

Leaving Nothing to Chance: Modeling the Proactive Structuration of a New Technology

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Abstract

Adaptive structuration theory (AST, DeSanctis and Poole 1994) describes how people come to understand and use a technology. In this paper we develop the idea of proactive structuration — how social networking can be proactively managed in order to speed the comprehensive adaptation of a technology within a community of users. We examine two facets of proactive structuration – formal institutionalization of a community of practice and socialization of users – and stochastically model the impact of proactive structuration on comprehensive adaptation latency. Implications for the effective management of new technology adoption are discussed.

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ABSTRACT

Adaptive structuration theory (AST, DeSanctis and Poole 1994) describes how people come to understand and use a technology. In this paper we develop the idea of **proactive structuration** -- how social networking can be proactively managed in order to speed the comprehensive adaptation of a technology within a community of users. We examine two facets of proactive structuration – formal institutionalization of a community of practice and socialization of users – and stochastically model the impact of proactive structuration on comprehensive adaptation latency. Implications for the effective management of new technology adoption are discussed.

Keywords:

Structuration Theory; Organizational Learning; Communities of Practice

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“The only true voyage of discovery, the only fountain of Eternal Youth, would be not to visit strange lands but to possess other eyes, to behold the universe through the eyes of another, of a hundred others, to behold the hundred universes that each of them beholds, that each of them is.”

- Marcel Proust (1923)

For decades researchers have explored whether and how technology is used in organizations. A common finding is that identical technologies do not provide identical results to groups and organizations (e.g., Barley 1990; DeSanctis and Poole 1994). To explain divergent paths of evolution-in-use, DeSanctis and Poole (1994) developed Adaptive Structuration Theory (AST) which describes the intertwined structures of technology, human understanding, and action. AST illuminates how the appropriation of different technology and organizational features combine to structure the innovative adaptation, use, and ultimate outcomes of technologies in organizations.

DeSanctis and Poole (1994) suggest that insights from AST into the structuration process could lead to improved technology designs and training that would promote productive adaptations (p. 143) in organizational form and action. Here we take the next step and explore how adaptive structuration can be proactively managed by an organization to enhance the diffusion of new technology adaptations within a community of practice. A community of practice is a collection of individuals bound together through common interest and language with

the goals of open communication, and exchange and retention of pertinent knowledge (e.g., Brown and Duguid 1991; Wenger 1998). In this context the community of practice refers to the community of individuals and groups focused on using the technology, for example, the “Enterprise Resource Planning Community of Practice.” Enhanced diffusion of new technology adaptations within a community of practice benefits organizations to the extent that use decisions are more likely based on a comprehensive understanding of the possibilities, rather than on more limited (idiosyncratic) perspectives. Proactive management of adaptation diffusion could be of value both during initial implementation and later. For example, Jaspersen, Carter, and Zmud (2005, p. 526) suggest that, “organizations may be able to achieve considerable economic benefits (via relatively low incremental investment) by successfully inducing and enabling users to (appropriately) enrich their use of already-installed IT-enabled work systems....”

In this paper we elaborate the idea of **proactive structuration** (Griffith et al. 2007) by describing how social networking can be proactively managed (harnessed) by an organization in order to speed the comprehensive adaptation of a technology within a community of users. Comprehensive adaptation is the comprehensive discovery and diffusion within a community of practice of the possible variations of adaptation, use, and outcomes related to a technology in its organizational setting. We examine two foundational mechanisms of proactive structuration – formal institutionalization of a community of practice and socialization of new users – and use a *monte carlo* simulation to stochastically model the impact of proactive structuration on comprehensive adaptation latency – i.e., how long it takes for all possible variations of adaptations of a technology to be diffused within a community of practice. Several implications for the effective management of new technology adoption, and adaptation, in organizations are discussed.

Evolution-in-Use of a New Technology

Adaptive structuration theory (AST) captures a lot of what is known about how a new technology is adapted by individual users for use in an organizational setting. AST provides a lens through which to see the emergent process of new technology use. AST describes how a particular user's (or user group's) experience with a new technology results in innovative adaptations and use.

A limitation of AST is that it is not a sufficiently dynamic theory – *socially* speaking – in that the focus of AST is the process by which a particular use of a technology emerges for a particular user or user group. Organizations, however, are filled with multiple users and user groups. Each distinct node (user, department, division, or location) of the organization will engage in its own idiosyncratic processes of sensemaking about (Barley 1986) and consequent enactment of (Weick 1979, 1990) the technology, depending upon which features of the technology different users attend to and explore. As suggested by Van Alstyne and Brynjolfsson (1996), “individual preferences” (p. 1479) are likely to determine sensemaking by each individual user or user group. Based on differences in experience, functional expertise, and perspective across different units, those individual preferences – along with planned and unplanned events that trigger sensemaking about particular features of the technology (Griffith 1999) – are likely to create divergent understandings of the technology, thus evolving different uses of the technology by different users or user groups.

