Information and Innovation in a Networked World

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The potential for the diffusion of information regarding successful governmental (international, national or subnational) innovation has increased enormously in recent years. Information from geographically distant locales is often simply a click away, where networks of intergovernmental information exchange are spontaneously emerging. The intertwining of information technology and globalization – extends the pool of accessible innovations and lowers the barriers for their diffusion. (Bernstein & Cashore, 2000; Coleman & Grant, 1998; Coleman & Perl, 1999; Evans & Davies, 1999)

This diffusion process has enormous potential for increasing public welfare, by allowing location B to adopt the successful innovation in location A. There is, however, a potential dark side to the increased diffusion of information. First, as information diffuses more efficiently, it becomes more of a public good. As the publicness of information increases, so does the likelihood of free riding. There is an incentive for each government to allow another government to take the risks of innovation, and then to simply adopt the successful innovations. Second, in complex policy areas, the diffusion process may be too efficient: resulting in either premature convergence on a non-optimal policy, or eliminating policy alternatives that while not optimal in the present, might be in the future.

The governance implication is that in the networked world special attention must be given to increase governments' incentives to experiment and innovate. (Moon & Bretschneider, 1997)

This paper will be organized as follows. First, it will briefly discuss some distinctive features of the diffusion process in the public sector. Second, it will analyze the "informational efficiency" of different types of networks. Third, it will examine the potential for informational free riding in the networked world. Fourth, it will study the paradoxical possibility that the more efficient the system is at spreading information, the less information the system might contain. Finally, it will discuss the implication for governance: how does one design a system that is efficient at "spreading the word" while encouraging experimentation?

Inter-organizational diffusion of innovation

Networked governance is in vogue (e.g., O'Toole 1997, Rhodes 1997). By "networked governance" I mean a system of interdependent sovereign units. Thus, one might think of the relationships among nations as networked governance (although typically with the threat of violence removed—Keohane and Nye 2000; Slaughter 2000). One might also think of the relationship among local governments as "networked", and even agencies within the federal government as effectively "networked" in that that hierarchy within the federal government intrudes little on the basic independence of federal agencies—especially where it comes to issues around coordination and cooperation with other agencies. In the US, due to both shared powers within the federal government, and a system of dual sovereignty between state and federal government, the networked nature of government has been an accepted feature of governance since the founding of the republic (although not with that vocabulary). As we move into the 21st century there is an increased awareness that the networked nature of governance is universal—in systems that heretofore might have been considered models of hierarchy (e.g., the British—Rhodes 1997) or anarchy (i.e., the international system).

Elsewhere I have argued that three strands of interdependence are coordinative, cooperative, and informational (Lazer 2001; Lazer and Mayer-Schoenberger 2002). For each of these interdependencies there are large literatures which can and should be mapped into the ideas around networked government, and descriptive and normative theories of "networked government" developed. In this paper I will develop the informational dimension.

The presence of the informational aspect of networked government is that policy generates potential informational externalities. When a policy actor adopts a policy, that adoption and subsequent experience conveys information to other policy actors. Some of those choices may be a matter of public record (statutes and regulations) and in principle accessible to all, and other important information will remain private. Policy actors thus simultaneously suffer from information overload and information deprivation. Actors need to adopt both network strategies—selective attention to help sift the public information and access private information—and internal filtering strategies to eliminate the large majority of information that is publicly available.

One may therefore usefully construe the universe of policy actors as a set of nodes among which there is a set of evolving connections. Over these connections flows information and attention about adoption success and failure, and just raw data. It is the assertion of this paper that this architecture matters, that some architectures are better at facilitating information transfer than others, and that it is necessary to understand how this structure emerges. The next section of the paper discusses the general processes by which networks emerge, and what the likely consequences for information diffusion in the emergent structure.

There exists, of course, a substantial body of literature on the diffusion of policy innovations – and adjacent topics such as policy networks, policy transfer, and policy convergence. (e.g., Abrahamson & Rosenkopf, 1997; Bennett, 1991; Berry, 1994; Berry & Berry, 1992; Coleman, 1994; Coleman & Grant, 1998; Dolowitz, 2000; Dolowitz & Marsh, 1996 & 2000; Evans & Davies, 1999; Gray, 1973 & 1994; Hubner, 1996; Kogut & Zander, 1995; Mintrom, 1997a & 1997b; Mintrom & Vergari, 1998; Robertson, Swan, & Newell, 1996; Savage, 1985; Schenk, Dahm, & Sonje, 1997; Seeliger, 1996; Stone, 2000; Valente, 1995 & 1996; Walker, 1969, Weenig, 1999)

