

*Technology Policy Working Group
Information Infrastructure Task Force*

*Division of Networking and Communications Research and Infrastructure
National Science Foundation*

*Science, Technology and Public Policy Program
John F. Kennedy School of Government, Harvard University*

INFORMATION INFRASTRUCTURE FORUM

**The Economics of
Information Infrastructure**

July 21, 1994

hosted by
The Annenberg Washington Program
Willard Office Building, Suite 200
1455 Pennsylvania Ave.
Washington, DC

*Funding for the Information Infrastructure Forum is provided in
part by a grant from the John and Mary R. Markle Foundation*

Compilation Copyright 1994 by the President and Fellows of Harvard College. The copyrights in the individual statements and contributions are held by their respective authors.

The views expressed by agency officials are their personal views and do not necessarily reflect the official positions of their agencies.

Sanford Berg

University of Florida

Our nation's information infrastructure will be a major determinant of our living standards in the years ahead. Policymakers have a significant impact on how telecommunications and associated industries respond to technological and commercial opportunities. If our economic performance is to be strong, we need to recognize pitfalls in the development of public policy. Examples from the area of compatibility standards are used to illustrate how sins of omission and commission can impair performance. In adding my voice to the policy debate, I am making three assumptions about the NII:

1. The infrastructure will be a set of interconnected networks with multiple databases.
2. Private investment and entrepreneurs will determine the level and mix of resources devoted to information infrastructure.
3. Government constraints, access regulations and subsidy programs will shape those private decisions.

To better appreciate the evolution of public policy, we need to understand rent-seeking activity. Groups and individuals seek to structure situations to maximize their advantage. We need a good grasp of the political economy issues associated with how such motivations are transformed into special interest legislative activity. If we put resources into developing case studies or better modeling of the political process itself, we can identify lessons from past experience. In the case of telecommunications, stakeholders are very powerful and have kept anything from happening legislatively for a decade at the national level. Thus, our public policy is made in the courts, rather than in Washington, DC. Some state legislatures and regulators have taken major initiatives in recent years. Within the judicial system, however, the status quo is given enormous weight. In battles before legislatures and courts, stakeholders seek to avoid the disruption of new competition and new technologies. That is the basic story of rent-seeking activity; it is present here and drives many industry developments.

A second issue is "mistake avoidance" by decision makers. This is another fundamental issue in the regulatory process. Policymakers fear the potentially negative consequences of approving new products or systems. Given that mistakes will be made, policymakers will try to make mistakes which will be difficult to detect. Policymakers will be driven to make choices where it is hard to tell if they "guessed" wrong. This leads to two corollaries. The first is that politicians need to keep their objectives vague. If they do, then whatever the outcome, they can always claim some good came out of it, and that the particular objective had been their priority! The objective is always labeled "in the public interest." However, one can argue that the term "public interest" is undefinable; it is often used to justify doing what you want to do anyway without much critical thought.

The second corollary is that the burden of proof is on those supporting a new policy initiative. This is not a bad rule for policymakers, as there are many dumb ideas. Some economists have argued that the purpose of the Council of Economic Advisors is to kill dumb ideas before they are raised to too high a level in the public debate and public

resources are spent on them, thus saving the taxpayers' money. The down side, though, is that such a burden results in a high likelihood of maintaining the status quo. An example is the FDA policy to avoid detectable mistakes. If a drug is approved and it has a problem, everyone knows the cost. If a drug is not approved, the lost (potential) benefits to society are not widely known. Hence, excessive risk avoidance will characterize FDA decisions.

The tendency to favor the status quo has led to regulatory lags in U.S. telecommunications policy that have robbed companies of the flexibility needed to introduce and use new technology. Policy mistakes are inevitable, but we run the risk of systematically making the wrong kind of mistakes. We can borrow from statistical theory to illustrate this point. For example, assume the null hypothesis is that the current regulatory policy is best: accept the status quo, do not do anything new. If you accept a new policy initiative, and the null hypothesis was correct, you made a mistake. In statistical terms, a Type I error occurs when you reject the null hypothesis when it is true. This error of commission results in mistakes being seen. A policy change leads to weak economic performance. The penalty of a Type I error, at least in the public policy arena, is very large because citizens see the negative impacts of a policy mistake.

	H_0 is True	H_A is True
Accept H_0	Correct Decision	Type II Error
Accept H_A	Type I Error	Correct Decision

H_0 : Current policy is "best";

H_A : Alternative policy option "A" is "best".

The Type II error, accepting the null hypothesis when it is not true, involves rejecting a new policy initiative when the change would represent an improvement over the status quo. This is something politicians are willing to put up with. They are more willing to tolerate these types of errors. For example, telecommunications regulators are afraid of approving new technologies or systems that might boost corporate profits because of negative public reaction. But the end result for consumers also can be better communications systems and easier access to technology. Often regulators treat the policy choice as a zero-sum game instead of a win-win situation. Many industry analysts argue that taking a more aggressive approach toward deregulation and the approval of new communications systems, despite the risk of mistakes, would lead to greater innovation. Consumers as a whole would be better off.