Such heterogeneity of evolution in use for a new technology – the proliferation of multiple understandings and adaptations of the same technology within a single organization – can pose significant problems for an organization. First, divergent lines of understanding may threaten an organization's effectiveness as a learning organization (Argote 1999; March 1991).

To the extent that evolution-in-use of a new technology represents a particular understanding resulting in successful adaptation and use of the technology to serve organizational goals and functions, divergent lines of evolution-in-use suggests that each evolutionary line may be learning things about the technology that the other evolutionary lines have not yet (or may never!) discover – or that other evolutionary lines already have long since discovered. Thus, allowing divergent lines of understanding means that no single organizational member (or group) is likely to possess a **comprehensive** understanding of the technology's capabilities, as those capabilities have evolved through independent adaptive sensemaking in other parts (other users or user groups) of the organization.

Different lines of evolution-of-use also suggest a lack of **consensus** about understanding of the technology, and thereby appropriate adaptation and use of the technology within the organization. This lack of consensus has both internal and external implications.

Internally, lack of consensus may create **coordination** problems when used for boundary-spanning activities at the interface of multiple units of the organization. For example, two units (departments, divisions, or locations) of the organization may run into significant coordination problems when they attempt to use the technology jointly – for which they have each evolved both idiosyncratic understandings and uses.

Lack of consensus in the understanding and use of a technology also may create **consistency** problems when used for boundary-spanning activities at the interface of the organization and its external environment. For example, two units of the organization may attempt to use the technology differently with the same client, thus creating inconsistent demands on the client and thus projecting an inconsistent external image of the organization in the marketplace.

Some of these limitations of “free-form” (independent) adaptive structuration – each user or user group evolving divergent idiosyncratic understandings and enactments of a new technology – can be overcome via the sharing of use discoveries among users within a community of practice. Such information sharing within a community of users – the dissemination of information about discovered innovation features – is a social influence process (Bruque et al. 2008; Caldwell and O'Reilly III 2003; Spears and Lea 1992), but it need not be a passive one. **Proactive structuration** (PAS) represents the active management (by an organization) of contact among individual users or user groups. The idea of active management of contact among users through proactive structuration extends AST in two significant ways. PAS theory considers both (a) why it might be more effective for an organization to manage the evolution-in-use of a new technology implementation in order to more comprehensively diffuse understanding, and (b) how – through what specific processes – that active management of contact among users might be accomplished.

In the sections below, we stochastically model the manner in which the discovered adaptations of a new technology are comprehensively understood by a community of users through individual evolution-in-use. In doing so, we identify social networking (Brass 1984; Bruque et al. 2008; Burt 1992) and its consequent social influence processes (e.g., Bandura 1976) as the core processes of managed evolution-in-use. Two component processes of proactive structuration – formally institutionalizing a community of practice and socializing users – then are offered as avenues to manage contact among adapting users for organizational benefit. Our focus is new technology implementation, but we contend that PAS applies to the management of innovation implementation more broadly as well. For example, organizational practice innovations (Jack 2005) and non-information focused technology innovations (Siino and

Hinds 2004) also can make use of structuration. While information technology may be especially fluid in its interpretive flexibility, such flexibility is not the sole purview of technology (e.g., Weick 1979).

THEORY & MODELLING

To explore the social dynamics of managed evolution-in-use, we utilize a *monte carlo* computer simulation which models the acquisition of a particular innovative adaptation of a new technology by any user (or user group) within a community of practice. Discovery of a new adaptation during a particular time period is treated as a probabilistic event. During each time period of the simulation, a random number is drawn for each user for each adaptable feature of the technology; that random number is then compared to the probability of adaptation discovery to see if that user has discovered that particular adaptation during that particular time period. The simulation runs until all users within the community of practice have acquired all possible uses of the new technology (comprehensive adaptation). Presented statistics are based on 250 runs through the simulation to stabilize average parameter estimates. Given the relative dangers of divergent evolution-in-use of a new technology, we take as given that a reasonable goal for organizations is comprehensive adaptation – all users or user groups having learned all possible uses of the new technology. (Note: We are not arguing for a single use of the technology, but rather a full understanding of the possible uses – we speak to this issue below.)