Similarly, there is a large literature on the diffusion of innovations through inter-organizational networks within and between corporations. (Atkinson & Bierling, 1998; Coleman & Grant, 1998; Dolowitz & Marsh, 2000; Dyer & Nobeoka, 2000; Evans & Davies, 1999; Gupta & Govindarajan, 1991; Kogut & Zander, 1992 & 1995; Liebeskind et al., 1996; Nooteboom, 1999; Radaelli, 2000; Robertson, Swan, & Newell, 1996; Rom, Peterson, & Scheve, 1998; Seeliger, 1996; Weale et al., 1996) This literature suggests that a tremendous amount of information flows through inter-organizational networks (typically measured through overlap of corporate boards).

This voluminous research examines the process of diffusion, how innovation evolves as it diffuses, the characteristics of early versus late adopters, etc. (Rogers 1995).

The objective of this paper is to consider what are the generic processes by which the architecture of diffusion of emerges—the network; what the normative implications of different architectures; and what is distinctive about diffusion among public organizations. Information diffusion through intergovernmental networks is quite different on certain dimensions from diffusion in the private sector. First, in the private sector, many innovations are proprietary, thus increasing both the cost of adopting an innovation, as well as the likelihood of the innovation in the first place, since the innovator may extract most of the benefits of that innovation.[1] The profit motive also means that the innovator has an incentive to spread information about the innovation. Second, where innovations are not proprietary, a corporation has an incentive to keep information secret from competitors as long as possible. The public sector, in contrast, has relatively little incentive to suppress information about successful innovations. Third, with survival less of an issue, and relative performance more difficult to measure, bureaucratic inertia is likely a greater barrier to adopting successful innovations in the public sector than in the private. Fourth, many policy makers are likely "proselytizers"—moved to innovate and to spread the word in order to increase their impact on society.

There is therefore substantial potential for diffusion of successful policy innovations, both intra and internationally. The question asked here is what is the impact of the shift from local to global informational networks. The next section examines the role that the structure of the informational network plays in the speed with which information spreads in a system.

The architecture of the network

First, a few definitions: A *node* is a unit which may contain and pass on information. It may be an individual or an organization. In this paper, I will largely focus on public sector actors, but at the end will speculate what the implications are for public-private partnerships. A connection between two nodes means that there is some passing of information between those nodes. At its broadest definition, it may mean that some

[1] Although spillovers occur not just in the public sector but in the private as well, despite the protection of intellectual property law. Baumol (1999) for example, estimates that

actors are just selectively paying attention to other actors (e.g., everyone is paying attention to California's experience in electricity deregulation). At its narrowest (and more typical) definition, it means that there is a private exchange of information among a subset (at least two) actors. An *informational network* is a set of connections among nodes. It is useful to distinguish among three kinds of informational networks: spatial, organizational, and emergent.

A *spatial network* is a network whose dyadic connections are determined by proximity: each actor speaks exclusively to other actors in its neighborhood. For example, in figure 1, A communicates only with its four immediate neighbors to the north, south, east, and west.

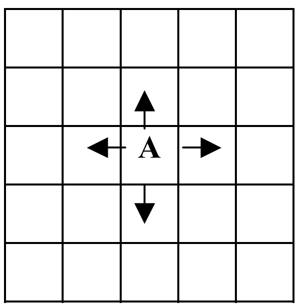

Figure 1: Example of a spatial network

The probability of communication between any two actors is strongly related to how close they are to each other. The relationship between distance and communication, of course, is vastly more complicated than characterized by the lattice in figure 1. As noted above, the Great Plains excepted, geography is typically not as smooth as characterized in figure 1. These irregularities affect the costs of communication between any two nodes. Distance is also partially a social construct. The probability that two local jurisdictions communicate is probably affected by whether they are in the same state, for example.

Finally, communication frequency is not a linear function of distance. As a general matter, communication drops off precipitously with distance (McPherson 2001).

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innovators retain only approximately 10% of the gains from their innovations.

An *organizational network* is simply the communications that result from the groupings within the organization (Mintzberg 1992). That is, the formal organizational chart is typically related to the architecture of the informational network. If faculty, for example, are grouped into departments, communication will typically be higher within those departments, in part because of a functional interdependence, in part because the institution then structures serendipity—departments will often be grouped together, departmental meetings guarantee that paths will cross, etc.

