SECTION 3 General Issues in Management

Innovation Diffusion, Network Features, and Cultural Communication Variables

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Abstract

Over the last two decades, the utilization as well as applied study of collaborative networks has become central to both public- and private-sector management. Interorganizational networks may function better or worse than the traditional institution of the firm, with its internal role and authority distribution structures, depending on a number of factors, among others *homophily* (isomorphism, similarity) versus *heterophily* (heterogeneity, variety), *cultural affinity* versus *cultural distance* in communications, the *quality of internal and external network relationships* as these evolve, and the *pace of innovation adoption*. All of these factors, delineated in the present study, help define the aptness of organizational network form to innovation adoption and adaptation. One of the authors (the late Everett M. Rogers), a pioneer in the communications and innovation-diffusion fields, defines a network as "interconnected individuals who are linked by patterned communication flows"; thus framed, networks span various levels of action analysis, from the individual to the interorganizational and systemic. As they encompass micro- and macro-cultural dimensions of communications about innovation (Rogers & Agarwala-Rogers, 1976, p. 10), networked interpersonal, inter-group, and intercultural communications may be seen as progressively more comprehensive critical variables in the diffusion of innovation.

The present study, built on an earlier research note (Rivera & Rogers, 2004), evaluates three social programs in the United States using Rogers' diffusion of innovations (DIM) model: (1) The STOPAIDS preventive health public education program in San Francisco, designed in the early eighties around the Rogers step-wise diffusion model (opinion leaders to adopters), and launched in two waves, first in the early eighties to early nineties and then again in the late nineties; (2) the National Library of Medicine's efforts to disseminate clinically-applicable scientific findings to health professionals, especially members of racial and ethnic minorities; and (3) a web-based, cancer prevention nutrition-education project of the National Cancer Institute across seven national demonstration sites, aimed at women in minority communities, called the *Health Communication Intervention Research Initiative*.

Introduction: Networks and Innovation Diffusion

Network analysis as a theoretical construct has been used by sociologists, economists, and students of management science (O'Toole, 1997). Various scholars have emphasized the importance of interorganizational networks for resource mobilization (Coston, 1995; King & Whitt, 1997), addressing large-scale social problems (Kaplan, 1982; Lawless & Moore, 1989; Perucci & Lewis, 1989), strengthening interorganizational and inter-group communication (Harlan & Saidel, 1994); and increasing organizational cooperation (DeLaat, 1987).

The ability of organizations to coalesce into stable and productive networks depends, to a great degree, on the amount of social capital they possess as a group. Social capital is defined as "a set of informal values or norms shared among members of a group that permits cooperation among them" (Fukuyama, 1999, p. 16). According to this definition, the *mutual values* found among people in organizations foster networks that have the potential to address social problems better than could independent action. A necessary ingredient in networks is trust, for Fukuyama "the lubricant that makes the running of any group or organization more efficient" (1999, p. 16). Therefore, for

instance, a network of public, nonprofit and for-profit mental health organizations may enjoy sufficient social capital to jointly address the problem of substance abuse in their community in a way the organizations individually could not.

For the purposes of this paper, the networks in which organizations are embedded will be considered to be "structures of interdependence involving multiple organizations ... which extend far beyond formally established linkages and policy legitimated ties" (O'Toole, 1997, p. 45). Furthermore, these are structures which come together more or less spontaneously without being created by any centralized authority, and they are characterized by an atmosphere of trust (Fukuyama, 1999). Warren uses the term "organizational field" to describe much the same phenomenon, although he describes the impact of networks on organizational behavior rather than the nature of the networks themselves (Warren, 1967, p. 397). Another synonym for networks of trust, or networks based on trust, would simply be "culture."