Baseline: Independent Evolution-in-Use

The starting point of our exploration is how features of a technology come to be understood and used – adapted – by users or user groups. Features are the building blocks of an innovative adaptation of a new technology (Griffith and Northcraft 1994). Features can be designed in (e.g., the existence of a camera in a cell phone) or user adapted (e.g., using a cell

phone's camera to scan documents). Features range from concrete (e.g., the wattage of a kerosene lamp) to abstract (e.g., the impact of LED lighting versus kerosene lamps on children's study habits) and from core (e.g., ability of an email system to send and receive mail) to tangential (e.g., the ability to spell check within the email system) (Griffith 2001). Features provide a unit of analysis to better anchor the issues of how people come to understand and use innovations in organizations. It is at the features level that individual sensemaking is triggered. Interaction between individuals with their different "senses" of the innovation is the mechanism by which structuration – "the process by which social structures (whatever their source) are produced and reproduced in social life" (DeSanctis and Poole 1994, p. 128) – moves from individual sensemaking to appropriation of particular features and the resulting outcomes in organizations.

Significantly missing in this story to date is the step from individual sensemaking and enactment of new technology features to the social (group-level) equivalent of adaptive structuration. Griffith (2001) describes how individual sensemaking is triggered and notes that this individual sensemaking serves as input to adaptive structuration. Adaptive structuration assumes a community of potential users and uses discourse as the object of study (DeSanctis and Poole 1994). What is still needed is a way to model the dynamics of discourse within a community of practice. Discourse is the mechanism, but what moves the discourse in particular directions so that appropriation moves can be diffused? How can discourse itself be proactively managed? DeSanctis and Poole (1994) provide a mechanism for describing appropriation moves, but what do the social dynamics of sharing those appropriation moves look like and what influences them?

Social contagion models (and specifically viral contagion models, e.g., Witten and Poulter 2007) provide a foundation for addressing these issues. Identifying the social dynamics of diffusion of new technology adaptation using these models provides a window into the effective design of proactive approaches to managing evolution-in-use of a new technology. We acknowledge first that technology and social systems can both be addressed by their features. We also acknowledge that while both technology and social system features have affordances whereby their nature invites particular uses (Gibson 1979; Hutchby 2001), it is when the technology and social system intertwine that we have the basis for understanding innovation outcomes (e.g., Zammuto et al. 2007). As a result we will focus more broadly than have prior features discussions by explicitly incorporating – and modeling – aspects of the social system.

Baseline parameters. There are three initial parameters in the contagion model we use to model a baseline of individual (independent) evolution-in-use of a new technology.

- **Clarity** is a probability capturing the overall likelihood that a user will discover a possible adaptation and use of a new technology's feature during a particular time period. Clarity is a combination of the weighting of core and concrete features (core/concrete being those features most likely to trigger sensemaking).
- **Complexity** is the number of possible features that exist to be discovered and enacted by users into successful adaptations of the technology. Complexity includes both designed-in features and those created by the users (Griffith 2001; Jaspersen et al. 2005).
- **Community** is the number of potential users (or user-groups) within the relevant community-of-practice.

Baseline results. Table 1 displays the number of time periods it takes a community of users to comprehensively adapt a new technology, assuming that all users (or user groups) are working independently to adaptively structure (identify, explore, and enact new features of) the new technology. The innovation displayed in Table 1 varies in clarity from 5% to 15% likelihood that any individual user will discover a new use for the innovation during any given time period, varies in complexity from 10 to 30 discoverable adaptations, and varies in size of the community-of-practice from 20 to 60 users.

Table 1 reveals three strong main effects: the larger the user community, the more complex the technology, and the less clear its potential uses, the longer (more time periods) it takes for a community of users to comprehensively adapt to a new innovation. It also appears that the effects of both complexity and community size decrease as a function of increasing adaptation clarity – i.e., complexity and community size do more to determine the speed of adaptation diffusion when uses for a new innovation are harder for users to discover.

 Insert Table 1 about here

Adding Social Networking & Social Influence

Social networking & influence parameters. Because the diffusion of innovative adaptations of a new technology is a social process, it is also susceptible to social influence within a community of practice. We consider three additional features of the social system to continue our assessment of the baseline diffusion of understanding. The most commonly accepted form of social influence comes from **proximity** (Festinger et al. 1950) – nearby users can share what they have learned with each other, thus promoting vicarious learning (e.g., Bandura 1965). The simplest form of this proximal social influence would occur when

immediate neighbors shared with each other what new uses for an innovation they had discovered. Thus, we can imagine within a community of users that if User #18 learned a new use for an innovation, that user might share that discovery with his/her immediate neighbors (User #17 and User #19). Such social influence can vary both in terms of its **reach** (do users only “infect” immediately neighboring users with their discoveries, or can they also infect more distal neighbors?) and also its **strength** (what is the probability that an infected user will grasp the new use of the technology?)

