

Gardening the Internet/Web: A Framework for Communications Policy

DRAFT - 31 January 2008

Précis

Pierre de Vries
Research Fellow, Economic Policy Research Center (EPRC)
University of Washington
pierredv@hotmail.com

I. INTRODUCTION

This paper lays out an approach to deciding whether and how government actors should regulate the internet/web. It provides a framework for action that reflects the underlying system dynamics, balances conflicting interests, and maximizes social benefits. It provides a bridge from day-to-day contingencies to policy plans by introducing principles that can guide policy making, and tools to implement the policies. While I will discuss some test cases, it will ultimately be up to policy makers themselves to apply the principles.

We are in the middle of a dramatic, decades-long reconfiguration of the means of communication brought about by internet technologies and web entrepreneurs. The new ways of communicating often don't fit well into old regulatory structures. Communications policy makers are challenged by the opportunities presented by the internet/web. Perennial policy questions about the public interest, economic growth and social values need to be addressed for the new media as much as for the old. How should policy makers act?

One needs to understand something before trying to act on it. The novelty and complexity of the internet/web therefore requires new mental models. The traditional metaphors of "silos" and "layers" don't work any more. Current metaphors for the internet (from pipes and highways to tools and places) don't fully capture its complexity, emergent behavior, or the human dimension. I propose that it is helpful to conceive of the internet as a vast garden, and communications policy as gardening on a regional scale.

II. THE POLICY CONTEXT

Societies have social and economic objectives, and regulation is one of the tools available for achieving them. The underlying goal is to increase the welfare of citizens. Policy makers are held accountable for ensuring the delivery of public goods, which do not change amid the flux of technological and commercial innovation.

There are two broad social objectives. The first is to ensure that services necessary to public welfare are provided where economic incentives alone don't suffice; that is, public goods. The second is protecting and projecting cultural values, particularly controlling speech and content. While policy makers are not primarily focused on innovation and the economy, unless this is their specific portfolio, acting in the public interest requires attention to economic objectives, including: protecting the public from abusive practices, ensuring competitive markets and managing scarce public resources.

One can recast these goals as five "policy imperatives": revenue, economic vitality, public safety, consumer protection, and culture and values.

III. THE GARDEN METAPHOR

A garden is neither pure nature, nor pure culture; it is nature in the service of culture. A garden more than just an ecosystem, defined as a community of organisms functioning as a unit. Human agency plays a special role. While the gardener is technically an organism like all the others, she has a conscious, forward-looking agenda that is qualitatively different. The existence and form of the garden is the result of intentional human action. In the same way, the internet/web is more than just a market-culture complex, where companies, customers and citizens interact. It is shaped by governance decisions that attempt to influence market and culture.

Gardens, particularly large ones like forest systems and commercial farms, are therefore an attractive metaphor for the internet/web. A garden is nature put to human use, and the internet/web is technology put to social use. The “nature” of the internet/web discourse is its technology and commerce, separate from the “culture” of politics and policy.

One needs to think of gardening broadly to represent the sweep of internet/web policy, particularly at a national and international scale: it is not a personal garden or small-holding – which is roughly the equivalent of a local area network – but rather a commercial farm, a watershed, a national park system, or even a planet. The act of making policy is not just gardening, but rather farming or forestry.

The mapping from gardening to internet policy is straightforward. Just like a garden, the internet/web has a life of its own through the actions of producers and consumers, but it is shaped at a global level by policy decisions. The policy makers and regulators are the gardeners; while they have a crucial role and great responsibilities, their reach is limited.

There are many kinds of gardens. They vary in scale from window-sill planters to national forests, and in governance from personal to public to commercial. Some gardening objectives are utilitarian, and others aesthetic: some see gardens as primarily productive and others cultivate them for pleasure. In the same way, some parts of the internet/web are public, and others are private; objectives range from personal and organizational productivity, to frivolous entertainment and idealistic political movements.

