processes (Rogers, 2003; Wirsan & Muller, 2006). These phases are not necessarily sequential, as experiences and decisions in one phase may require returning to an earlier phase.

O'Callaghan (1998) felt that the organizational adoption process is perhaps the least useful part of the DOI model because it provides no insight into the often extremely time-consuming, risky, and often unsuccessful *technology implementation process* (Andriessen, 1994; Cooper & Zmud, 1990; Johnson & Rice, 1987). His more comprehensive diffusion process model included (1) preexisting organizational and environmental context, (2) technology assessment, (3) planning and adoption decision, (4) usage or internal diffusion, and (5) organizational changes (1998, p. 399). Andriessen's (1994) organizational-level diffusion of innovation model included (1) creation in the industry (research and development), (2) transfer to the organization (diffusion often requiring adoption, by a cluster of organizations, then adoption within a particular organization), and (3) introduction into the organization (design/implementation and incorporation, within different contexts).

◆ *Innovation Characteristics*

The likelihood and form of adoption are influenced by how potential adopters perceive the primary *innovation characteristics* of relative advantage, complexity, trialability, compatibility, and observability/communicability. Other central characteristics include *ease of use* and *usefulness,* central concepts in the technology acceptance model (TAM), which is typically applied to understanding the adoption of information technologies in organizational settings (Venkatesh, Morris, Davis, & Davis, 2003). Moore and Benbasat's (1991) review of information systems research concluded that relative advantage (similar to perceived usefulness), compatibility, and complexity (similar to perceived ease of use) had the most consistent influences on adoption. Fidler (1997) added another innovation attribute: *bridges of familiarity.* These include links to the past, whereby new media initially incorporate (and may be limited by) both technological and social forms from prior media, though these then are elaborated, transformed, and replaced over time. Bridges of familiarity also include metaphors, whereby both media messages and design elements provide ways of understanding and contextualizing new media characteristics through familiar metaphors, such as computer "desktops" or early TV programs replicating radio shows (see Jensen, 1990, for a discussion of how responses to media that are new at the time, such as radio and TV, take the form of one of four general metaphors).

Vishwanath and Goldhaber (2003) developed an integrated TAM/DOI model specifically to predict possible intention of adoption by mobile phone *nonadopters* (there were many more of those in 2002!). The interesting approach here was using perceived innovation attributes as *mediators* between typical TAM and DOI influences. The model almost perfectly fit the data, showing that demographics influenced communication factors, such as media use, new media ownership, and change agent contact (sales representatives and friends), which in turn differentially affected perceptions of relative disadvantages, perceived complexity, lack of observability, and perceived incompatibility, which in turn fostered a negative attitude toward using mobile phones, leading to decreased behavioral intention. Rice and Webster's (2002) integrated model also portrayed innovation attributes as mediators between exogenous influences and adoption, diffusion, and use of new media.

Other distinctions among innovation characteristics include *incremental* vs. *radical/discontinuous, administrative* vs. *technological, process* vs. *product,* and *content* vs. *role/process* (Robertson, 1971; Schein, 1994). For example, HDTV is a radical innovation because it requires discontinuous changes in technical standards, program production, and TV sets, and allows new content in the form of digital

information used for tracking, retrieving, and reprocessing of program content. However, the actual viewing experience and program content may change only incrementally. Further, a new medium may be perceived by a potential adopter as fitting into an acceptable *technology cluster,* conceptualized as either the extent to which technologies similar to the innovation have already been adopted by the individual, or as interrelated components of a technological innovation (LaRose & Atkin, 1992; Lin, 2002).

As noted earlier, with respect to DOI, media (mass and digital) are unique in that they may be channels for information and influence about an innovation, as well as innovations to be diffused and communicated about, and in some cases both in the same study (Rice, 1987). For example, Rice (1993b) found that peer influence in organizational settings about perceptions of social presence in various media was a significant factor only about the newest medium (desktop video conferencing) and then only when communicated through that medium itself.