Social networking & influence results. Table 2 models how this proximity-based social contagion can affect the dissemination of discovered uses for a new innovation. Social influence is activated when a user discovers one of the available adaptations for the new technology. A random number is then generated for each user within the discovering user’s reach, and that random number is compared against the strength-of-social-influence probability to determine whether the non-discovering user has now vicariously successfully acquired the adaptation. Table 2 compares influence reach of 10 neighboring users, 20 neighboring users, and all (n) users within the community of practice, for interpersonal influence likelihoods of 10%, 20%, and 30%. For baseline comparison purposes, all calculations are based on a technology complexity of 20 adaptable features, and an independent user discovery likelihood of 10%. The first line of Table 2 provides (from Table 1) the comparable comprehensive adaptation latencies for 20, 40, and 60 user (or user group) communities of practice.

The key aspect of Table 2 – and in fact the key to understanding the critical role of social networking in the successful diffusion of new technology adaptation within a community of practice – is revealed by the changing effects of community size on comprehensive adaptation latency. When social influence has low reach (e.g., only ten neighboring users) and low strength

(e.g., a probability of successfully socially transmitting a new use for the technology between two users of 10%), the effect of community size is very similar to that found in Table 1 where adaptive structuration is independent – namely, the number of users in the community increases the time it takes the entire community to converge on a comprehensive understanding of the new technology. However, when the reach of social influence is both extended and strong, the picture changes quite dramatically: the size of the community of users turns negative – i.e., the more users in the community who are experiencing the new innovation, the faster the community of users will converge on a comprehensive understanding of the new innovation.

 Insert Table 2 about here

This reversing effect of group size on comprehensive adaptation latency as social contagion increases reflects the power of social influence. When there is no social influence – i.e., when users are left to their own (independent) devices to explore, discover, and enact features of a new technology – speed to comprehensive understanding reflects the slowest adaptor in the community: the community cannot comprehensively understand until the last person discovers the last innovative adaptation of the technology. When social influence is very strong, on the other hand, comprehensive understanding reflects instead the fastest person in the community: once anyone in the community identifies a new innovation feature, social influence quickly makes sure that everyone understands it.

Proactive Structuration

Proactive structuration seeks to manage the organizational environment in a way that harnesses the power of social influence by enhancing opportunities for proximal social contact among users within the community of practice. Two vehicles for proactive structuration are (1)

formally institutionalizing communities of practice, and (2) socializing users to a new technology.

As mentioned above, a community of practice is a collection of individuals bound together through common interest and language with the goals of open communication, and exchange and retention of pertinent knowledge (e.g., Brown and Duguid 1991; Wenger 1998). In this case, a community of practice is a group of individuals who share an interest in exploring and identifying the as-yet hidden innovative possibilities of a new technology. Communities of practice can happen accidentally and naturally – as a form of incidental proximal social influence (Orr 1996; Wenger 1998). However, organizations can also create and support formal opportunities for users to network together and share their discoveries (Griffith and Sawyer 2006). In effect, an institutionalized community of practice is a way for an organization to promote positive social influence by managing opportunities for proximal information sharing (innovation use contagion).

Formal institutionalization of community of practice parameters. The effects of an institutionalized community of practice can be modeled by assuming a significant increase in new use contagion at a particular point in time – as if something formally connected (**congregated**) all users at that particular point in time (e.g., a teleconference of the community of users, or a user “summit” or “retreat”). Formally institutionalizing a community of practice can vary on three dimensions. The effects of congregating users can be modeled as simply the establishment of proximal social influence connections among users, and therefore (like proximal social influence) will vary on the dimensions of **reach** (the number of other users any individual user becomes connected to as a consequence of the user congregation) and **strength** (the probability that any newly-established user-to-user social connection will result in the

successful transmission of a discovered adaptation during any time period). Additionally, to the extent that congregation of the community of practice is an event managed by the organization, **timing** of the congregation in the implementation of the technology (when the congregation of users occurs) is also a variable of interest.

Formal institutionalization of a community of practice - reach. Table 3 portrays the effect of a formally institutionalized community of practice – congregating users via a “summit” or “retreat” – that occurs 20, 10, or 0 time periods into the implementation of a new technology, with the strength of successful transmission of discovered adaptations among connected users fixed at 20%. For comparison, the first line of Table 3 again replicates the effects of varying community size on comprehensive adaptation latency assuming no social influence (from Table 1), for a technology clarity of 10% and a technology complexity of 20 adaptable features.