While most of the work in a garden is done automatically by the plants and other providers of ecosystem services, humans impose their desires regarding outcomes. Similarly, internet/web innovation is driven by entrepreneurs and technologists according to their own agendas, though governments try to impose their will on the outcomes.

The old silos of traditional communications regulation are like commercial farming. There are a limited number of well-defined fields, each with its own crop: corn, wheat, beans, vegetables, and so on. It's clear who's responsible for the farm, and the measures of success, like bushels per acre per dollar of inputs, are well defined. Today's internet/web is more like a patchwork of wilderness, forests and wilderness parks that straddle borders, and making internet policy is like public forestry. Control is decentralized, and there is a great deal of variety. There are many competing uses and users, from logging to pleasure to ecosystem services. Given this pluralism, success metrics are ambiguous at best.

The analogy of the internet/web to a garden is of course incomplete, like any analogy. Different perspectives of the internet will each reveal truths regarding that system that are neither entirely independent nor entirely compatible. The garden metaphor, though, captures the web's complex system dynamics in a familiar way. It fits in the tradition of other place-based metaphors for the web (as a building, market, library, or public venue). There is a resonance with tool metaphors, since gardens are as a means to an end, whether pleasure or production. The link to the "internet as communications infrastructure" metaphor is less direct, but they don't contradict each other. Finally, it's worth recalling that the concept of "systems" in general and "ecosystems" in particular, is only a metaphor. An ecosystem, and even more a managed ecosystem, is a human construct imposed on multifarious and slippery reality. It's a just a model; and all models are incomplete.

IV. INSIGHTS FROM COMPLEXITY THEORY

While gardening lore can inform internet/web policy, there is fortunately a deeper theory to draw on: managed ecologies in particular and complex adaptive systems in general. It should not be surprising that the gardening metaphor makes sense, since both gardens and the internet/web can be modeled as complex adaptive systems.

A system is an organized collection of elements that acts over time to perform some function. There are many schools of system thinking. Systems thinking shifts the emphasis from an analysis of the working of individual parts to their organization, and from static analysis and description to dynamic activities and processes. There is a web of relationships linking all the elements in a system. Each element affects the whole, and the whole influences the behavior of the parts. The parts cannot be understood by studying the whole, and the whole has properties not inherent in any of the parts. Systems organize themselves, and their characteristic structural and behavioral patterns are mainly a result of interaction between the subsystems.

There are four attributes of complex systems, in particular, that inform the policy tools and principles that are proposed later on: conflicting explanations, hierarchy, cycles and multiple equilibriums, and surprise and novelty.

A. Conflicting explanations

David Weinberg posited the "complementary law", which states that different perspectives on a system will reveal truths regarding that system that are neither entirely independent nor entirely compatible (Skyttner 2001:92). In other words, there are many, non-overlapping but equally valid descriptions for a complex system. Any given model under-represents the system. This means that conflict in policy making is unavoidable – as soon as people have different perspectives, they will have different assessments of the situation, and valuations of desirable outcomes.

B. Hierarchy

Systems consist of nested subsystems with linked dynamics at different scales. As a system grows, its complexity increases and a hierarchy emerges. Each level is made up of several systems, which can be decomposed at a lower level. The higher levels control certain aspects of the lower level subsystems: less complex systems control more complex ones (Skyttner 2001:60).

Panarchy theory (see e.g. Gunderson & Holling 2001), describes how hierarchies turn into dynamic structures in a biological setting. Natural systems have a variety of time/space scales. Growth and collapse cycles operate at different rates at each scale. Individual levels of the hierarchy have non-linear multi-stable properties which can be stabilized or destabilized through critical connections between levels. Cross-scale interactions are particularly important at times of change and renewal. Critical change in one cycle can cascade up to larger and slower scales when they're vulnerable, e.g. when a ground fire in a forest spreads to the crown of a tree, then to a patch in the forest and then to a whole stand of trees before it is finally extinguished. Conversely, renewal at a given level can be supported by drawing on resources at larger/slower scales, as when a burnt forest draws on the accumulated seed bank and soil nutrients to regrow. In the late part of the growth phase at a given scale, three things are happening simultaneously: the system's potential for novelty is increasing, its connectedness and self-regulation are increasing, but its overall resilience is falling. At this point, a sudden event can trigger the collapse of the whole ecosystem.

