Networks, swarms, policy

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Abstract

Modern policy making arose in the 20th century as a series of techniques to optimise a simple system, like a machine. There are now signs that 21st century policy makers are starting to view societies and economies as a complex system instead: one of them is the adoption of network modelling by senior decision makers. We propose that policy making, when viewed as a complex system, is akin to a manipulation of what theoretical biologist Stuart Kauffman calls the adjacent possible. Directed policy action opens or blocks the way towards possible future states of the economic and societal system at hand: in this sense, policy is a variability engine. Once that has happened, the selection of the state to which the system will actually move depends on the actions of a great many agents, including local communities and "smart swarms" of networked citizens. We look at some of the emerging consequences of this new world view for public policies, including a new set of policy tools for smart swarm deployment. We conclude by trying to paint a big picture of the shift in modern policy making and the role of the state.

1. Setting sail: redefining participatory policy

When we kicked off INSITE three years ago, one of our goals was to better understand what kind of policy was best suited to social innovation. Our point of departure was the concept of participatory policy: The idea was that a policy maker could influence society's trajectory by tweaking its permission structure – who is allowed to do what. We were armed with networks as a simple, yet rigorous way to think about participatory policy and permission: our working hypothesis was that you could detect the effect of any change in the permission structure in a policy space by observing the networks of interaction within that space reconfiguring itself around the new permissions. We derived the concept of permission structure from Lane and Maxfield's (1997) theory of innovation; in the context of INSITE, where a lot of attention is paid to ICT, it acquired some of the hard-edgedness of ICT itself. System administrators of communication networks allow or disallow modalities of interaction, and maintain complex authorization profiles that allow fine-grained control of what individual users can or cannot use the system for. This (software) technological layer, called affordances in media studies, has been shown to influence the social interaction it carries in various ways (Baym & Boyd, 2013).

As we engaged with policy makers, we discovered that the concept of participatory policy was not easy to operationalize. Policy makers seemed not to see the payoff in adopting it, possibly because it partially overlaps with regulation pure and simple – like a "no parking" sign, which is certainly a form of policy that works by changing the permission structure but is not very interesting.

At the opposite end of the spectrum – that of prompting desirable actions instead of inhibiting undesirable ones – participatory policy seemed to overpromise. Policy makers tend to expect that enabling something to happen is equivalent to making it happen. If you build it, they will come. If you put up funding for social innovation, you will get social innovation. This position implies policy to be similar to water engineering: there is a sort of potential energy of social dynamics that can be exploited at all times, just like water cannot help flowing downhill. In INSITE, we have been holding up the view that this way of looking at things, whatever its other merits, does not work to explain innovation.

If the "action" side of tweaking the permission structure is not like water engineering, what is it like? We have come to think of it as akin to expanding what Stuart Kauffman calls the adjacent possible. Altering the permission structure changes the space into which a dynamic system can go next. The system will only move into a subset of the adjacent possible, often a tiny one; this lends innovation and innovation policy their unpredictability.

2. Thinking in networks: what it means for the policy makers

INSITE has engaged consistently with policy practitioners. Though our evidence is only anecdotal, it seems fairly safe to claim that policy makers are increasingly taking up networks as a way of looking at the world. Among many examples of this, we quote a few that look particularly clear-cut.

- OpenCorporates is an open database of over 60 million corporations worldwide. Using unique identifiers and information on ownership structure, you can build visualisations like that of figure 1: a conglomerate, in this case Goldman Sachs, is represented as a network in which nodes are companies and edges represent corporate control. Red nodes represent companies in tax havens. The location of nodes is mapped onto a world cartogram, where countries are represented as polygons with roughly the same shape as they would have on a normal map. Their size depends on the number of companies of the conglomerate that are incorporated in that country. This is a civil society project. But government is sitting up and taking notice.