◆ *Adopter Categories*

Although adopter categories have traditionally been divided into the five groups described earlier (innovator, early adopter, early majority, late majority, and laggard), recent research has explored alternative ways of grouping potential adopters. For example, Lin (1998) created *nonadopter, likely adopter,* and *adopter* groups, which were statistically distinguished by many of the usual new media predictors (such as demographics, innovativeness, less TV viewing, and other communication technology adoption). Von Hippel (1986) introduced the distinctive category of *lead users,* who contribute to product concept and design and foreshadow the needs of the general marketplace, and thus are especially relevant during the innovation development process. Another newer distinction is between *innovators*—those who make their decision to adopt independently based on their innovativeness and awareness of the innovation through media—and *imitators*—those influenced by the nature and timing of others' adoption (O'Callaghan, 1998). This distinction is the basis for the Bass diffusion model, described in the following section.

Finally, a pragmatic extension to the traditional adopter categories is the concept of a *chasm* between early and later adopters, relevant for discontinuous (primarily technological) innovations (Moore, 2002). Firms must *cross the chasm* from an early market dominated by a few *visionary* customers (innovators and early adopters) who are interested in the sophisticated technology features or the status of early adoption, to a mainstream market dominated largely by *pragmatists* (early majority) and *conservatives* (late majority), who look for value, maintenance of ongoing practices, and ongoing vendor support.

◆ *Forms of Adoption*

The concept of adoption is more complex than a simple binary use/no use. Adoption may involve *purchase, usage, acceptance, resistance, discontinuance, avoidance,* or *reinvention/adaptation.* At-risk audiences may well adopt the knowledge and attitudes promoted by a communication campaign, but not alter their practices. Organizational adoption of a new medium, such as shared online calendars, may require usage but not gain acceptance (Hiltz & Johnson, 1989). An innovation, once adopted, may later be discontinued, such as when a newer technology achieves *critical mass* (the number of users sufficient to stimulate and justify adoption by other members of the social system; Kraut, Rice, Cool, & Fish, 1998; Markus, 1987). Fidler (1997), for example, provided a detailed

analysis of the eventual diffusion failure of teletext, after several national trials and services.

One particularly interesting form of adoption is *reinvention,* or the adaptation of an innovation after adoption (Hays, 1996; Johnson & Rice, 1987), which includes the development of new features and applications of the initial innovation. The telephone and the mobile phone, for example, are exceptionally rich contexts for reinvention with a constantly changing diversity of bundled services and features. Such reinventions pose considerable challenge to the traditional adoption/diffusion model of a dichotomous adoption of a fixed innovation (LaRose & Atkin, 1992; Wirth, von Pape, & Karnowski, 2008).

There are many mass media, sociological, and organizational theories potentially applicable to understanding reinvention (Wirth et al., 2008). *Uses-and-gratifications* theory emphasizes the active choice and reinvention by users in selecting and applying media (Blumler & Katz, 1974; Rubin, this volume). Sociological approaches such as *domestication* (Silverstone & Haddon, 1996) and *social shaping of technology* (Lievrouw & Livingstone, 2002; MacKenzie & Wajcman, 1999) show how adopters can project their own interpretations and derive their own meanings about both mass media (TV use in the home) and new media (mobile phone use by teenagers) to make them more useful and meaningful. *Frame analysis* has been used by Ling (2004) to analyze mobile phone use. Because social norms lag behind technological diffusion, people apply current *normative frames* to try to make sense of, and understand how to use, this malleable and changing medium. Studies of adoption of information/communication technologies in organizations apply the concept of *adaptive/technology structuration* (e.g., Majchrzak, Rice, Malhotra, King, & Ba, 2000; Poole & DeSanctis, 1990). A related concept as applied to reinvention in new media is *metacontrol,* the negotiation of the shaping of user control options—an unintended consequence of converging digital media resulting in detailed personalization of a new medium (Kilker, 2003).

◆ *Diffusion of an Innovation Through a Social System Over Time*

The traditional DOI theory largely focuses on predicting adoption by individuals or organizations, rather than diffusion per se. *Diffusion* is the cumulative number of adopters over time, and may be represented through different visual curves and statistical models, taking into account factors such as supplier marketing, environmental influences, market capacity, competition, and so on (Wirsan & Muller, 2006). Kotler and Roberto (1989, p. 120) described three kinds of diffusion curves. The *rapid penetration* model identifies the likely percentage of total adopters from the population (say, 40%) over time, and the percentage of remaining adopters likely to adopt in each time period, leading to the ceiling adoption level. The *gradual penetration* diffusion model is the typical S-curve (central to the DOI theory), with a normal distribution of adopters in each time period, using the standard adopter categories, with an initial adoption rate, a rapid *take-up* portion, and a leveling off to the maximum adoption percentage. The *contagion-like,* or Bass (1969), diffusion model takes into account the separate influences of media and of prior adopters on nonadopters. Showing that the Bass diffusion model nicely fits data about U.S. radio, TV, cable, VCR, and the home computer, Dimmick and Wang (2005) proposed that such media are adopted to the extent that adopters anticipate deriving various gratification utilities before adopting the medium. Applying a diffusion approach to agenda setting, Fan (1988) compared time-series analysis of computer-generated content analyses of media coverage with time-series analysis of

opinion poll results about various issues, essentially showing the influence of media content on the subsequent diffusion of public agenda issues over time.