In social and organizational networks, network characteristics in and of themselves can be salient causal factors. Sociocultural differences, and differences in value and goal orientations, are prone to affect information system development and integration, as author Rivera found in a study of the failure of an automated record system at the U.S. Bureau of Land Management (Rivera & Casias, 2001). The ability of socio-organizational networks to give effect to policy or program innovation depends directly on goal congruence and shared values among network members (Mahajan & Peterson, 1985), a kind of cultural affinity that is also necessary for strategic coalignment among network member organizations. Consideration of strategic elements of directed diffusion is increasingly important to studies of innovation, particularly in public health interventions involving public information and education campaigns.

Researchers looking at network-based innovation have thus begun to emphasize the nature of networked organizations as social communities with potentialities and traits of their own (Kogut & Zander, 1996). Fichman and Kemerer (1993) have proposed that program innovations based on information technologies are prone to temporal *assimilation gaps*, or lags, owing to a combination of: (1) strongly increasing returns to adoption (Arthur, 1988), and (2) substantial knowledge barriers impeding adoption (Attewell, 1992). Increasing returns to adoption may owe to network dynamics as such (Katz and Shapiro, 1986), scale economies, informational returns, and reductions in transaction costs (Van de Ven, 1993). Adoption is blocked or significantly slowed when knowledge and skill acquisition is made difficult – unduly complex – by the implementers of new policies or programs (Attewell, 1992).

Communications and Innovation Diffusion

Communications within and across depend on tacitly- or explicitly-accepted communicative conventions. While some conventions are taken for granted, as cultural norms, others result from concerted effort, as with culturally-sensitive public education programs that bridge sending and receiving cultures. It is therefore the case that communications and coordination presuppose shared valuation systems, at least as these pertain to cross-cultural efforts (Rogers, 1995). It is in this vein that Cooper and Zmud (1990) view implementation as a process involving both innovation diffusion and the creation of a new social-network spanning and articulating sending and receiving networks. Cooper and Zmud build an implementation model that turns on Rogers' postulate of mutual causation in innovation-diffusion between the *sociocultural organization* of senders and that of adopters, i.e., cross-cultural directed diffusion of innovation (Rogers, 1995).

The diffusion literature, largely initiated by the work of Rogers (Rogers 1995; Rogers & Shoemaker, 1971) and developed by others (e.g. Cooper & Zmud, 1990; Lai & Mahapatra, 1997), has also addressed the relation between the implementation of innovation initiatives and the adoption of innovations. Rogers regards implementation as but one step in the diffusion process, occurring when an individual or organizational decisional unit adopts an innovation or puts it to use. In this context, diffusion is strongly related to implementation over time, involving timing and sequencing decisions and implicating adoption thresholds. This thesis is further developed by Kwon and Zmud (1987), who specify six temporal stages: initiation, decision, adaptation, acceptance,

routinization, and infusion. Bass (1969) proposed an epidemiological model for the forecasting of consumer durable sales driven principally by advertising campaigns.

System- or macro-level lags and thresholds in the diffusion of innovations are found reflected in corresponding adopter categories, such as those of early, early-majority, late-majority, imitative, and laggard adopters. One analytical scheme that has been applied to the evolution of the internet has a six-stage evolutionary cycle of technical invention, penetration, growth, maturity; self-defense, and adaptation, convergence, and/or obsolescence, emphasizing the often conflictive interaction between old and new media (Lehman-Wilzig and Cohen-Avigdor, 2004). Threshold-diffusion models have become an important theoretical complement to the more linear and spatial diffusion models that dominated early innovation-diffusion theories.

Anticipation of network lags and thresholds can be used in directed diffusion efforts, by addressing behavioral contagion, thereby predicting patterns of innovation diffusion, and by carefully identifying and differentiating opinion leaders and imitative followers (Valente, 1996).

Thresholds may be seen as "tipping points", as does Gladwell (2002) in characterizing the transitional moments when a technology, idea, normative behavior, marketing campaign, epidemic, or other physical, biological, or social process reaches a critical diffusion mass. These transitions may occur linearly and more or less predictably or non-linearly and unpredictably.