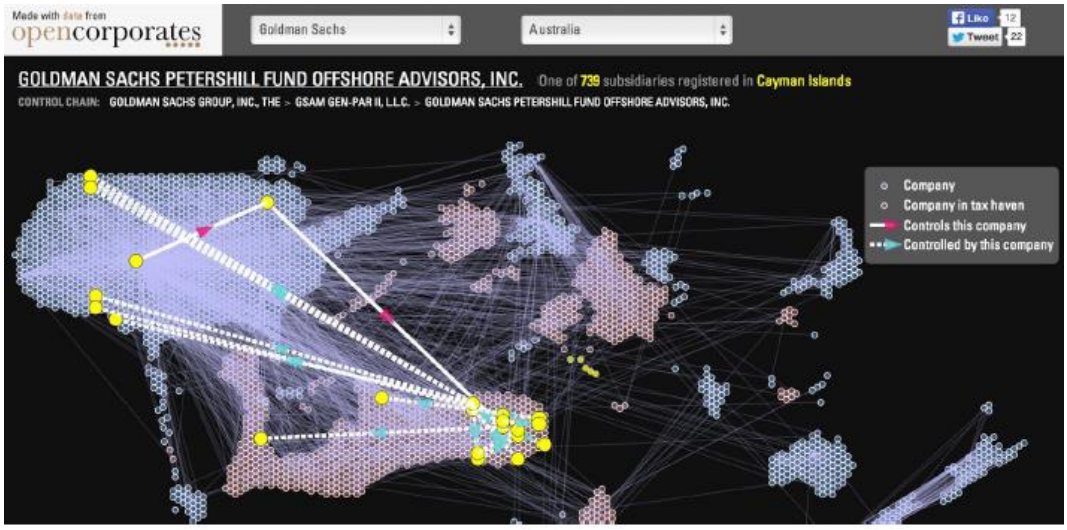

Figure 1 - Network representations help make sense of complex conglomerates

- Ricardo Hausmann and César Hidalgo's (2007) notion of product space is also regarded with interest by policy makers. They propose a multiplex network of countries connected by products they produce to derive a measure of country "capabilities". This has been shown to predict growth, and more importantly it tells countries what they might conceivably make next with a good probability of succeeding. As a measure of economic health, it is arguably more elegant and operational than the Sen-Stiglitz-Fitoussi commission's (2009) recommendations.

- INSITE itself has been quite active in that debate, both in word and in deed. A talk called "Thinking in networks: what it means for the policy makers", given by Cottica, was scheduled at the European Commission's Policy Making 2.0 2013 event. We prototyped policy-geared hands-on network analysis in the two Masters of Networks events in 2013

and 2014. We have seen with our own eyes policy makers that had never used networks before go through their "aha" moments. Data on World Bank contractors and Italian Ministry of Education research funding beneficiaries were instantiated as networks of firms that participate in different consortia; such networks where explored on behalf of, and with the participation of, the institutions that run those policies and generate those data, leading them to fresh insights.

- At the time of writing, the United Nations Development Program is running an experimental horizon scanning exercise in Armenia, Egypt and Georgia. They are using online conversations to gather qualitative data. During Masters of Networks 2, we helped them prototype a procedure to detect emergent groups of specialists in the conversation. The purpose of these is to "train" social networks of citizens to explore scenarios and deliver expert advice on vertical policy, which is what UNDP wants to do with respect to working towards their Post-2015 Development Goals. Ricardo Hausmann and César Hidalgo's (2007) notion of product space is also regarded with interest by policy makers. They propose a multiplex network of countries connected by products they produce to derive a measure of country "capabilities". This has been shown to predict growth, and more importantly it tells countries what they might conceivably make next with a good probability of succeeding. As a measure of economic health, it is arguably more elegant and operational than the Sen-Stiglitz-Fitoussi commission's (2009) recommendations.

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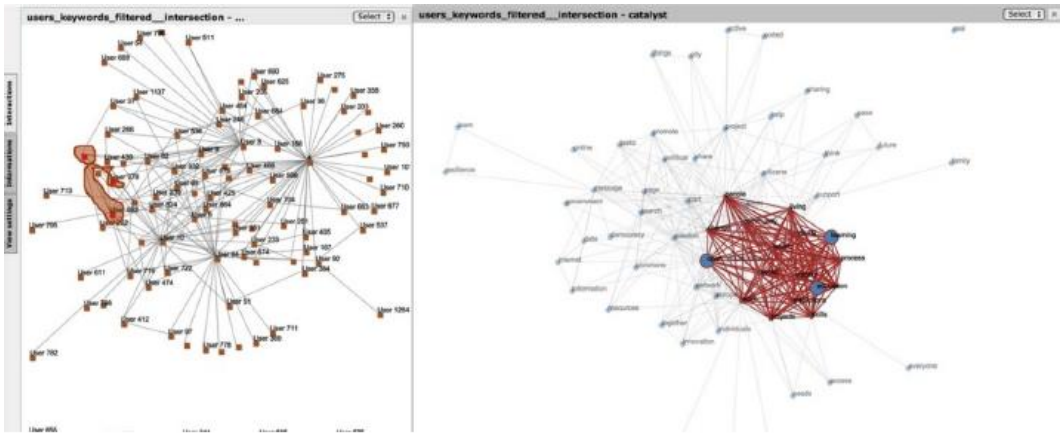