Worth noting in this table is how the formal institutionalization of a community of practice – **congregating users for the express purpose of creating connections or social ties that allow inter-user sharing of adaptation discoveries** – harnesses the power of social influence. Even assuming a relatively weak social influence effect (a 20% probability that two connected users will share adaptation discoveries), formally institutionalizing a community of practice dramatically increases the speed with which comprehensive adaptation is achieved across the community – and more so to the extent that the community is larger (more users to discover and share uses of the innovation).

Insert Table 3 about here

Formal institutionalization of community of practice – timing. Table 3 also portrays the effects of changing the timing of the congregation of the community of practice: 20 time

periods, 10 time periods, or 0 time periods into the implementation of the technology. Perhaps paradoxically, earlier institutionalization of the community of practice does not always lead to faster comprehensive adaptation within the community of users. Not surprisingly, earlier establishment of social connections via the congregation of users provides adaptation sharing opportunities that speed comprehensive adaptation within the community of practice.

Formal institutionalization of community of practice - influence during congregation.

To this point in the discussion, the primary implication of formally institutionalizing a community of practice has been *to establish social ties* (connections) among users or user groups that can lead to downstream (post-congregation) proximal social influence. The idea is that once users within the community of practice are formally networked together they will henceforth share ideas (i.e., discovered adaptations of the new technology). However, as an event, the congregation of users also can be managed for the specific purpose of sharing adaptations of the new technology while the community of practice is congregated. Table 4 portrays the additional effects of congregating the community of practice (at time period 10) assuming that users are specifically asked to share discovered adaptations during the congregation. For comparison, the first line of Table 4 (taken from Table 3) shows the effects of assuming use of the congregation only to establish downstream proximal social influence (reach = 10 users, strength of social influence = 20%, again assuming a technology with a clarity of 10% and a complexity of 20 discoverable adaptations). Even entertaining relatively conservative assumptions about the probability of adaptation sharing among congregated users (10%), bringing together all users for the express purpose of sharing any heretofore discovered adaptations has a definitive effect on the comprehensive diffusion of adaptations.

Insert Table 4 about here

In effect, the formal institutionalization of a community of practice has a “double whammy” benefit on speed to comprehensive adaptation within the community. First, the formal connecting of users provides the opportunity for downstream (post-congregation) sharing of discoveries. Second, the formal connection time itself can be used to share already-discovered adaptations. The impact of both effects should be heavily dependent upon the number of users in the community of practice, the strength of the proximal social influence effects they induce, and the timing of the congregation of the community of practice.

Complexity and clarity of the technology may also be critical here. To the extent that a technology is not complex and very clear (easy to discover innovative adaptations), information sharing during congregation should have definitive effects on comprehensive adaptation latency – particularly if the community of practice is large enough to have discovered all possible uses prior to congregation. However, when a technology is very complex (many adaptable features) and not very clear (it is difficult to discover adaptive users of the technology) – and particularly if the community of practice is small – the establishment of downstream social connections may prove more critical to speedy comprehensive adaptation than an early congregation of users. Under such circumstances, the innovative adaptations of a new technology may take quite a while to emerge, and the successful diffusion of those adaptations then may be highly dependent on the prior establishment of user social ties to “spread the word.”

Socialization parameters. Another vehicle for proactive structuration is through formally **socializing users to the new technology**. The socialization of users to a new technology presumably would be an event that happens early in the implementation of a new technology. Naturally, one implication of socialization – particularly if it involves an early “summit” of all

users – is (again) the social networking of users to enhance the downstream (post-socialization) sharing of discovered adaptation of the new technology (as shown in Table 3 for timing = 0).

That said, the convening of users or user groups early in the implementation of a new technology offers two additional enhancements of the proactive management of adaptation: one organization-initiated, one user-initiated. **Feature exploration** is a user-initiated component of new technology socialization. Feature exploration is a period of “free play” (March 1971) or active experimentation with the innovation, in order to identify features – in effect, a “technology of foolishness.” Feature exploration provides users the opportunity to discover/identify uses of the innovation before having to use it. Perhaps more importantly, feature exploration provides the opportunity for this discovery in a social setting – i.e., where all or many other members of the community of practice are present – where any discoveries can be immediately shared/acquired through social influence with other users. **Feature triggering** (Griffith 1999), on the other hand, is the organization-initiated component of new technology socialization. Feature triggering shortcuts the exploration process for users by providing adaptation “hints” – focusing user attention on features of the new technology and by doing so increasing the probability of innovative adaptation discovery.