Both of these network archetypes are flawed at spreading information. Spatial networks are often broken by spatial "chasms"— mountains, rivers, or climate in a geographic context, buildings in an organizational context, railroad tracks and highways within communities— between which little information flows. Further, even in the absence of these discontinuities a purely grid-type of network, such as in figure 1, would only slowly (if inexorably) spread information. If one assumed that it takes one period to spread information to a node's immediate four neighbors, it would take eight periods for a piece of information to spread from one corner of the system to the other.

Similarly, organizational networks are often characterized by dysfunctional chasms—communication within stovepipes but not between. In fact, the "networked" organization, cross-functional teams, the matrix form, etc, etc, is often seen as an antidote to the stovepipes of the organizational chart. However, as discussed below, organic (emergent) network structure have their own disfunctions.

Serendipity is the underlying principle of *emergent networks*. Emergent networks result from the myriad of decisions by individual nodes to pay attention or not pay attention, by pairs of nodes to form a relationship, and by larger numbers of nodes to create formal or informal groupings that then form the basis for larger scale communication. The assumption I make here is that these decisions are made on an egoistic basis, made in a boundedly rational fashion. It is this "think locally, act locally" assumption that can result in outcomes that at the systemic level are suboptimal. There are a number of fairly robust patterns that have been observed in a wide range of social networks: the emergence of cliques, power-laws of connectedness, homophily, powerful core-periphery tendencies, each of which is discussed in the context of governance networks.

Cliques: Networks often break down into cliques, where there is a much higher density of communication within cliques than between. Thus, for example, a tie between A and B and a tie between B and C predicts a tie between A and C (Davis 1967). There are a variety of reasons why cliques might emerge. For example, B's tie to A and C might facilitate a tie between A and C. Cliques might also emerge out of a functional need to collectively produce something that all benefit from, and for which a certain scale is required (e.g., a pick up softball game). Informationally, it might also be more efficient to share information within a group than dyadically (reducing repetition and redundancy).

Cliques might also be epiphenomenal: the result of homophily or proximity. As discussed below, similarity and proximity predict communication. If A is similar/close to B and C, then it is likely that B and C are similar and close to each other.

Scale free networks: Notably, in networks where nodes have no constraints on communication the frequency at the node level of any given level of connectedness of a node is proportional to the inverse of that level of connectedness, raised to some power (i.e., "power law" distributed, also known as scale free networks—xx—see other contributions to this volume). In essence, the more connected, the less frequent. In a power law world, the well connected are vastly more connected than the average connected nodes, and thus play a vastly disproportionate role in the flow of information in the system. Such a power law distribution has been observed with respect to websites (xx), citation frequencies (Price 1976; xx), and, surprisingly, number of sexual partners (xx). One suspects, in the policy world, that particular exemplar policies emerge with the bulk of attention; thus, policymakers look disproportionately at California's experiences in deregulation, Wisconsin's experiences with welfare reform, etc.

Power law frequency distributions tend to emerge from stochastic growth processes, where the growth of any particular observation is proportionate to its size (e.g., the growth rate of small units is about the same as large units—e.g. Simon 1956).

These hubs, in a power law world, play a disproportionate role. One could imagine (as discussed below) that they help systems overcome problems in diffusing and processing information that would likely result from the other types of processes enumerated here (and probably do, to a certain extent—see small world section below). One could imagine that hubs are the nodes with the highest processing capacity, and serve as instruments to aggregate and re-disseminate information (and they probably do, to a certain extent—see information aggregation section below). However, the conditions under which they typically arise limits their potential as conduits of information—since for most of the cases enumerated above, the well connected nodes only send information, and do not receive. That is, one might imagine a power law world where the exceptionally well connected received as much as they sent; however, in the policy world, it seems unlikely, for example, that California pays as much attention (and then retransmits) the experiences of others as much as others pay attention to California.

Homophily: It does turn out that birds of a feather do tend to flock together. Similarity turns out to be a strong predictor of communication across a wide variety settings (McPherson 2001). There are a number of likely explanations for this. First, similar actors will be more likely to have useful information for each other. Imagine moving to a new city: would it make any sense to talk to someone who had a much larger income than you, and thus could afford a much more expensive house? Similarly, one might expect that policymakers would do best to pay attention to those in similar circumstances. Second, especially in political contexts, there are strategic reasons to share information more with those with similar preferences. Information assists actors in achieving their goals. If the goals of another individual are opposed to your goals, you would be unlikely to share information with them.