Figure 2 - Networks to detect groups of specialists in online conversation

3. What drives the adoption of network thinking?

All in all, there seems to be a lot more interest for networks in the policy world than there was when INSITE got started. We now turn to identifying the reasons why this interest has come about. What do policy makers gain by thinking in terms of networks?

Impact is an obvious one. If policy is conceived as broadcasting, it will deploy inefficient, ineffective tools. Thinking in networks lets policy makers see and reuse the societal infrastructure relaying information and even behavioural change (Christakis and Fowler, 2007, 2008). A policy maker equipped with a "broadcast" model of AIDS will try to squeeze behavioural change out of the system with broadcast measures like posters in high school and colleges, where they will be seen by people whose behaviour is normally not dangerous. One equipped with a network model of AIDS will understand that all the action is with few people with very many sexual partners; try to figure out who these people are, and design for a much more surgical intervention.

Reduced iatrogenics is another. As our societies get ever more complex, they get ever more difficult to second guess. There is a real risk of what Nassim Taleb (2012) calls iatrogenics, harm

done by the healer. An example from public spending will help clarify. In Italy, the north of the country is well-developed, with quite a strong manufacturing economy, whereas its south is lagging behind. This is a high political priority, and for at least fifty years Italian authorities have made substantial efforts to close the gap. As a result, people in that part of Italy, per capita, see a substantial pot of money – 200 times their counterparts in the rest of the world. Policy makers see themselves as really trying to help by "investing". But of course, this "investing" is broadcast: it mostly ignores the social structure underpinning it, which in turn got encoded into the nuts and bolts of the regulation on government spending allocation: for example, the requirements for eligibility to apply for grants are stratified over multiple regulatory levels (from the EU partnership agreement for each programming cycle down to the regional level) and a time span of several years, with pressure from vested interests, lobbying and multistakeholder dialogue occurring at all level).

As a result, spending backfires. While most of the money goes (unintendedly) to networks of incumbents, the best and brightest young people in Italy's Mezzogiorno focus on getting some of the crumbs, which can be substantial. But of course, in development terms, this is just a distraction: as they write funding applications, they are not starting companies, or leaving the country, or squatting buildings; they are not engaging in collective, trial-and-error discovery of the paths that lead to the healing of the economy. The government means mostly well, but the amount of damage inflicted is terrifying.

Accountability is another benefit of network thinking. In the age of big data, it is paradoxically getting more difficult to take responsibility for decisions made on the basis of evidence. This is because big data allow for – and often require – the deployment of sophisticated data processing techniques to extract information from large amounts of data with a low signal to noise ratio; the results from such techniques can be difficult to interpret.

A good example is machine learning: result are obtained by evolving algorithms to make decisions, then feed them unfathomable quantities of data. Even the people who trained the algorithms have trouble interpreting what they do: for most senior decision makers, it is unrealistic to expect they take the time and effort to unpack results in terms of what, in the algorithms, bring them about. A modern policy maker making a decision on the basis of machine learning, then, is not too different from an ancient Greek city-state king making a decision on the basis of a soothsayer looking at pigeon entrails: everybody can see the the entrails (the data), and

hear the soothsayer's response (the result), but how the soothsayer gets from the former to the latter is unaccountable. Network modeling is relatively intuitive, in the sense that simple, intuitive, visualizable models get us quite far.

Measurability is another important benefit. Social media are a game changer in this space. Because of the technology we use to support it, online social interaction leaves traces encoded in databases. We can then mine those databases to rebuild the graph of social interaction. Corporates like Google and Facebook do this routinely: but academics, decision makers and citizens can do the same on a smaller scale, and they increasingly do. (Watts 2012, Lazer et. al. 2009).