C. Cycles and multiple equilibriums

Complex adaptive systems can have many equilibrium states, shifting from one to another from time to time. Sometimes they return to states previously visited, showing cyclical behavior. In other cases, a system might flip to an entirely new equilibrium state, unlike any previously occupied.

Holling's panarchy theory (Gunderson & Holling 2001) proposes that biological systems exhibit cycles of growth, collapse, regeneration, and again growth. Such systems have a variety of spatial and temporal scales, and this adaptive cycle operates at different rates at each of them. During the *exploitation* stage of the cycle, there is rapid colonization of recently disturbed areas, for example after a forest fire or windstorm has removed large amounts of biomass in a forest. The connectedness between organisms is low, which leads to high resilience; the loss of one doesn't lead to the loss of another. As the forest matures it moves into the *conservation* phase, dominated by the accumulation of material. The network of connections between biomass and nutrients becomes increasingly tight, and fragile; every niche in the forest is filled, and every resource is used. Organisms become much more interdependent; food chains become dense and interconnected. The conservation phase is followed by a dramatic *release* phase, triggered in a forest by fire, drought, insect pests, etc. A lot of energy is unbound, and networks are broken up. This sets the scene for the fourth phase, *reorganization*: opportunistic species, which have been suppressed by the stable configuration of the conservation phase, move in. This is a period of innovation and restructuring, laying the groundwork for a return to another exploitation phase. A system is robust if the cycles at different scales aren't in sync, e.g. a forest is relatively robust against catastrophic fire

damage if its peak maturity (and thus susceptibility to fire) doesn't coincide with a temperature peak in the regional climate cycle.

D. Surprise and Novelty

It is very difficult to discern cause and effect chains in many complex systems. The interlocking interactions of subsystems generate behavior that cannot be tied back to the isolated behavior of single components. When cause and effect can be linked, the distance (in time or space) between the events can be very large.

Even systems that have been developed to have deterministic behaviors, like biological organisms and human-engineered machines, are unexpectedly and catastrophically fragile in some rare configurations (Carlson & Doyle 2002). Their external behavior is typically robust, but there's a risk of rare but potentially catastrophic cascading failures initiated by quite small perturbations. Carlson and Doyle argue that there is a trade-off between internal simplicity and robustness. Simple systems cannot operate in highly fluctuating environments; robust systems have to be complex. However, such systems can be catastrophically disabled by cascading failures initiated by tiny perturbations. For example, organisms work well under most conditions, but a rogue mutation can trigger a fatal cancer.

Further, humans have an innate tendency to overestimate their ability to predict key trends and discontinuities (Lempert et al. 2002, Taleb 2001). Surprise stems from several sources (Lempert et al. 2002): extrapolating the present even though discontinuous jumps are common shapers of the future; under- or over-estimating the extent of an anticipated event; not anticipating the timing of events; differences between our revealed ability to respond to events versus what was anticipated; over-estimating one's confidence in knowing the future; and self-limiting prophecies where predictions elicit responses which counter their expectation. Human intuition is particularly prone to break down under conditions of complexity.

The upshot is that "rational policy making" is little more than inspired bets rationalized after the fact with "Just So" stories. This is revealed by unintended consequences and self-fulfilling prophecies, the two faithful companions of decision making.

V. POLICY TOOLS AND PRINCIPLES

Given that making policy for the internet/web is like gardening a large and complex biological system with many human stakeholders, what outcomes should a policy maker seek? And what mix of intervention and forbearance – since forbearance is as much an action as intervention – are most likely to deliver on the public policy imperatives?