Cores and peripheries: Emergent networks often will have a "rich get richer" dynamic. Assume that nodes have unequal access to private information. Those nodes with more private information will be more desirable as partners with which to exchange information. If all nodes have constraints on how much they communicate (this does not apply to attention networks, for example) then the node with the most information will be in the greatest demand to form ties with. It would presumably choose ties with those who have the most private information. Those with less information would be in a less of a position to be so picky. Out of a process where the most informed choose the most informed, the moderately informed will be left with each other to choose to communicate with, and the least informed to choose each other. That is, the network will have a well-informed core, that distributes information internally, and a less-informed periphery, with occasional leakage of information from core to periphery. Thus, while the diffusion of information has the potential to reduce informational inequalities in a system, it will potentially just replicate those inequalities.

This tendency will be exacerbated by the fact that nodes that are the most informed will often have the capacity to form more connections. If connectedness were roughly proportional to the informedness of nodes, it is conceivable that the spread of information would (while raising the absolute informedness of everyone) actually exacerbate the informational inequalities in the system. One would expect that out of such a scenario would emerge a highly informed and interconnected core, and a highly uninformed and unconnected periphery.

<u>Small worlds</u>

Emergent networks thus tend to result in clusters of nodes which are highly similar to each other, within which there are many connections, and between which there are very few connections. Clearly, this is not an effective architecture for spreading information. Might networks automatically adjust themselves so as to reduce the worst effects of this inefficient configuration? For example, Burt (1995) enumerates the competitive advantage actors can achieve by bridging these "structural holes" in the network. One might imagine the larger the advantage, the greater the likelihood that actors will seek to close these holes. There are a number of obstacles to this, however, especially in the public sector. The combination of cheap intra-clique communication and lack of property rights may discourage such communication. By their very nature, cliques allow for accidental (and inexpensive) collisions. The lack of property rights means that a node that seeks extra-clique communication that brings novel information may pay a high price for novel information, where the benefits quickly diffuse to the entire clique.[2] Those nodes that do not attempt to bridge the structural holes will actually

[2] Obviously, this is a critical assumption that will differ in different systems.

fair better, under these circumstances, than those that do. An additional deterrent to inter-clique communication is that inter-clique information may be less reliable, because the communicators have fewer reputational concerns. If they pass on inaccurate information, there are few/no consequences, since the two nodes are not embedded in the same social structure (Granovetter 1985, Uzzi 1996).

The above analysis suggests that it is likely that organizational, spatial, and emergent informational networks in the public sector world will tend to be inefficient at spreading information. However, what may be true of each of these networks may not be true of the networks together, as the "small world" findings of Watts and Strogatz (1998) illuminate. What these findings demonstrate that is that while a highly structured network (e.g., the lattice) is not effective at spreading information, and a purely random network (e.g., where the probability of a tie between A and B is uncorrelated with the probability of a tie between any other dyad in the system), an overlay of structure and random networks is very effective at spreading information. This is indicative of a more general phenomenon: *cross-cutting types of networks are typically more effective at spreading information than equally dense networks of a single type.*

A simple illustration will demonstrate why. Consider the network represented by figure 2, where each actor communicates with its immediate four neighbors.

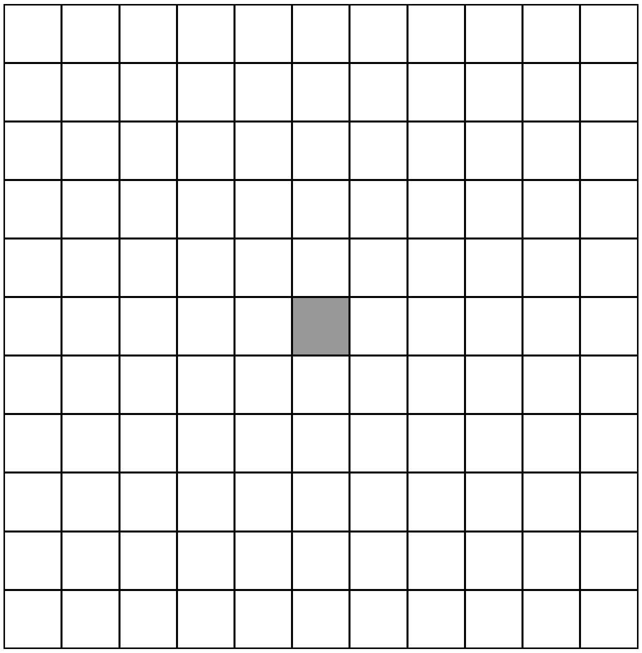

Figure 2: 11 x 11 world

Assume, now, that the actor in the middle of the chess board has a successful innovation, which is then adopted by its four neighbors, which is in turn adopted by each of their neighbors, and so on. It will take 10 rounds of communication before the whole system has adopted the innovation. By comparison, a "random-collision" network, where actors randomly "collide" with four other actors each round, will take just 4 rounds before the whole (99+%) system has adopted the innovation.[3]