Due to the Internet and digital markets, the diffusion curve has been extended both temporally and conceptually, resulting in what Anderson (2006) called the "long tail." Storage, search, retrieval, and distribution costs of digital information are nearing zero. Potential adopters can access a Web site providing media products and content from around the world. Collaborative filtering and recommender software can introduce people to otherwise unknown, but appropriate, products. Thus, companies or individuals can now maintain inventories of, and make money from, otherwise obscure and niche products. All of these factors extend the right side of the diffusion curve along the full length of the "long tail," often leading to even more total adopters than associated with media "hits" and "bestsellers," and making media content (books, music, art) available that otherwise would have been removed from physical inventory.

♦ *Consequences of Innovation Adoption and Diffusion*

The implementation and diffusion literature provides many frameworks for identifying and evaluating the direct/indirect, short-term/long-term, intended/unintended, and positive/negative social consequences of innovation adoption (O'Callaghan, 1998; Rice, 2008b; Tenner, 1997). Perhaps those that have received the most attention are those that involve the negative and/or unintended consequences of diffusion. Like the unintended consequences of media campaigns, such as boomerang effects where at-risk audiences develop greater awareness of, more positive attitudes toward, or engage more in, the risky behavior (such as youth drug use; Hornik et al., 2003), innovation diffusion may also backfire, spreading too quickly for a social system to adapt, creating disequilibrium and dysfunctional feedback loops (especially in complex technological and biological systems; Tenner, 1997).

In addition, as Rogers (2003) has claimed, without proactive policies and diffusion strategies, innovations in general tend to *increase* socioeconomic inequalities. This point is supported by research on the knowledge gap hypothesis, which highlights how, for example, the diffusion of educational information through the media may raise knowledge levels of children overall, but will benefit those who are already higher in socioeconomic status (SES), further widening the knowledge gap (Tichenor, Donohue, & Olien, 1970).

The adoption and diffusion of media itself has significant economic consequences, both as *factors affecting the adoption* (the technology and service), and as *outcomes,* such as increased distribution of information about production and purchasing of goods and services (Dimmick & Wang, 2005). Economic aspects of media structures (such as concentration of media outlets and ownership by nonmedia corporations) affect the diffusion of information about the media itself and its content (such as controversial topics, critiques of the media organization or its owners, or new reporting resources; Rice, 2008a).

♦ *Critiques and Conclusion*

DOI theory has been criticized on a number of grounds. Rogers (2003), for example, has noted several biases in the theory, including the *pro-innovation* and the *individual blame* biases. Other, more recent, challenges focus on the need to broaden the scope of diffusion research to consider all the factors leading up to public access to the innovation, and involving relevant communities in any diffusion efforts (Kreps & Hider, 2004). Cooper (1998) emphasized the need to consider multiple dimensions of innovations, each of which may be associated with somewhat different influences

and adoption processes. Rogers (2003) also suggested the need for a much wider array of methodologies than the traditional cross-sectional survey employed, in which only a single innovation is examined from the adopters' perspective, using recall data from relatively late in the diffusion process. Newer methodological approaches might include panel studies for causal analysis, point-of-adoption data collection, archival records, quasi-experimental field studies, technological forecasting, network analysis, and qualitative evidence (Klopfenstein, 1989; Valente, 2005).

The diffusion of innovations theory is a complex and comprehensive interdisciplinary framework for understanding how new ideas diffuse (or not) through a social system. Central to the process is the role of mass and digital media, in combination with interpersonal communication and social networks, in reducing the potential adopter's uncertainty. I hope this chapter has served as a means to appreciate not only the richness of the theory but also the unique role of media as both the channel for communicating and providing information about an innovation, as well as (especially with digital media) an innovation itself.