The over-arching policy goals are **productivity** and **stability**. Society wants as much value from the internet garden as possible, in terms of both economic welfare and cultural benefits. Since innovation is a proven source of social welfare, policy makers need to create an environment where beneficial serendipity occurs. The policy maker also

needs to ensure that productivity continues as smoothly as possible; this requires the system to be stable. However, given the susceptibility of complex systems to cycles and shocks, resilience is the best one can hope for. Values such as equity and justice are outputs of a properly productive social system.

The next task is to find ways to deliver productivity and resilience given the characteristics of complex social systems. Decisions in internet/web policy, like those in gardening or other policy debates, concern processes that exhibit surprise, self-referential/feedback loops situations, and imperfect information. Forest managers need policies that work during all phases of the biological cycle, from growth and maturity to collapse and regeneration. In the same way, communications policy needs to address both mature industries and sectors in flux. We need a policy approach that works equally well for traditional telecoms and the burgeoning web.

Since communications systems are constantly changing, a policy approach should be built on a few enduring principles that apply no matter which phase of the adaptive cycle the internet/web, and its successors, finds itself. This section explores a variety of tools that can be used to obtain these outcomes. The tools turn out to be ways of implementing three policy principles: experimentation, flexibility, and resilience. The principles (strategies) and the tools (tactics) are a bridge from a given set of circumstances to a set of policy actions and inactions. The principles are sufficiently general to maintain their value even as technology and business models evolve, but specific enough to be a guide to action.

A. Tools

1. Diversity

| |
|--|
| Diversity: Encourage new companies and industries to enter markets. Act against firms that abuse significant market power |
|--|

Diversity refers to a large variety of different players, with different goals and means. In an industry context, diversity entails nurturing new entrants (both new firms and new industries) and allowing them time to mature. A seedling needs special care for the first few years, making sure that it has enough water and fertilizer, and is protected from being eaten by snails or deer. Once it has become established, it no longer needs protection and becomes productive. Similarly, early stage companies and industries may need protection from competition for a limited time.

Diversity needs to be maintained. A market economy is the most efficient available way to create and allocate goods. The competition which is at the root of the success of markets, however, necessarily also provides incentives for firms to establish monopolies or cartels. These structures, if unchecked, allow firms to extract non-cost based rents, and extend their dominance into adjacent markets. While market dominance has some benefits in terms of standardization and stability, it also reduces diversity. This reduces innovation, and the robustness of the market system to unexpected shocks. It is necessary to have provisions that limit the ability of firms to abuse significant market power to the detriment of the overall health of the system.

2. *Open Mind*

Open Mind: Don't prejudge outcomes. Do not specify the implementation in detail. Determine ends, not means. Policy should be technology and business-model neutral. Prefer *ex post* to *ex ante* action. Prepare for unexpected events.

Surprise, sometimes experienced as failure, is the normal case in complex systems; long-term prediction is impossible. Since the outcome of system evolution is so uncertain, it is unwise to pick, predict or optimize for a specific preferred outcome; this is bound to lead to disappointment at best, and many undesirable, unintended consequences at worst.

Ignorance of the details of how a rapidly evolving system works, combined with the likelihood of unwanted and unexpected effects of intervention, means that regulation should fix as few parameters as possible to achieve its goal.

Regulation should therefore strive to be agnostic about technology and business models. Firms and consumers that actually generate public goods are best placed to do the detailed implementation within frameworks created by policy. The government should not, and cannot, design products. If intervention is necessary, it should set overall performance requirements, not specifications. Since the outcomes of interventions in complex adaptive systems like the internet/web are hard to predict, there should be a bias against detailed policy prescriptions that purport to achieve a specific outcome, e.g. achieving network neutrality.

3. *Delegation*

Delegation: Rely on players close to the action, like consumers, firms and civil society, to solve problems in the first instance; regulate only if they fail.