A spatial network is inefficient at spreading information simply because the informed are spending most of their time communicating with other informed actors. Only at the periphery of the informed set of actors is information actually spreading.

An overlay of an emergent network on a spatial network is potentially far more effective at spreading information than just a spatial network, for the simple reason that the emergent network will provide bridges between the regions (or, alternatively, the

[3] Note that this is a very different notion of a "random network" than Watts and Strogatz (1998) use.

spatial network will provide bridges between the cliques), thus increasing the proportion of the uninformed in communication with the informed.[4]

A minor elaboration of the above example will illustrate why. Imagine, now, that while all actors still communicate with all other actors, the actor in the middle of the chessboard communicates also with an actor in the distant corner.[5] What impact will adding just this one tie to the 242 that already exist have on the speed with which the innovation spreads? It will take *40% less time for innovation to spread*. Alternatively, what is the impact of simply accentuating the existing spatial network by doubling the neighborhood with which an actor communicates? Increasing the number of neighborhood ties by 242 is only slightly more effective than adding one non-neighborhood tie-- the time it would take for an innovation to spread drops by 50%.

Figure 3 presents the rate of diffusion for four diffusion models: random-collision, spatial with 4 neighbors, spatial with 8 neighbors, and spatial with 4 neighbors + one non-spatial tie.

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[4] Note that this general observation works with any cross-cutting networks—e.g., two emergent networks, two organizational networks, etc. The key is that each network have a logic that is orthogonal to the other network.

[5] In this scenario I am assuming that the chess board "wraps around"; i.e., the actors on the top communicate with the parallel actor on the bottom; actors on the left communicate with the parallel actor on the right.

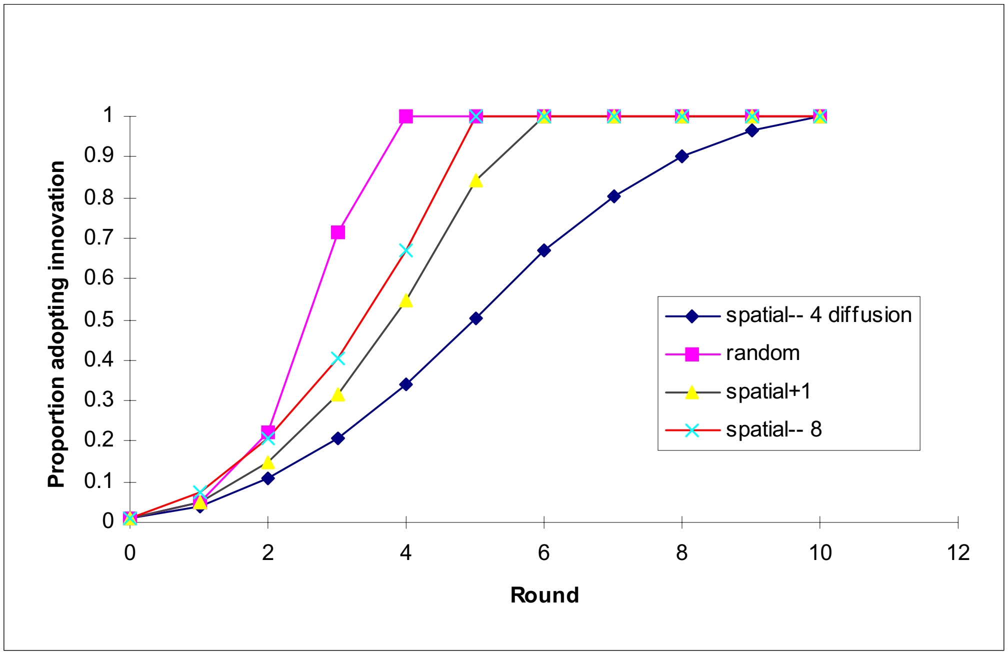

Figure 3: Four modes of diffusion

The above analysis highlights how even the slight overlay of one network on another can dramatically increase the rate of the diffusion of information in that network. It also demonstrates how technologies that reconfigure the logics of the networks in a system can have effects disproportionate to their use.