Enabling or predisposing conditions, for example the deployment of change agents to initiate and direct marketing campaigns, render the innovation diffusion and adoption process more predictable (Gladwell, 2002). Uncertainty, and in particular environmental or contextual uncertainty, affects organizational predisposition toward innovation along two different dimensions, namely environmental complexity (heterogeneity) and environmental variability (dynamic variety), and in accordance with three innovation characteristics – perceived relative advantage, compatibility, and complexity (in the sense of difficult to learn and adopt); on balance, environmental and adoption complexities are negatively correlated with perceived advantage and compatibility, and therefore with probability of adoption (Sia, Hock-Hai et al., 2004).

A common failure of network analysis is to take systemic network traits and network-level interactions *as such* for granted, rather than consciously considering them and anticipating them, and tracing them over time (as do epidemiologists in following the course of disease contagion). Without an awareness of the temporal dimension of network functioning, network analysis will miss causal influences and sequences (Salancik, 1995). By their very nature, networks can obscure connections among decisions, implementation steps, and immediate to long-term impacts. Network functioning can also reduce program feedback, particularly from stakeholders or client communities, thereby impeding policy or program communications. Increasingly, therefore, there is recognition that networks can create both positive outcomes (such as flexibility and adaptability, in contrast to the traditional firm) and liabilities (exclusion, loss of feedback, cultural distance); (Brass & Labianca, 1999; Brown & Duguid, 1996; Gargiulo & Benassi, 1999).

Linkages among organizations can prompt the generation and adoption of innovations, but the likelihood of systemic dysfunction is also high among networked organizations. It has been observed, for instance, that networks can become excessively insular, or isolated (Cohen & Levinthal, 1990). Insularity is often a function of cultural gaps and communications failures between network members and their stakeholders, client groups, or constituencies (Gulati, 1998). It has also been found that changes in constitutive network logics – or undue extensions of the functional capabilities of a particular network – can prompt network failure, particularly when network members or constituencies are not a party to those changes (Miles & Snow, 1992). In general, "network externalities" – i.e., the projection of network dysfunctions onto network domains (stakeholders, constituencies, clients, authorizing frameworks) – is both a mechanism for and a symptom of network failure (Goldenberg, Libai & Muller, 2004).

Resource scarcity will often force organizations to integrate and coordinate systems and programmatic development tasks with other agencies in ways that will give rise to networked functions without a corresponding development of interorganizational capabilities. In particular, for instance, it has been found that the joint adoption by public organizations of advanced information technology is likely be of benefit to institutional and decisional capabilities, but that information technology in those contexts also tends to generate increasingly complex internal and external

demands on information management capacities, leading to systemic failures. In interorganizational domains, a history of technical collaboration, along with shared mission and common interests, and compatible organizational cultures, are factors that are prone to condition and advance the process of adoption of information systems (Malone & Crowston, 1994).

Resource dependency may compromise organizational autonomy by circumscribing the range of decisions organizational leaders can consider (Oliver, 1991). Even when interorganizational networks are developed intentionally and strategically, there is typically little communication and collaboration among members concerning the definition, clarification, implementation, measurement, and assessment of performance indicators proper to common projects. Instead, what appears to be the norm is the slippage of goals, resources, operational performance criteria, and programmatic mechanisms as action moves across the span of participant organizations.

As La Porte suggests, "failing to understand network dynamics either in situations of change, like policy implementation or reform, or in operating systems that face external challenges can lead to grievous, unintended, but induced, error " (La Porte, 1996, p. 51). Failing to communicate about and collaborate in the definition of shared program responsibilities and programmatic goals and means is just as serious a threat to effective collaborative action. Similarly problematic is failure to sufficiently communicate such aims and means to clients or constituency groups or communities targeted by the given program. Commonsensically, network members who fail to communicate and collaborate among themselves are unlikely to do so in their external dealings.