Thinking in networks tends to inspire policy makers to treat self-organizing social dynamic with respect – a feature rather than a bug, to use an analogy from computer programming. Even very simple network models of preferential attachment simulate convincingly the emergence of "superstars", highly connected hubs, starting from identical nodes. Superstars are desirable in many network, because they result in a topology that turns out to be very efficient in propagating information across the network. But this efficiency property at the system level comes at a price: high inequality at the node level. And this inequality seems unfair: superstars acquire their status by being born early, or getting a lucky break early on. The system dynamics does the rest.

The ability of such models to display sophisticated behavior from extremely simple rules teaches policy makers that some systems have ways to self-heal and laws of motion that it could prove expensive or impossibile to counter. From such respect, in turn, stems a preference for policy to be narrowcast and minimal intervention rather than broadcast and heavy duty.

Compassion is a final benefit. Most network models assume identical nodes: working with these models fosters awareness that our special positions in society can be explained as a function of variables we have no control on. This challenges the "underserving poor" rhetoric and leads to compassion, empathy for the people who get pushed to the right of the degree distribution, that might well be as smart, or smarter, as some of the superstars.

4. The rise of swarms

We have come to believe that thinking in networks produces cultural change more than it requires it. Like the rest of us, once policy makers start seeing networks, they cannot unsee them, and are nudged towards a way of thinking that is quite consistent with complex systems thinking. By focusing on connectivity, they start to see people not as instantiations of some representative agent with predictable aggregate behaviour, but as agents constantly exchanging information with, and adapting to, each other. That is, they start to see aggregate behaviour as swarm-like.

Since a few years before INSITE started, "smart swarms" of citizens loosely coordinating on the Internet and with no central control have achieved significant policy impact in the West. In 2012, a sudden, highly networked continent-wide mobilisation started in Poland sank ACTA, an obscure and highly technical treaty that had hitherto had no political opponents to speak of, by persuading MEPs to vote it down. In the United States, similar attempts to regulate the Internet failed in a similar way and in the same period. Hackers associated with 4Chan and Anonymous (neither of which is an organization in a strict sense) engaged in epic battles with PayPal, Visa and other financial operators in their effort to support Wikileaks, whose credit lines had been shut down in the wake of the cablegate. Party politics, too, was affected, when the Swedish Pirate Party surprised everyone by scoring 7% in the 2009 European elections with a campaign that had cost all of 50K EUR. Party leader Rick Falkvinge went on to write a book about the experience, titled "Swarmwise" (Falkvinge 2013).

5. Making policy for swarms and its unorthodox tools

Swarms involvement in policy seems to follow a similar pattern across different episodes. Large groups of people coalesce around an issue, apparently coming out of nowhere; they run rings around traditional actors; and then dissolve once again. Can policy makers deploy the same logic, and get swarms of citizens to work towards policy goals? Some preliminary experience seem to indicate that this might be possible in some circumstances. However, policy for swarms requires strange tools. They are quite powerful, and we predict policy makers are not going to be able to stay away from them. One of us (Cottica) has personal experience in assisting senior policy maker to deploy such tools. His experience and that of several colleagues indicates that

their adoption by senior management is possible. In this section we list actions that are used to mobilise and deploy swarms of citizens towards a policy goal.

Note that by definition deploying a swarms implies mobilising people, who do not work for the policy maker, do not take (much) money from government agencies and need to be convinced that the policy is sound and worth the effort. This mean that any policy involving swarms needs to pass a reality check right at the start. This characteristic is desirable in itself, as it leads to failing early – therefore cheaply. All tools for mobilisation and management listed below can only work in the context of a policy that a sufficient number of citizens finds worthy and meaningful, deployed by a policy maker they find credible. An initial, necessarily sketchy list includes:

1. **Falkvinge's Law**. Swedish Pirate Party founder Rick Falkvinge has proposed a clear and operational definition of leadership in a swarm. According to him, swarms are led from the front. Leaders wishing to mobilise a swarm stand up and announce: "I am doing X. Who's in?" This is more radical than it seems. Taleb (2012) has pointed out that modern society rewards non-risk takers (corporates, politicians, bureaucrats), and that this is new (Alexander the Great led his own charges). Falkvinge's Law restores the idea that risk-takers should be honored and rewarded.