Experimental results suggest that the outcomes of these two approaches vary based on the time available to the users. Griffith and Northcraft (1996) demonstrated that users can be provided limited information about a technology and still be effective users, if they are provided enough time to reach an understanding of the technology. User performance under such circumstances can equal that of users provided with full information, but the limited information users gain the benefit of learning how to learn (adapt the technology). A community of practice where users undergo feature triggering socialization is similar to providing users with full

information. These users will have a higher likelihood of knowing those features they are specifically told about. In communities where feature exploration is encouraged, users are given an institutional opportunity to have the time to explore and learn to learn about the technology. Thus, these socialization approaches both provide the opportunity to learn about the technology, and to do so in a setting where transmitting what is learned will be facilitated by social influence.

Table 5 portrays the effects of feature exploration on speed to comprehensive adaptation within a community of users, both without (line 2) and with (line 3) feature triggering. For computation purposes, feature exploration was operationalized as a zero-time-period opportunity to discover innovative adaptations of the technology (clarity = 10%), but with immediate opportunities for social influence within the community of practice (inter-user diffusion strength = 10%); feature triggering was operationalized as an enhanced probability (strength = 15%) of discovering innovative adaptations for a new technology by virtue of focusing user attention on features for the express purpose of exploration and innovation discovery. For comparison, line 1 of Table 5 (from Table 4) displays the effects of using socialization only as an opportunity to establish social ties (connections) among users (reach = 10 users) for the purpose of later downstream sharing (strength = 20%) of discovered adaptations, again assuming a technology with a clarity of 10% and a complexity of 20 adaptable features. Clearly both feature exploration and feature triggering enhance opportunities to speed comprehensive adaptation of a new technology within a community of practice by heightening the probability of innovative adaptation discovery during socialization – both before the technology will actually be used “when it counts,” and while (all?) other users in the community are present to immediately share innovative discoveries.

 Insert Table 5 about here

DISCUSSION

Our modeling of new technology adaptation and evolution-in-use suggests that if users are left to their own devices, new technologies are more likely to be comprehensively understood (i.e., the full range of adaptation, use, and outcomes known across the entire community) when the technology is less complex and/or the user community is small. More to the point, **when left unmanaged, latency to comprehensive adaptation will always follow the slowest user or user group.** Greater clarity (technologies that are easier to explore and adapt) and reduced technology complexity (not much to discover) minimizes these risks such that comprehensive adaptation is more likely overall.

Social networking offers an avenue to change this – especially for complex technologies whose innovative uses are not clear – by harnessing the power of social influence. When social contagion of adaptations is possible, comprehensive adaptation can follow the users or user groups that adapt the new technology most quickly. These results are consistent with previously presented work on triggers for sensemaking (Griffith 1999). Triggers can come from the technology or the social system, but not all technologies are created equal *vis-a-vis* these internal effects. Proactive structuration is suggested when comprehensive understanding is needed, regardless of the initial conditions.

Proactive structuration harnesses social influence and provides a means of harvesting social contagion effects through formally institutionalizing communities of practice and socializing users to promote faster comprehensive adaptation of the new technology. Socialization in this context is an operationalization of Louis and Sutton's (1991) idea of

deliberate initiative. They suggest that one way active thinking (versus habit of mind) can be triggered is to ask people to think; to provide them with deliberate initiative to develop new schemas. While the benefits of both institutionalized communities of practice and socialization are common themes in the literature, proactive structuration applies them specifically to trigger sensemaking and providing opportunities for innovative adaptation of new technologies. These interventions have the ability to foster comprehensive understanding of complex, opaque features sets in a way that opens opportunities for more effective use in organizations.

Without proactive structuration, technology features, adaptations, and uses risk becoming “hidden profiles” (e.g., Stasser and Titus 1985). That is, different (diverging) lines of evolution-in-use of the technology will exist in the organization, but discovered innovative adaptations may not be shared. This limited diffusion of understanding is an act of omission, rather than commission. Of course, even formally establishing social connections among divergent lines of evolution-in-use within a community of practice is no guarantee that adaptation discoveries will be successfully shared. Users may fall victim to the *common knowledge effect* (Gigone and Hastie 1993), where they talk about the (limited) knowledge of technology uses they have in common, rather than exploring the broader constellation of knowledge that they may hold uniquely. This dynamic limits the likelihood of comprehensive adaptation if proactive steps are not taken – not just proactive steps to establish social connections among users, but also proactive steps to establish norms (for example, via group-level performance incentives) for using those established connections to communicate adaptation discoveries.