In a study of total quality management program adoption by hospitals, Westphal, Gulati, and Shortell (1997) found that *isomorphism* – defined as institutional similarity or equivalency – and lags in adoption are predictors of the conformity of late adopters to early adopters of quality-control systems. For late adopters, the density and strength of network ties are predictive of conformity to normative patterns established by early adopters, whereas for early adopters, network density and strength are correlated with the creative adaptation and customization of administrative form and process. However, both early and late adoption have the potential of positive and negative outcomes, or externalities. Early adoption is a sign of creativity, but it can lead to the institution of quality systems ill-fitted to the wisdom of already-established organizational accountability systems and norms (recall Simon's "bounded rationality"). On the other hand, late adoption, while gaining for the lagging organization a kind of derived legitimacy, can lead to organizational inefficacy or inefficiency if the received model is ill-fitted to existing organizational systems and norms.

Program Analyses

STOP AIDS in San Francisco, California

The STOP AIDS HIV-prevention education program in San Francisco was created in the early- to mid- nineteen eighties based on Rogers' diffusion of innovation theory, as have numerous preventive health education programs since then. Evaluations of these programs suggest that greater differentiation (heterogeneity) – by way of broad coalitions of activist groups using diverse arsenals of proven health-promotion interventions – makes for greater stability, sustainability, and effectiveness (a review of the STOP AIDS experience and literature is found in Bertrand, 2004).

Bertrand indicates that "the changes in behavior needed to halt the HIV/AIDS epidemic constitute what Rogers has labeled a 'preventive innovation,'" with the catalytic event occurring when "'trend setters' in a social network begin to model a new behavior to others [and therefore reduce uncertainty and alter the perception of what is normative]…(Bertrand, 2004, p. 115). Bertrand noted that as current prevention efforts shift "from a predominant focus on individual behavior to recognition of the importance of social norms in defining sexual behavior," diffusion of innovations is reasserting itself as a leading theory in the fight against HIV/AIDS (Bertrand, 2004, p. 120).

The causal importance of heterogeneity, diversity, and plurality in social action is consistent with *law of requisite variety* (Ashby, 1970), which posits that system variation needs to match the corresponding features of environmental demands – i.e., match environmental complexity – if organization and collective action are to be effective. In social action networks, heterogeneity

makes possible the connectivity and synchronization of networks. With sufficient differentiation, "synchronizability is drastically enhanced and may become positively correlated with heterogeneity," potentially reducing the costs involved in the creation of effective network ties (Motter, Zhou and Kurths, 2005, p. 334). In a differentiated network, network synchronization is more likely to emerge than in more homogeneous networks, rendering innovation sufficiently predictable for the purpose of program planning (Cowan, Pines and Metzer, 1995).

STOP AIDS succeeded in the eighties because it became a self-sustaining, expansive program led by opinion leaders in the gay community using a variety of media and social marketing tools, from posters to television and meetings in homes. It became a self-coordinating or self-synchronizing program as more and more of community members educated in preventive health practices accepted the message, lived it, passed it on to others, and otherwise reinforced it. With that turn, there was decreasing reliance on community leaders as sole sources of information and influence.

The program waned as a new generation of gay-community members moved into San Francisco in the late eighties and early nineties. However, with a resurgence of the HIV-AIDS epidemic, the program was restarted, recapturing its earlier dynamism after a brief lag, and remaining an effective intervention to the present day. The program leadership's awareness of and reliance on the temporal sequencing of interventions, and its design around self-sustenance, have marked it not only as successful, but also as possibly the most faithful implementation of Rogers' DIM approach.