Both gardeners and policy makers can exert only limited control over their charges, in the first instance because their time, knowledge, and resources are limited. This limitation is exacerbated by difficulties in tracing cause and effect, which severely complicate diagnosis, prognosis and prescribing remedies.

Decentralized, local, self-optimizing searches for consumer benefit are more efficient at finding solutions than central planning; hence, policy makers should rely on firms and civil society first, and regulate only if that fails. Allowing the market and civil society an opportunity to solve a problem without the constraints and ancillary consequences of regulatory action is likely to produce a more satisfactory solution than the regulator trying to act as a market/consumer surrogate.

4. *Clear Boundaries*

Clear Boundaries: Provide clear goals that describe and justify the outcomes sought. Build in expiration dates. Specify glide paths for new entrants to meet policy objectives.

A gardener has a vision of the garden she wants, and intervenes at a relatively high level to bring it about. She can desire roses, and plant rose bushes, but cannot make the rose plants bloom and often struggles vainly against the various maladies that afflict them. She needs to be patient in allowing new plants to become established, but also needs to know when to cut her losses and move on. Intervention is sometimes unavoidable. Since the garden keeps changing, practices need to take time into account.

The use of the “open mind” and “delegation” tools provides the flexibility that will allow participants in the internet/web to find creative solutions that meet the policy imperatives. However, experimentation needs to be given clear boundaries that define the scope of regulation. A regulator has the responsibility to frame policy goals and create the contexts within which other participants can deliver on them.

When the time comes to draft regulation, for example when a hands-off approach has failed to deliver social goods or when there are abuses of significant market power, regulators should step carefully. Since the passage of time may invalidate assumptions, it is useful to build checkpoints into regulation, e.g. through a termination date, or “sunset”, for regulation.

5. *Holism*

Holism: Take a broad view of the potential solutions to policy problems. Where possible, use generic rather than sector-, technology-, or business-specific regulation. If there are choices among applicable regulations, start with the least onerous one.

There are many properties of the internet/web that cannot be associated directly with the performance of a particular part. For example, traffic volume depends on the amount of fiber capacity, transport and application technologies, the financial health and business arrangements of service providers, the momentary popularity of particular applications and sites, and legal initiatives. Each of these factors depends on the others; the resultant traffic volume is an emergent property.

Consequently, policy makers should take a holistic view. This means taking a expansive view of the potential sources and nature of solutions to policy problems. For example, existing instant messaging tools offer solutions to web communications for the deaf; text-via-telephony solutions needn't necessarily be mandated. It also implies using general rather than sector-, technology-, or business-specific regulation wherever possible. A holistic approach also implies a broad view of the regulator's role: not only to regulate, but also sometimes to forbear.

If there are pre-existing precedents for a converged service (e.g. video) in many classification silos, and regulation is deemed to be necessary at all, then start with the weakest available regulation, not the strongest rule in the set of silos.

6. *Transparency*

Transparency: Allow monitoring by consumers, civil society and the market. Mandate disclosure to the public domain, particularly by regulators and firms with significant market power.

System complexity means that a decision maker has limited insight into what's going on; a gardener has to be able to read subtle signs of trouble in her garden, such as egg masses on trees in winter hinting of an infestation that's invisible when the leaves are out. In the internet/web system many of the participants are human, and so supervision can be improved by enabling them to observe what's going on. The limited capacity at the top of the control hierarchy can be complemented by distributing monitoring throughout the system.

Visibility into the workings of a complex system reduces volatility and improves robustness. But in a market system with lots of players, how does the regulator get information, and how does it intervene? Since complex systems are difficult to monitor, and since funding for monitoring by regulators is limited, it's important to allow civil society and the market to monitor players.

Since the internet/web is such a diverse system, observation of its dynamics needs to be distributed. This requires disclosure mandates, particularly on regulators and players with significant market power.

7. *Modeling*

Modeling: Use computer systems to simulate the consequences of regulatory choices.