Additionally, in settings where proactive approaches are not taken, there is the possibility that groups will not effectively manage the flow of the broad information held across members. *Production blocking* (Diehl and Stroebe 1987) is the simple case where everyone cannot talk at

once, and so less information makes it into the discussion. This form of process loss (Miner 1984) can be mitigated by formal practices or technology tools that facilitate the group process (Gallupe et al. 1994). Particularly for large communities of practice, the congregation effects of immediate (rather than downstream) adaptation diffusion will be highly dependent on managing the competition for “air-time” among users in the community of practice. This suggests that our modeling of discovery diffusion during community of practice congregation may prove more a testament to possibility than typical reality.

Certainly this competition for air-time can be managed by reducing the allowed congregation size for any meetings (socialization or later) among users. This then begs the trade-off, however, between reach and strength of social influence. Socializing or congregating smaller groups of users (subsets of the community of practice, rather than the entire community) can mean establishing stronger social connections among attending users that should yield higher-probability sharing of adaptation discoveries downstream. The cost is limited reach – those stronger connections come at the expense of meeting and hearing from fewer users.

Of course, technology may help provide solutions here. Congregation or socialization of users can happen virtually as well – for example via the establishment of user chatrooms, electronic newsletters, “living” on-line user manuals, etc., (Ahuja and Galvin 2003). In this sense, unfortunately, technology may prove a sword that cuts both ways. Although technology may allow greater (virtual) connectivity among users, lean connectivity (e.g., e-mail rather than face-to-face interaction) may limit the probability that critical information will get exchanged (Cramton 2001). The real risk here is that virtual connectivity may lull an organization into a false sense of security that connections among users have been established when in fact those connections are not successfully diffusing adaptive innovations.

Limitations and Future Research

Our modeling of the parameters of proactive structuration, operationalized through managed communities of practice, offers an effective approach to gain the most from adopted innovations. Communities of practice are a growing organizational mechanism for knowledge transfer and these results suggest that they can be effectively applied to the implementation of technology and other innovations. In particular, communities of practice represent the potential for many individual to look at the same technology and see something different. For those differences to represent an important organizational resource, however, organizations must proactively foster and manage the connections among those individuals. That's what proactive structuration is all about – the harnessing of the power of social networks to speed both the discovery and diffusion of critical technology adaptations.

A central challenge for all organizations is to manage the tension between exploration and exploitation (He and Wong 2004; March 1991). In terms of technology implementation, exploitation refers to putting the organization's investment in the technology into productive use, while exploration refers to identifying new uses of the technology (even those never thought of by the designers!) that can increase the productive power of that investment by the organization.

The above discussion largely focuses on the benefit of exploitation versus exploration in that it assumes a finite number of discoverable innovative uses for a particular technology – and thereby suggests that exploration is a process for any technology that eventually ends. Our focus on comprehensive understanding is based on an organization's need for a base level of common ground for coordination and communication to occur (Clark 1996). Without shared boundary objects (Carlile 2004), or other linking information to provide a minimal set of boundaries, even divergence-building strategies such brainstorming are unlikely to succeed. However, any belief

that exploration has an end point – and particularly such a belief that is behaviorally enacted (for example, by not occasionally re-congregating the community of users over the course of a technology’s useful life) – may unintentionally limit the opportunity for the most innovative approaches. Below we outline some tensions related to achieving an effective balance between exploitation and exploration through structuration. We organize the example issues as cognitive, motivational, and social. We propose these as seeds for further consideration and future research.

Cognitive. Over-structuring the socialization process can inhibit creativity. Boundaries limit the ability to come up with creative ideas (recall Osborn’s 1957 original proscription against criticism in brainstorming activities). Even success at being creative can limit future creativity as it put boundaries around expectations (Audia and Goncalo 2007). Breaking constraining cognitive frames created by perceived standard operating systems can be helped by incorporating network ties external to the organization – and thus external to any lines of evolution-in-use within the organization – into the CoP for the technology (e.g., Audia and Goncalo 2007; Hargadon and Sutton 1997; Perry-Smith 2006). This can help assure that new perspectives are constantly refreshing and renewing the organization’s sensemaking and use of the technology. Future research can extend the suggested CoP approach to a CoP that crosses organizational boundaries. For example, earlier we suggested an “Enterprise Resource Planning Community of Practice” as an example, but with the assumption that this CoP was internal to a single organization. Here we suggest the possibility of a CoP that crosses organizational boundaries, adding additional sensemaking opportunities (and concomitant security nightmares).