The National Library of Medicine, Washington, D.C. and multiple sites

In a 1997 study of network innovation involving computer information systems, "The Diffusion of Innovations Model and Outreach from the National Network of Libraries of Medicine to Native American Communities," Everett Rogers and Karyn Scott evaluated National Library of Medicine (NLM) outreach activities intended to convey scientific findings to health professionals and thus, indirectly, to the public. The program fell short of expectations for lack of sufficient attention to communication strategies affecting adoption rates. These included the elements of *compatibility* (whether an innovation is perceived as being consistent with the existing cultural values, expectations, and needs of potential adopters) and *complexity* (whether an innovation is perceived as difficult to understand and use, often for cultural reasons).

The NLM program's target audiences ranged from participants in Continuing Medical Education courses, to health professionals concerned with the AIDS epidemic, to others in poverty areas in the American South and Native American communities in the Pacific Northwest. The communication channels used to reach these intended audiences included one-on-one training sessions in practitioners' offices and training sessions and demonstrations for small groups of health professionals in hospitals, clinics, and medical libraries.

Rogers and Scott concluded that the program did not sufficiently capitalize on outreach to early adopters and opinion leaders, so as to attain critical mass and make the transition to a self-sustaining diffusion process. Outreach activities were aimed primarily at the "least advantaged" segment (the "information poor") of health care professionals, who also happened to serve least-advantaged populations. However, the diffusion strategy of targeting early adopters (so as to achieve critical mass in diffusion) was not used, nor were cultural differences among intended audiences sufficiently taken into account. Thus the potential for the innovation-diffusion process went unrealized.

The lesson learned from this evaluation is that program implementation requires close attention to cultural differences in communications, as well as to outreach strategies targeting early adopters and opinion leaders. The failure to acknowledge the importance of cultural affinities in innovation diffusion – of *homophily*, or the tendency to selectively interact with and learn from individuals seen as similar to self – was a crucial implementation variable in this context. The case also confirms that heterogeneity in network processes – sometimes called *heterophily* – is an important factor in the ability of networked organizations to find and exploit opportunities created by networked functioning. In the NLM program, program sites remained disparate and the messages

ill-suited to specific minority cultures, so that program interventions across sites could not come to significantly reinforce or inform one another.

The Health Communication Intervention Research Initiative, in multiple sites

The authors evaluated a web-based national cancer prevention education program aimed at women in poor and minority communities across the United States by a public-private, networked partnership sponsored and led by the National Cancer Institute (NCI) and the National Institutes of Health (NIH) at the Department of Health and Human Services, with additional sponsorship from the National Technical Information Administration, the National Library of Medicine, eRate, and other agencies and organizations in the United States. The program, the *Health Communication Intervention Research Initiative* (hereafter, Initiative), in which design and evaluation by Rogers were centrally involved, was an NCI-funded cancer-prevention nutrition education effort using the Internet and web.

One project location of the Initiative incorporated forty sites in northern New Mexico and southern Colorado in the Western United States. Program implementation was conducted by a not-for-profit implementation network that included the University of New Mexico, Colorado State University, the AMC Cancer Research Center in Denver, Colorado, the La Plaza Telecommunity, and San Luis Valley Community Interconnections. Process innovations in these sites provided an alternative approach to outreach for the NCI program. These entailed (1) the use of change agents (*Community Outreach Trainers*) drawn from target communities – young women recommended and approved by tribal and community leaders and therefore equipped to operate in those pueblos and towns to maximum effect, and (2) the use of tribal languages and Spanish in both program outreach and web-based training. Rogers helped evaluate this project element against the stated goals and objectives of the national program. Author Rivera's interest was in evaluating the role of provider networks in determining program success, as well as in assessing the interrelation of technical and cultural factors in the network systems involved.

Using communications audit and cross-case evaluation techniques, data were gathered through pretests, cross-sectional surveys, focus group studies, and structured interviews, to gauge successful and unsuccessful patterns of innovation adoption across all program sites, approached as a large-scale network of governmental, nonprofit, and community provider organizations. Multicriteria evaluation suggested that communications and coordination among providers – from webpage design to the timing of program deployment across participant agencies and contractors – were critical for program success. Equally important were cultural communication factors, indicating the appropriateness of pretest and focus group research as means of determining the self-identified priorities and needs of client communities.