2. **The fishing rod model**. Policy for swarms needs an interface – in fact, probably several layers of it. Government agencies are Weberian bureaucracies for well-established accountability reasons. Swarms are very clearly not (Cottica 2010). Mechanisms are needed for smart relaying of information between the inside of the government agency and the outside, with the swarm having some kind of legitimacy without being subject to the hard constraints of public servants. The result construct is reminescent of a fishing rod, thick and rigid at the handle, thin and flexible towards the end.

3. **Timing**. Scholars of swarms and social networks focus typically on the behaviour of the formed swarm. But practitioners agree that the hardest part is to start one. The knowledge of how to successfully start one is still much more art than science, and an "embryology of swarms" does not seem to be in sight. Anecdotal evidence suggests that successful instances of mobilizing a swarm pay close attention to timing. For example, leaders could spend some social capital (for example leveraging trust network of friends)

to ensure that a certain number of people will respond publicly to their call for joining a new swarm, and only then issuing the call (and giving immediate positive feedback to the first wave of joins).

4. **Randomness/mutation**. The need to make policy stems from the diagnosis that an undesirable situation is not fixing itself. In system dynamics term, this is equivalent to saying that the system has become stuck on a local attractor, but other, more desirable ones are deemed to be within reach. The standard solution would be to deploy "big government" intervention to push the economy towards the global maximum, which is potentially iatrogenetic. A swarm-based alternative is to inject randomness in the system dynamics to get the system unmoored from the present attractor, then letting its own law of motion take over. This maps elegantly to innovation, social or otherwise. Recall Lane and Maxfield's (2007) theory of generative relationships: innovation stems from people being similar enough that they can communicate well, but different enough to give each other mild cognitive shocks, inducing new ways to look upon things. It is not hard to assess the generative potential of a relationship, but it is impossible to predict in advance which potentially generative relationships will actually lead to breakthroughs. Organising parties and social events, with a little curation, will act as variability (or mutation) engines, seeding new relationships, each of which will be generative with a certain probability. Therefore, parties can be regarded as a legitimate innovation policy tool.

5. **Transparency**. Radically transparent behaviour is advantageous when running a swarm, because it wins trust. Transparency also doubles up as a management tool: most people will just appreciate that the policy maker is being honest about, for example, how much taxpayer money is spend on what, but occasionally somebody pays close attention and makes useful suggestions. This is especially useful in situations where the policy maker needs to confront an established narrative of public policy as being corrupt and self-referential. Experience, including our own, shows that transparency is an amazingly effective tool in reducing conflict and suspicion.

6. On policy and innovation: insights from INSITE

What have we learned about the component of the innovation society we call policy after three years of INSITE? We have tried to argue that many policy makers seem to be starting a journey that starts with thinking in networks; a minority are taking a step forward and experimenting with swarm-like, distributed policy making. If this is true, where does it lead us? Far-reaching change seems to be afoot, but perhaps in too early a stage to draw hard conclusions. In the interest of the debate, this section ventures into speculation and tries to point out possible outcomes of the processes we have tried to describe above. What follows has nothing to say about whether such outcomes might be desirable; we focus exclusively in describing, not evaluating them.

We propose that policy makers thinking in networks might mean we are finally getting ready to let go of the 20th century in policy making. The century we left behind was the state's finest hour: armed with the tools of (19th century) science and planning, policy makers dreamed themselves as the people at the helm of the mightiest engine ever invented for human progress. Their successes were astounding, and very concrete. Walther Rathenau, Germany's technocrat-in-chief during World War 1, invented a planned economy that could keep its armies in the field and adequately supplied long after observers had predicted its collapse. A generation of reformers sat up and took notice. James Scott (1998) calls their ideology, a comprehensive aspiration to administrative ordering of society and nature, "high modernism". It inspired many heroic efforts: some benign (Roosevelt's New Deal), others tragic (Stalin's collectivisation of agriculture in the 1930s). Ever-more sprawling government bureaucracies looked, literally, to the stars.

In the end, iatrogenics took most of these efforts down – or left them stumble on, hopelessly inefficient but still good enough at parasitism to survive. Stalin's collectivisation effort failed spectacularly at growing crops, but it worked well at appropriating whatever was grown to feed the cities and their industrial population, and at keeping the peasantry in check. A pattern emerged: government agencies would start from a simplified model of the world, that justified their intervention in it. Next, they took action that invariably ended up disempowering and commodifying the skill set and culture of their "target group", while enhancing their own centrality in the system. And the state became very central indeed: the government budget as a share of GDP in the USA was 6% in 1902, but had climbed to 40% in 2010.