Producing information

The second key dimension of an informational network is the production of information by the network nodes. Does the architecture of the network affect the incentives to produce information? Yes—and there is a potential downside to a more informationally efficient system, however. Generally, the absence of property rights discourages investment in producing information in the public sector (although see caveats to this general proposition below).[6] A system that is more effective at spreading information may further aggravate this. Specifically, governments may become more complacent with respect to innovating, in the hope that someone else will bear the costs of a successful innovation.

[6] See Strumpf forthcoming; Rose-Ackerman 1980.

An illustration highlights why this might happen. Imagine a potential innovation that yields $1.10 worth of benefits and costs $1.00 to produce if a government produces the initial innovation, or is free if some other government produces the innovation. Assume, further, that there are 100 governments. In the absence of any information diffusion (call this the "island scenario"), every government will spend $1.00, and produce $1.10 worth of benefits, for a total of $110 of benefits for $100 of costs. In the networked world where there is rapid diffusion of information, assume that there is an initial innovator, that spends the initial $1.00, and reaps $.10 worth of net benefits. All other states then adopt the innovation, for $1.10 worth of net benefits. From the systemic point of view, that $1.00 of cost has yielded $109.10 of net benefits, as compared to just $10 in the previous scenario. From a systemic point of view, this is an enormous success. From 99 governments point of view, this is an enormous success. For the 100th government, this is, in absolute terms, exactly the same as the island scenario.

The networked world scenario is therefore pareto superior to the island scenario. However, it is not a stable scenario if you assume that the choice to innovate is endogenous. If you assume (1) that each government is choosing whether to innovate; and (2) that governments are in part benchmarked by each other's performance (Beslsy and Case 1995) and that therefore the innovation decision, over the long run, is itself modeled on the decisions of the governments that produce the highest net benefits, the equilibrium scenario is *zero* innovation by any government-- 0 net benefits.[7]

The impact of free riding is particularly acute because the benefits of an innovation would be so much greater in the networked scenario-- in fact, innovations that result in net absolute losses for an innovator could result in welfare gains for the system. If one assumes that the initial costs of an innovation are F, the costs of adoption for each government after the initial innovator are c, the benefits for each government from that innovation are B, and N governments benefit from that innovation, then the innovation would result in net benefits if $N*(B - c) - F > 0$. For example, if $N = 100$, $c = 0$, $B = \$1.10$, that innovation would produce net systemic benefits even if $F = \$109$. The

[7]More technically, "no innovation" is an evolutionarily stable strategy-- see Axelrod 1984.

innovator, however, would face net losses of $107.90. If the innovator retained rights to its information, then it could, in principle, extract many of the benefits that everyone else in the system receives.

The danger of free riding is determined, in part, by whether governments have different underlying preferences with respect to a potential innovation. Free riding is a great danger where "one size fits all"-- governments have identical preferences. It is no danger if each government requires a unique solution (of course, in this latter scenario, there is no benefit to the networked world either).

The possibility of free riding may be reduced to the extent that policy makers are "proselytizers", valuing the possibility that their innovation will spread. If one assumes that, rather than being egoists, policy makers are proselytizers, then the rate of innovation in the networked scenario will be greater than the rate of innovation in the island scenario. That is, those who seek to maximize their impact on the world rather than their jurisdiction will have greater opportunities to affect a networked world.

<u>The Rabbit and the Hare</u>

A second danger in the highly networked world is that some diversity of policy solutions will be lost, to the detriment of the system. The decision to attempt an innovation will rely in part on a government's assessment of the innovations adopted by other states, and whether there is a consensus in the system as to what best practice is. In a poorly networked world, a government will occasionally look at what a small number of other governments are doing-- if none have a clearly superior alternative, that government may experiment. A successful innovation somewhere in the system will spread slowly, resulting in continued experimentation in the rest of the system during a slow "take off" period. If that innovation is the optimal solution this is clearly dysfunctional; however, if it is not, the continued experimentation in the rest of the system may uncover a better solution.

Alternatively, even if the successful innovation is optimal, it may not be optimal in the future, and maintaining a diversity of approaches would therefore be healthy. Heterogeneity is a systemic property that may yield benefits to all within a system.