To the extent that the program fell somewhat short of expectations, it was cultural factors that were at play; of particular concern to Rogers was the inadequacy of web material presented in English only and without due attention to the local culinary cultures and local-cultural attitudes toward diet, prevention, and health. There was also an apparent underestimation of the difficulty involved in changing embedded cultural patterns, here relating to diet and preventive health, and particularly doing so in the direction of majoritarian cultural patterns of outlook and behavior.

Cross-program comparison and conclusion

Factors related to cultural communications, sequencing, and the extent of involvement by early adopters and opinion leaders have been found to be key to innovation diffusion in social networks, and to the relative success of the STOP AIDS campaign and the NCI Initiative. Specifically, the *homophily* construct has been found to be an essential element in the design of both STOP AIDS (particularly in its second iteration in the nineties) and the NCI Initiative.

A lack of goal congruence among providers and clients in the NCI Initiative was found to be due in large part to cultural distance, i.e., to excessive and sustained distance – heterogeneity rather than homophily – between the interventionists and their target communities. Also crucial in that instance was the constraining role of computer and web technologies themselves. These technologies were for the most part alien to these target communities, notwithstanding the aforemen-

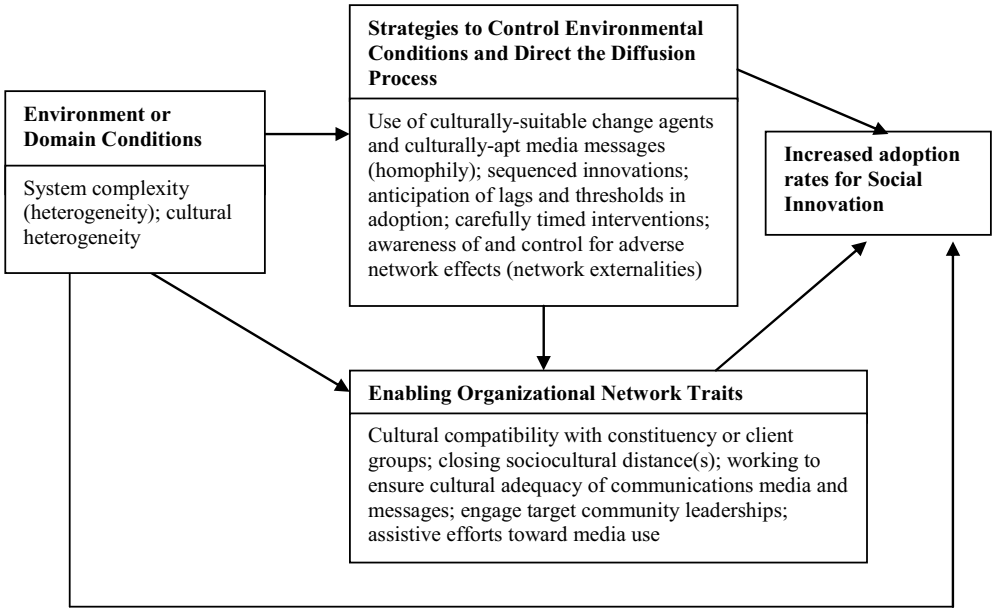
tioned use of change agents from those same communities, or the use of community centers for computer access, with all due help available to potential clients (a consideration particularly for older women unfamiliar with computers and the web).

These problems are consistent with the opening discussion of the diffusion literature in the present study; they were largely absent in the STOP AIDS case because the community leaders and members involved relied, with sophistication, on a wide variety of media, from small-group meetings to television and (most recently) the web.