As a textbook example of the fundamental flaws of high modernism, even when benevolent, Scott chooses Julius Nyerere's villagization campaign in Tanzania in the early 1970s. Nyerere's advisors, influenced by Western agriculture experts, claimed that the "messy" polyculture practiced by farmers was inefficient, the legacy of the lack of modern education. Tanzanian farmers needed help to change their ways completely. A bureaucracy was rigged to move them away from their fields and reorganise them into villages where monoculture would be practiced, which were located on main roads to facilitate administrative control and monitoring. Tanzania has a very high variability from one area to the next in type of soil, rainfall, infestant species etc. The result of villagization was a self-fulfilling prophecy: taken away from his field, the Tanzanian farmer – who had been a highly skilled specialist, as agronomist realised too late – became an unskilled pair of hands, that indeed did need government experts to tell him what to do.

7. Emerging new roles for networked communities and the State

We know better now. We are beginning to suspect, for one, that everyone is a policy maker. Some scholars and practitioners argue that the Internet age has enabled a wave of collaborative "policy by editing" (Noveck 2009; Cottica 2010). Citizens participate not only in debate and decision making, but sometimes even in the delivery of policy. David Cameron's Big Society is an example of such a trend becoming sanctioned policy by a major government.

This tendency seems to have gained new ground over the last few years. A neighbourhood in Cairo, Egypt, called Al Mu'tamidiya has become the symbol of wiki citizenry. In 2011, as the security apparatus was occupied with Tahrir Square, they went out with shovels, bulldozers and cement and built four illegal access ramps to the ring road in Cairo. The ring road is 20 meters above ground level: to gain access to this critical infrastructure, the local community not only defied the law, but it shouldered all the funding, the engineering and the workforce, at a total cost estimated at a million Egyptian pounds (though they are built to government specifications, that's about 25% of what it would have cost the government to do the same work). Then they called out for the chief of police to inaugurate it. Egypt has a movement that calls itself "tactical urbanism" and is hard at work to make the most of its thiriving informal settlements (Nagati & Stryker 2013). Egypt may be a particularly advanced example, but urban planners across the planet are

looking at slums, shantytowns, favelas and other informal settlements with new, more sympathetic eyes (Brand 2010).

Policy, we have argued, shapes the adjacent possible, usually in the sense of expanding it. Once that has happened, a subset of that adjacent possible will actually come to pass, powered by whoever has both the desire and the ability to push the system forward. Since these doers will have agendas of their own, there is no guarantee that what they do will increase GDP. Indeed, in the context of the smart city debate, we have argued that most things we would consider smart (bicycles, emphasis on repairing, insulation, urban farming) destroy GDP by reducing dependencies (Cottica 2012).

These trends are broadly consistent with INSITE's manifesto (Lane 2014). But if everyone is a policy maker, if citizens and communities are expected to do much of the heavy lifting, to the point of producing their own infrastructure, what role is left or the state? We expect an emphasis on monitoring and experimentation. Monitoring feeds early warning information back to the distributed policy making system and the innovation society itself. Experimentation enhances variability, and thereby expands the adjacent possible in promising directions. We are definitely seen moves in both these directions: entities like the U.N.'s GlobalPulse are exemplars of the first direction, whereas the What Works and Nudge Units already established in several government are exemplars of the second.

Thinking in networks and policy for swarms are apples from the complex systems intellectual tree, and true to the saying they have not fallen far. The Santa Fe Institute never had a policy focus, but already by the end of the1980s it was clear that complex system thinking was at odds with high modernist big government. Speaking to scientific journalist Mitchell Waldrop (1992), this is what Brian Arthur had to say on the matter:

"If you think that you're a steamboat and can go up the river, you're kidding yourself. Actually, you're just the captain of a paper boat drifting down the river. If you try to resist, you're not going to get anywhere. On the other hand, if you quietly observe the flow, realizing that you're part of it, realizing that the flow is ever-changing and always leading to new complexities, than every so often you can stick an oar into the river and punt yourself from one eddy to another."
[p. 330 -331]

Is this where public policy is going? If so, there are reasons to celebrate. This position does not promise miracle remedies, but it is intellectually humble and unlikely to produce many iatrogenetics effects. INSITE ends, but the debate is far from over. We look forward to further developments.

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