Motivational. As a growth mechanism, heavy-handed socialization can also rob prospective users of the evolution-in-use initiative. Two recommendations here: (1) It is critical

through the socialization process to convey an expectation that sensemaking of a technology always remains “unfinished” and that the goal of the CoP is learning (Cadiz et al. 2009), not uniformity; (2) The inclusiveness of the socialization process can be used to model user evolution of sensemaking and use of the technology. Future research can consider the intrinsic and extrinsic incentives (e.g., Amabile 1998) and tacit and explicit goals (e.g., Shalley 1991) for extending the adaptation of the technology and incorporating this knowledge into the community.

Social. Communities of practice are a form of collective, and their establishment for a technology therefore creates a **social dilemma of exploration**. In effect, if users have to choose between spending time evolving the use of a technology and using that technology for production, the establishment of a community of practice may provide an excuse to avoid (unrewarded) exploration in favor of (rewarded) exploitation, since there are many salient others (the community of practice) who can address the organization’s exploration needs. The solution for this dilemma may be to focus the process on social facilitation (Zajonc 1965) versus social loafing (Latane and Darley 1970). Future research can consider whether presence effects (mere, electronic, or otherwise) help or hurt this process.

As an additional social tension, the power behind contagion can also apply to fears and concerns. This may point to the importance of “play” during socialization where discovery can be made more “safe” by the organization, thus increasing (even assuring!) the probability of a success experience and positive (rather than negative) social influence. Processes that focus on “small wins” (Reay et al. 2006; Weick 1984), rather than vast change may also promote a lower risk setting. Community activities could be instigated to promote small versus large-scale efforts. If these activities were electronically supported, short-term mini-experiments (see the

discussion of Yahoo!'s use of micro-experiments in Pfeffer and Sutton 2006) could examine the downstream effects of small versus large-scale attempts at discovery by watching for number and types of contributions.

Conclusion

Secretary of State Hillary Clinton popularized the phrase, "It takes a village..." (Clinton 1996) as a description of the number and diversity of efforts and perspectives it takes to raise a child effectively. Although her take on child-rearing has proven controversial, the application of that phrase to the comprehensive adaptation of a new technology probably is not. Adaptive structuration casts the discovery of innovative uses of a new technology as a fundamentally independent, individual process. Our modeling suggests that while it can take a village of those individual processes to discover everything a new technology has to offer, it takes the mindful management of that village by an organization – proactive structuration – to spread the word of those discoveries and ensure that they come to benefit everyone.

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TABLE 1**Comprehensive Adaptation Latency for Independent Evolution-in-Use**

Community of Users		20	40	60
Clarity of Technology				
Complexity of Technology				
5%	10	114.7	128.2	137.5
	20	128.2	142.9	150.4
	30	137.5	150.4	158.7
10%	10	55.5	62.1	66.1
	20	62.1	68.8	72.6
	30	66.1	72.6	76.1
15%	10	35.0	40.1	42.3
	20	40.1	45.7	47.5
	30	42.32	47.5	49.2

Table 2
Evolution-in-Use with Social Influence

Community of Users		20	40	60
No Social Influence		62.1	68.8	72.6
Strength of Social Influence				
Reach of Social Influence				
10%	10	55.4	62.1	65.9
	20	51.7	58.2	62.1
	<i>n</i>	51.7	53.3	53.8
20%	10	51.6	58.3	61.9
	20	48.4	54.1	57.7
	<i>n</i>	48.4	46.7	48.0
30%	10	49.6	56.3	58.6
	20	42.6	50.7	54.3
	<i>n</i>	42.6	44.3	43.4

TABLE 3
Institutionalizing a Community of Practice

Community of Users		20	40	60
No Social Influence		62.1	68.8	72.6
Timing of Congregation				
Reach				
<i>t</i> = 20	10	59.8	67.6	70.8
	20	58.2	63.7	70.1
	<i>n</i>	58.2	62.2	65.2
<i>t</i> = 10	10	57.0	64.3	66.9
	20	53.0	61.4	64.4
	<i>n</i>	53.0	55.3	56.0
<i>t</i> = 0	10	51.6	58.3	61.9
	20	48.4	54.1	57.7
	<i>n</i>	48.4	46.7	48.0

Table 4**Institutionalized Community of Practice with Influence during Congregation**

Community of Users	20	40	60
Downstream Influence Only	57.0	64.3	66.9
Plus During-Congregation Influence	10.2	10.1	10.1

Table 5**Socialization with Feature Exploration and Feature-Triggering**

Community of Users	20	40	60
Socialization	51.6	58.3	61.9
With Feature Exploration	8.54	10.9	9.9
Plus Feature Triggering	5.9	6.3	8.4