♦ References

Agarwal, R., & Prasad, J. (1998). The antecedents and consequents of user perceptions in information technology adoption. *Decision Support Systems, 22,* 15–29.

Aikat, D. (2001). Pioneers of the early digital era: Innovative ideas that shaped computing in 1833–1945. *Convergence: Journal of Research into New Media Technologies, 7*(4), 52–81.

Allport, G. W., & Postman, L. J. (1947). *The psychology of rumor.* New York: Holt, Rinehart & Winston.

Anderson, C. (2006). *The long tail: Why the future of business is selling less of more.* NY: Hyperion.

Andriessen, J. H. E. (1994). Conditions for successful adoption and implementation of telematics in user organizations. In J. H. E. Andriessen & R. Roe (Eds.), *Telematics and work* (pp. 411–439). Hillsdale, NJ: Erlbaum.

Bass, F. M. (1969). A new product growth for model consumer durables. *Management Science, 15*(5), 215–227.

Blumler, J. G., & Katz, E. (1974). (Eds.) *The uses of mass communications: Current perspectives in gratifications research.* Beverly Hills, CA: Sage.

Bordia, P., & DiFonzo, N. (2004). Problem solving in social interactions on the Internet: Rumor as social cognition. *Social Psychology Quarterly, 67,* 33–49.

Coleman, J. S., Katz, E., & Menzel, H. (1966). *Medical innovation: A diffusion study.* New York: Bobbs-Merrill.

Cooper, J. R. (1998). A multidimensional approach to the adoption of innovation. *Management Decision, 36*(8), 493–502.

Cooper, R., & Zmud, R. (1990). Information technology implementation research: A technological diffusion approach. *Management Science, 36*(2), 123–139.

DeFleur, M. L. (1987). The growth and decline of research on the diffusion of news, 1945–1985. *Communication Research, 14,* 109–130.

Dimmick, J., & Wang, T. (2005). Toward an economic theory of media diffusion based on the parameters of the logistic growth equation. *Journal of Media Economics, 18*(4), 233–246.

Fan, D. P. (1988). *Predictions of public opinion from the mass media.* New York: Greenwood Press.

Fidler, R. (1997). *Mediamorphosis: Understanding new media.* Thousand Oaks, CA: Pine Forge Press.

Gladwell, M. (2000). *The tipping point: How little things can make a big difference.* New York: Little, Brown & Co.

Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology, 78,* 1360–1380.

Hays, S. P. (1996). Influences on reinvention during the diffusion of innovations. *Political Research Quarterly, 43*(3), 631–650.

Hiltz, S. R., & Johnson, K. (1989). Measuring acceptance of computer-mediated communication systems. *Journal of the American Society for Information Science, 40*(6), 386–397.

Hornik, R., Maklan, D., Cadell, D., Barmada, C. H., Jacobsohn, L., Prado, A., et al. (2003). *Evaluation of the National Youth Anti-Drug Media Campaign: Fifth semi-annual report of findings.* Washington, DC, Report by Westat to Office of National Drug Control Policy, National Youth Anti-Drug Campaign.

Howell, J. M., & Higgins, C. A. (1990). Champions of technological innovation. *Administrative Science Quarterly, 35,* 317–341.

James, M. L., Wotring, C. E., & Forrest, E. J. (1995). An exploratory study of the perceived benefits of electronic bulletin board use and their impact on other communication activities. *Journal of Broadcasting and Electronic Media, 39,* 30–50.

Jeffres, L. W., & Atkin, D. (1996). Predicting use of technologies for consumer and communication needs. *Journal of Broadcasting & Electronic Media, 40,* 315–330.

Jensen, J. (1990). *Redeeming modernity: Contradictions in media criticism.* Thousand Oaks, CA: Sage.

Johnson, B., & Rice, R. E. (1987). *Managing organizational innovation: The evolution from word processing to office information systems.* New York: Columbia University Press.

Katz, E., & Lazarsfeld, P. F. (2005). *Personal influence: The part played by people in the flow of mass communication* (Rev. ed.). New Brunswick, NJ: Transaction Publishers. (Original work published 1955)

Katz, J. E., & Rice, R. E. (2002). *Social consequences of Internet use: Access, involvement and interaction.* Cambridge, MA: MIT Press.

Kilker, J. (2003). Shaping convergence media: "Meta-control" and the domestication of DVD and Web technologies. *Convergence: The International Journal of Research Into New Media Technologies, 9*(3), 20–39.