Adherence to unconventional and suboptimal policies today may provide diversity in the system for all to benefit from tomorrow. It also serves as a platform to experiment from. Excellent policy solutions may only differ from policy disasters on a few dimensions. A world where everyone rapidly converges to "best practice" will likely have better policy outcomes in the short run than a world where everyone experiments in different "neighborhoods" of the policy space and then only slowly converge to best practice. However, the latter world will have more experimentation and may be more likely to produce better policy outcomes in the long run.[8]

A classic example of premature convergence is the convergence on the QWERTY layout of keyboards. Early in the typewriter industry, there was substantial diversity of key layout. The QWERTY layout was originally designed to slow typing to prevent the mechanical jamming of the typewriter, and, over time, through a diffusion process, the QWERTY layout became standard. While the mechanical jamming of typewriters is no longer a problem, the QWERTY standard remains.[9] One might hypothesize that QWERTY-type of outcomes are more likely in an informationally efficient system.

The likelihood of A adopting B's innovation should drop as the similarity of A and B's policy objectives drops, since B's innovation would presumably be tailored to its policy objectives. Heterogeneity in underlying policy objectives should therefore help maintain a diversity of policy approaches (although limit the benefits to policy diffusion as well).

Aggregating information

The third dimension to thinking about informational networks is how well that network *aggregates* information. Bad information as well as good spreads in informational networks. A more efficient network at spreading information is also a more efficient network at spreading fads, manias, etc. As the information cascade literature demonstrates, in a system where adoption is the only thing that one actor can

[8] See March (1991) more generally on the trade off between exploration and exploitation.
[9] See David 1986. Also see Liebowitz and Margolis (1990) for a critique of David's analysis, which debunks Dvorak as a superior alternative to QWERTY (although does not demonstrate that QWERTY is an optimal layout of keys).

observe about another can easily result in the spread of misinformation (Strang and Macy 2001). Essentially, if one imagines that each node in the system has private information about the value of an innovation, but that this private information can be outweighed by the observation of the adoption decisions of others, then all it might take for the system to get rolling in the wrong direction is for a few of the initial adopters to have incorrect signals. At that point, the private information of subsequent adopters is outweighed by what they observe others to have adopted, resulting in a potential bandwagon going in the wrong direction.

These potential bandwagon effects might be ameliorated by a number of potential dynamics. First, potential adopters could pool their private information regarding an innovation. Given a large enough set of nodes sharing their private evaluations, this pooled knowledge could outweigh the information conveyed by a "bandwagon" (since, actually, bandwagons do not convey that much information). Second, adopters might send information about their experiences. That is, not only is adoption information conveyed, but success/failure information. This would vastly increase the amount of information conveyed in the adoption process; and every bandwagon would contain the seeds of its own destruction since the bandwagon would create a body of data about its failings. The potential of success/failure information to eliminate bandwagons depends on (1) the lag between adoption and success/failure data; (2) whether such data are even generated by the process (as noted above). It is in fact not in the interest of adopters to produce data that demonstrate that they chose failing policies. There is an incentive to suppress negative feedback, and, even worse, to suppress any feedback at all in fear that it could be negative.

<u>Parallel processing</u>

The vision sometimes conveyed of networks is that they distribute the informational load over the many nodes within the system, as compared to an hierarchical system, which overloads the top node. It is not at all clear that such a network would emerge organically, however, or that the ideal configuration differs greatly from an hierarchy. Imagine the following scenario: each node receives a signal about the state of the world—let's say a quantitative estimate of something of importance to the system. Each node has a certain processing capacity—let's say a capacity to "average" its information and the information of 10 other nodes. What would be the most efficient organization of the system? An hierarchy, where at the bottom of the hierarchy nodes were grouped by 10, each communicating with one node above it, which averaged the 10 bits of information along with its own. This layer would be identically organized in groups of 10 passing information upwards. This structure would continue iteratively upwards, until the single top node averaged the information from its immediate 10 subordinates.

Would such structures emerge organically, without centralized intervention? It seems unlikely. The hierarchical structure described above is, arguably, at best, a very hard to reach equilibrium, if one posits that the nodes are seeking to maximize their own informedness. The reason for this is that there is little reason for nodes to communicate with the nodes below them, as compared to the nodes above them, or at their own level. Consider the nodes one level down from the top. A pair of nodes at this level, given the opportunity to switch one communication from one of their subordinates each to each other, would certainly improve the quality of information they were receiving. The one caveat here (and the reason why the hierarchy is a potential equilibrium) is that if one assumes that the top node "broadcasts" its solution once it has calculated it, none of its subordinates will have the incentive to deviate from their communication pattern, since it would be detrimental to the quality of this signal. However, there is no smooth path to that equilibrium, because the actors that emerged as more central would have an incentive to drop their ties to less central nodes, which would undermine the hierarchical structure outlined above.