Human intuition is a frail guide to action when dealing with complex systems, from gardens to the internet/web. The large number of variables exceeds our cognitive capacity, and non-linear interactions don't match the linear models our brains tend to prefer. Long delays between causes and effects further confound our ability to understand dynamics. Complex adaptive systems typically have both slow and fast variables. People respond best to fast variables. Changes in slow variables may not be recognized because they're imperceptible, or because they do not fit into the mental models of observers; yet, they often tip a system into a new state. Even when they're recognized, the fact that collective action is needed to address slow variables constrains responses. This leads to emphasis on short-term welfare that is counter-productive in the long run (Walker & Abel 2001).

However, these systems can be modeled, and policy makers can experiment with the consequences of regulatory choices *in vitro*. Simulations of the internet/web will help to make their behavior more familiar to policy makers, and experimentation may help find solutions to the collective action dilemma.

B. Principles

The tools I have described are tactics for managing a complex system. When viewed from a broader perspective they accrue to three principles which provide the strategic framework for this approach: fostering experimentation, designing flexible policies, and building resilience into a system.

The three principles interlock, each reinforcing the other. Fostering experimentation allows flexible policy making to work because it stimulates many ways to address social needs, and it increases resilience by generating diversity. Flexible policies increase resilience by allowing the system to bend rather than break in adverse situations, and they foster experimentation by not limiting implementation choices. Finally, increasing the internet/web's resilience allows experimentation to proceed without the risk of causing catastrophic failure, and it supports flexible policies by providing a stable base for development.

1. Foster Experimentation

Foster experimentation: Give participants the leeway to find solutions. Simulate various policy options before choosing one.

One of the over-arching goals of policy makers is productivity, of both economic and social goods. Just as gardens are smarter about the details of producing fruit than gardeners, the participants that make up the internet/web know more about making it work than regulators. Policy makers should therefore give them adequate leeway to find solutions.

The experimentation principle has two aspects: policies that encourage the discovery of new opportunities by internet/web participants, and experiments in the policy making by regulators. Allowing participants to experiment is vital for a productive internet/web, and exploration of policy options in setting where mistakes can do limited harm will lead to a more resilient as well as productive system.

2. Design Flexible Policies

Design Flexible Policies: Fix as few parameters as possible; design in the ability to change course.

The internet/web is constantly evolving. Innovation constantly adjusts the products on offer, the needs and wants of citizens, and the situation that confronts the policy maker. Fostering experimentation is a necessary first step in allowing the internet/web system to find solutions to problems rather than intervening to devise solutions "by hand." However, it is also important for the policies themselves to adapt to change.

3. Build in Resilience

Build in Resilience: Encourage diversity of participants; keep away from economically optimal but vulnerable regimes; limit tight coupling between

layers; don't pick outcomes; develop contingency plans; analyze the robustness of chosen strategies against a multiplicity of plausible futures.

Occasional catastrophic failures cannot be designed out of a complex adaptive system. They're a consequence of its ability to operate under a variety of circumstances (Carlson & Doyle 1999). Even without such unpleasant surprises, unexpected behavior and perpetual novelty is an important attribute of complex systems.

Policy for the internet/web should therefore not only prepare for collapses; it should build in the conditions that allow periodic small collapses and minimize the likelihood of rare catastrophes.

System resilience can be improved by: allowing a diversity of participants, and facilitating entry of newcomers particularly in times of disruption; favoring robustness over efficiency by not operating the system in a regime that is vulnerable to shocks, even if that were the most economically efficient; and ensuring that different system scales are not too tightly coupled, so that disruption at one scale doesn't cause a system-wide collapse.

A variety of techniques increase the resilience of policies: trying not to pick or determine a single preferred outcome; including contingency plans for the worst case; designing policies that adapt to changing circumstances by evolving over time in response to new information; modeling the systems dynamics of the problem under consideration; and analyzing the robustness of chosen strategies against a multiplicity of plausible futures.