Kincaid, D. L. (2004). From innovation to social norm: Bounded influence. *Journal of Health Communication, 9*(6), 37–57.

Klopfenstein, B. C. (1989). Problems and potential of forecasting the adoption of new media. In J. Salvaggio & J. Bryant (Eds.), *Media use in the Information Age: Emerging patterns of adoption and consumer use* (pp. 21–41). Hillsdale, NJ: Erlbaum.

Kotler, P., & Roberto, E. L. (1989). *Social marketing: Strategies for changing public behavior.* NY: Free Press.

Kraut, R., Rice, R. E., Cool, C., & Fish, R. (1998). Varieties of social influence: The role of utility and norms in the success of a new communication medium. *Organization Science, 9*(4), 437–453.

Kreps, G. L., & Hider, M. (2004). Forty years of diffusion of innovations: Utility and value in public health. *Journal of Health Communication, 9*(6), 3–11.

LaRose, R., & Atkin, D. (1992). Audiotext and the re-invention of the telephone as a mass medium. *Journalism Quarterly, 69,* 413–421.

Lievrouw, L., & Livingstone, S. (Eds.). (2002). *Handbook of new media: Social shaping and social consequences.* London: Sage.

Lim, T.-S., & Kim, S. Y. (2007). Many faces of media effects. In R. Preiss, B. M. Gayle, N. Burrell, M. Allen, & J. Bryant (Eds.), *Mass media effects research: Advances through meta-analysis* (pp. 315–325). Mahwah, NJ: Erlbaum.

Lin, C. A. (1998). Exploring personal computer adoption dynamics. *Journal of Broadcasting & Electronic Media, 42,* 95–112.

Lin, C. A. (2002). Perceived gratifications of online media service use among potential users. *Telematics and Informatics, 19*(1), 3–19.

Lin, N., & Burt, R. S. (1975). Differential effects of information channels in the process of innovation diffusion. *Social Forces, 54*(1), 256–274.

Ling, R. (2004). *The mobile connection. The cell phone's impact on society.* San Francisco, Oxford: Elsevier/ Morgan Kaufmann.

MacKenzie, D., & Wajcman, J. (Eds.). (1999). *The social shaping of technology* (2nd ed.). McGraw-Hill Education.

Majchrzak, A., Rice, R., Malhotra, A., King, N., & Ba, S. (2000). Technology adaptation:

The case of computer-supported inter-organizational virtual teams. *MIS Quarterly, 24*(4), 569–600.

Markus, M. L. (1987). Toward a "critical mass" theory of interactive media, universal access, interdependence and diffusion. *Communication Research, 14*(5), 491–511.

McCombs, M. E., & Shaw, D. L. (1972). The agenda-setting function of the mass media. *Public Opinion Quarterly, 36*(2), 176–187.

Moore, G. A. (2002). *Crossing the chasm: Marketing and selling disruptive products to mainstream customers*. New York: Collins Business Essentials.

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research, 2*, 192–222.

O'Callaghan, R. (1998). Technology diffusion and organizational transformation: An integrative framework. In T. Larsen & E. McGuire (Eds.), *Information systems innovation and diffusion: Issues and directions* (pp. 390–410). Hershey, PA: Idea Group.

Perse, E. M. (2001). *Media effects and society*. Mahwah, NJ: Erlbaum.

Poole, M. S., & DeSanctis, G. (1990). Understanding the use of group decision support systems: The theory of adaptive structuration. In J. Fulk & C. Steinfield (Eds.), *Organizations and communication technology* (pp. 173–193). Beverly Hills, CA: Sage.

Rice, R. E. (1987). Computer-mediated communication and organizational innovation. *Journal of Communication, 37*(4), 65–94.

Rice, R. E. (1993a). Using network concepts to clarify sources and mechanisms of social influence. In W. Richards, Jr., & G. Barnett (Eds.), *Progress in communication sciences: Advances in communication network analysis* (pp. 43–62). Norwood, NJ: Ablex.

Rice, R. E. (1993b). Media appropriateness: Using social presence theory to compare traditional and new organizational media. *Human Communication Research, 19*(4), 451–484.

Rice, R. E. (2001). The Internet and health communication: A framework of experiences. In R. E. Rice & J. E. Katz (Eds.), *The Internet and health communication: Expectations and experiences* (pp. 5–46). Thousand Oaks, CA: Sage.