Institutions in the middle

There are potential institutions to play an aggregating role. In particular, one might imagine institutions that have both high processing capacity and high levels of connectedness. For example, the federal government might play the role of a central node that processes the experiences of the states, develops and disseminates best practices.

However, arguably, the federal government focuses more of its analytical capacities on developing its own mandates, rather than enabling state and local governments develop their policies.

There are also a variety of national organizations of local and state governments (the National Governors Association, the National Conference of State Legislatures, the National District Attorneys Association, etc). There exist also various international organizations that serve (in a network sense) a similar function, such as the Organization of Economic Cooperation and Development, the World Bank, etc. In the US context, however, these organizations often have a somewhat limited desire to serve as a conduit of information, in significant part because they really act as industry associations—representing their collective needs to the outside world, rather than facilitating the smooth flow of information among their members. In fact, the reason for this is that these two objectives are at odds: facilitating the smooth flow of information, aggregating information into studies of best practice, etc, in fact means picking the practices of a small number of members as winners and the rest as losers. Such a strategy might quickly undermine the support of such an organization.[10]

Finally, academia plays a potential role as a central node—collecting, comparing, and critically examining the practices of many jurisdictions.

The organizational nexus: networks, markets, and hierarchies

Markets, networks, and hierarchies offer different mechanisms to deal with the issues around information diffusion, creation, and aggregation. Networks rely on reciprocity and embeddedness to regulate the behavior of their members. They are relatively poor at dealing with complex chains of exchange—for example, where A has something B needs, and C has something A needs, and B has something C needs. In this scenario, the network cannot be sustained by reciprocity or reputation, but instead may at best be supported a complicated system of arbitrage. Networks, in the absence of markets

[10] I thank Robert Behn for this point. Notably, some of the international organizations are exceptions. Arguably, this is in part because of the political irrelevance of those organizations. Further, in many of these cases—the international development organizations—critical examination is not of donor countries, but of recipients.

and property rights, may do poorly at encouraging significant investment in new information, because of the lack of control of that information once it is produced.

Markets institutions standardize goods along salient dimensions, offer a standard for exchange (money). Supporting institutions, such as property rights, also encourage production of information (although at the cost of efficiency in the monopoly rights conveyed). People thus write books, develop new medicines, create new software, in the expectation that the properties of the goods will somehow be captured by dimensions that have emerged as salient in the market (of course, these dimensions are themselves highly contested). Markets work less well at supporting transactions where the properties of the good is not easily captured by the dimensions that the market has defined. Consider the vast array of little bits of information, gossip, etc, exchanged in informational networks: "the biggest difficult we encountered in implementation was…" "the next division chief is going to be…" etc. These non-standard bits of information, essential to the operation of any system, would be impossible to put valuations on (or far too costly). Instead, this type of information exchange is governed by reciprocity, norms, etc.

Hierachies (by which I mean authority structures), have a variety of mechanisms to deal with the issues raised above. At the simplest level, information sharing and information production can simply be commanded. Thus, if A is in a position to discover something, A is ordered to do so. If A has information B would find useful, A is ordered to share information. Of course, such a system would typically put demands that would quickly outstrip the capacity of the apex an organization.

There are other, less blunt, authority tools. Hierarchies standardize behavior and information, facilitating information flow. Hierarchies also create the public goods for information exchange—e.g., infrastructure. Hierarchies can also recognize and reward information production and information sharing ex post, a less difficult task than doing it a priori.

A particular system will generally operate by multiple institutional logics. The prescriptive question is whether there is a match between what a particular institutional logic is effective at, and what it is being asked to do.

Conclusion: how to maintain innovation.gov?

The objective of this paper has to be view the intergovernmental network as an informational network: each node producing information and potentially transferring information to other nodes. The shift from relatively geographically bound networks to global networks should greatly increase the informational efficiency of international policy networks. Yet, by increasing the rate at which successful innovations spread through the system, globalization may discourage policy experimentation due to free riding and premature policy convergence. This suggests a counter-intuitive governance prescription: as governments receive more information regarding what other governments are doing, incentives for all governments to continue experimenting (and thus creating information) should be increased.

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