The role of community leaders and advocates in expanding the scope, base, and reach of both STOP AIDS and the NCI Initiative was clearly evident, while largely absent in the NLM case. By virtue of leadership involvement, which increased over time in large part because of Rogers' insistence on cultural sensitivity and fit, the former programs redefined key programmatic elements to ensure better cultural fit. These programs owe their relative success to the extent of their cultural responsiveness, as well as their willingness to make mid-course corrections so as to become more culturally-attuned (homophilous) and thus better-fitted to a highly complex environment.

In contrast, as indicated earlier, the NLM program failed to use sequencing and step-wise diffusion factors (such as targeting opinion leaders and moving toward early adopters) to its advantage. It also failed to intentionally maximize cross-organizational and programmatic links and communications so as to create program synergies.

The key elements of the model here proposed may be graphically summarized as follows:



Adapted from the *Conceptual Model of Innovation Adoption* developed by Sasithorn Phonkaew, in "Propensity for Innovation Adoption : Integration of Structural Contingency and Resource Dependence Perspectives" *ABAC Journal* Vol. 21 No.1 (January-April, 2001).

Fig. 1. Summary Innovation-Adoption Model (lines indicate causal/influence paths)

It may be said that networks are characterized by an *institutionality of process* rather than hierarchy – the defining feature of the classic firm. Networks involve an identity-type of relation, i.e., interpersonal and inter-group relations based on shared values and outlooks, along with structural relations based on common organizational interests. Networks rely, therefore, on cultural affinities that encompass organizational and social cultures. Social and human capital are a function of trust, as suggested earlier. These forms of capital are also a manifestation of various kinds of *brokering*, as key individuals (*boundary-spanners* such as the NCI Initiative's Community Out-

reach Trainers) facilitate transactions on the basis of cultural sensitivities and the ability to gain trust and communicate in and across cultural communities.

Culture connotes community, and communication by definition is easier within than across communities. In this context, boundary-spanners are essential actors in the implementation of bridging communications. The formation and reconstitution of networks turn on the extent that both shared and disparate values can be articulated in common terms, in effect in an operative communicative culture, during the course of program operations, as occurred successfully with both the first and second iterations of STOP AIDS.

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Mario A. Rivera, Ph.D., is Regents' Professor of Public Administration at the University of New Mexico in Albuquerque, New Mexico, USA. He is the Editor of the *Journal of Public Affairs Education* in the United States and a member of the editorial board of *PPM*. He was honored to collaborate with Professor Everett M. Rogers, renowned for his pioneering and enduring contributions to diffusion of innovations theory, from 2000 to 2004, in a series of articles for publication. The first of these, with Rogers as coauthor, was a research note preparatory to the present study: "Evaluating Public Sector Innovation in Networks: Extending the Reach of the National Cancer Institute's Web-based Health Communication Intervention Research Initiative", *The Innovation Journal: The Public Sector Innovation Journal* 9 (3), 2004. Since the research note was the basis – though with significant revision and extension – for the present, more fully-developed study, Dr. Rogers' contribution to its authorship is acknowledged.

The present study therefore constitutes the second article in sequence. The final article, though actually published before the present study, was the culmination of Professor Rogers' thinking about networks, complexity, and innovation diffusion, a problem indicated but not fully explored in the present study. That final article in the sequence, and the last publication on which Dr. Rogers worked before his death, was the following: Everett Rogers, Una Medina, Mario Rivera, and Cody Wiley," Complex Adaptive Systems and the Diffusion of Innovations", *The Innovation Journal: The Public Sector Innovation Journal* 10 (3), 2005.

Dr. Everett M. Rogers was Distinguished Professor and Regents' Professor at the University of New Mexico, in the Department of Communication and Journalism, until his untimely death in October 2004. One of the greatest social scientists of the 20th Century and also one of the most collegial and generous of men, he is missed by many. Of his vast legacy of applied work, it was the STOP AIDS program with which Dr. Rogers most closely identified, the one most closely modeled on his diffusion model, and the one which he advised in most sustained fashion

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