Rice, R. E. (2008a). *Media ownership: Research and regulation*. Cresskill, NJ: Hampton Press.

Rice, R. E. (2008b). Unusual routines: Organizational (non)sensemaking. *Journal of Communication, 58*(1), 1–19.

Rice, R. E., & Atkin, C. (2001). *Public communication campaigns* (3rd ed.). Thousand Oaks, CA: Sage.

Rice, R. E., & Katz, J. E. (2003). Comparing Internet and mobile phone usage: Digital divides of usage, adoption, and dropouts. *Telecommunications Policy, 27*(8/9), 597–623.

Rice, R. E., & Webster, J. (2002). Adoption, diffusion and use of new media in organizational settings. In C. Lin & D. Atkin (Eds.), *Communication technology and society* (pp. 191–227). Cresskill, NJ: Hampton Press.

Robertson, T. S. (1971). *Innovative behaviour and communication*. New York: Holt.

Rogers, E. M. (1962). *Diffusion of innovations*. Glencoe, IL: Free Press.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.

Rogers, E. M. (2004). A prospective and retrospective look at the diffusion model. *Journal of Health Communication, 9*(6), 13–19.

Rosen, E. (2000). *The anatomy of buzz: How to create word-of-mouth marketing*. New York: Random House.

Ryan, B., & Gross, N. (1943). The diffusion of hybrid seed corn in two Iowa communities. *Rural Sociology, 8*, 15–24.

Schein, E. (1994). Innovative cultures and organizations. In T. Allen & M. Scott-Morton (Eds.), *Information technology and the corporation of the 1990s: Research studies* (pp. 125–146.) New York: Oxford University Press.

Sedman, D. (1998). Market parameters, marketing hype, and technical standards: The introduction of DVD. *Journal of Media Economics, 11*(1), 49–58.

Silverstone, R., & Haddon, L. (1996). Design and the domestication of information and communication technologies: Technical change and everyday life. In R. Silverstone & R. Mansell (Eds.), *Communication by design: The politics of information and*

communication technologies (pp. 44–74). Oxford: Oxford University Press.

Streeter, T. (1996). *Selling the air: A critique of the policy of commercial broadcasting in the United States.* Chicago: University of Chicago Press.

Tenner, E. (1997). *Why things bite back: Technology and the revenge of unintended consequences.* New York: Vintage.

Tichenor, P. J., Donohue, G. A., & Olien, C. N. (1970). Mass media flow and differential growth in knowledge. *Public Opinion Quarterly, 34,* 159–170.

Valente, T. W. (2005). Network models and methods for studying the diffusion of innovations. In P. Carrington, J. Scott, & S. Wasserman (Eds.), *Models and methods in social network analysis* (pp. 98–116). Cambridge, UK: Cambridge University Press.

Van den Hooff, B., Groot, J., & de Jonge, S. (2005). Situational influences on the use of communication technologies: A meta-analysis and exploratory study. *Journal of Business Communication, 42*(1), 4–27.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425–478.

Vishwanath, A., & Goldhaber, G. M. (2003). An examination of the factors contributing to adoption decisions among late diffused technology products. *New Media Society, 5,* 547–572.

von Hippel, E. (1986). Lead users: A source of novel product concepts. *Management Science, 32*(7), 791–805.

Walker, W. R., & Gibbons, J. A. (2006). Rumor mongering as a collective coping strategy for traumatic public events: Evidence from face to face interactions and rumors on the Internet. *International Journal of Cognitive Technology, 11,* 31–35.

Wang, F.-Y., Carley, K. M., Zeng, D., & Mao, W. (2007). Social computing: From social informatics to social intelligence. *IEEE Intelligent Systems, 22*(2), 79–83.

Winston, B. (1998). *Media technology and society: A history: from the telegraph to the Internet.* London: Routledge.

Wirsan, J., & Muller, C. (2006). Applicability and assessment of adoption and diffusion models: Review of the models of Bass, Milling and Maier, Rogers and Frambach and Schillewaert. *International Journal of Enterprise Network Management, 1*(1), 62–78.

Wirth, W., von Pape, T., & Karnowski, V. (2008). An integrative model of mobile phone appropriation. *Journal of Computer Mediated Communication, 13*(3), 593–617. Retrieved April 2009 from http://www3.interscience.wiley.com/cgi-bin/fulltext/119414158/HTMLSTART