Part of the art of policy is identifying these policy options. Consider the technical standards needed for our telecommunications infrastructure. If we take the null hypothesis as continuing the government's current level and mix of compatibility standards activities, then one policy is just to continue the status quo. An alternative is to let the National Institute of Standards and Technology (NIST) dictate all interconnection standards. Now, here would be a case where I would want a strong burden of proof placed on that policy alternative because historical experience suggests that such a policy would not be such a

great idea. However, there may be some other very promising alternative in the area of interoperability standards.

What promising standards policy is being rejected for fear that if we do move in that direction (and it turns out to be wrong), the political penalties are too great? I could not think of that promising policy option, partly because although the theoretical literature on this issue is well developed, it does not help us much in making forward-looking decisions. We can evaluate standards policy after the fact, but our ability to characterize actual market situations in advance is weak. Consider what the market might do: it might have excess inertia; therefore, we do not get a standard—which slows things down. We may end up with incompatible technologies due to rivalries, which might not be good since they can involve much duplication and stranded investment. Or, we might have a bandwagon effect in which we latch on to something too early, and that might be the wrong direction to have gone. Those are all market outcomes, with no intervention. Alternatively, government might promote cooperation which is also a market outcome. Voluntary consensus might emerge from some government R&D. Finally, we could mandate standards as another policy option. The basic analytical result, in terms of why we may not get appropriate standards, is that there may be differences in managerial preferences, coordination difficulties among firms, or divergent competitive positioning. The latter strategic situation arises when a firm desires to stay insulated from rivals or if there are firm-specific or patent-specific technological processes.

Where does this leave us in the area of standards policy and the ability of academic research to assist policy development? Some solid work has been done on the cost of converters, or gateways. In addition, we have an improved appreciation for both the cost of delayed standards and the cost of premature uniformity. From the standpoint of policy development, we need to identify some good alternative hypotheses (to the null hypothesis of what we do today) that are being rejected unnecessarily.

How can the tendency towards mistake-avoidance be countered? Several developments might reduce the probability of both sins of omission and commission. First of all, we have more data: data from case studies over time and across industries, and information about experiences across countries. Changes in our international competitive position are exposed more rapidly than in the past. Also, we have an improved understanding of the strengths and limitations of markets and government in this general area of technical standards: better ways of systematically looking at standards issues.

New technologies are creating opportunities for changing our information infrastructure. However, public and private decision makers face penalties when mistakes are made. Private-sector decision makers have a bottom line for which they are accountable. It is not clear what that bottom line is for the public decision makers. Public policy tends to focus on avoiding Type I errors. My conclusion is that we ought to be making more Type II errors. Secondly, we need to find a good alternative infrastructure standards policy which shows some promise and begin exploring that policy.

Do the Right Thing: Make the Right Mistakes

**by Sanford V. Berg
Public Utility Research Center
University of Florida**

Three assumptions:

- (A1) The infrastructure will be a set of interconnected networks and multiple data bases;**
- (A2) Private investments and entrepreneurs will determine the level and mix of resources devoted to the information infrastructure; and**
- (A3) Government constraints will shape those private decisions (via entry restrictions, access regulations, and direct and indirect taxes on suppliers).**

BACKGROUND

Rent seeking activity:

There is substantial corporate gaming as regulators and legislators become arbiters of basic conditions and market structures

Stakeholders:

Publishers

Broadcasters

Cable companies

LECs

IXCs

Cellular

Status quo given weight:

- (1) Stakeholders want to avoid disruptive effects of new competitors and new technologies**
- (2) Mistake avoidance by decision-makers**

Physicians' Law

Do no harm.

Berg's Law

Given that mistakes will be made, decision-makers will try to make mistakes which are difficult to detect.

Corollary (1): Keep objectives vague.

Private decision-makers: bottom line

Public decision-makers: "public interest"

Corollary (2): Burden of proof should be on those supporting a new policy initiative

Not unreasonable for many policy alternatives

e.g., Purpose of CEA: "Kill dumb ideas."

FDA example: avoid detectable mistakes

MAKING MISTAKES

	H_0 is True	H_A is True
Accept H_0	Correct Decision	Type II Error
Accept H_A	Type I Error	Correct Decision

H_0 : Current policy is "best";

H_A : Alternative policy option "A" is "best".

IDENTIFYING POLICY OPTIONS

H_0 : Continue current level and mix of standards intervention

H_{A1} : Let NBS dictate all interconnection standards

H_{A2} : Let NBS play a "greater role" in standards specification

H_{A3} : [fill in the blank with a promising policy option]

EVALUATING POLICIES

Market Outcomes

- No standard -- slow growth
"excess inertia" (wait and see)
- Incompatible technologies (rivalry)
- "Bandwagon" effect (premature adoption)

Cooperative Standards

- Voluntary "consensus"
- Government R&D

Mandated Standards

- Platform for promoting innovation?
- Bureaucratic outcome that smothers innovation?

ANALYTICAL RESULTS

Lack of Standards due to

- (1) Differences in preferences**
- (2) Coordination Difficulties**
- (3) Strategic Competitive Positioning**
 - (a) insulated from rivals**
 - (b) firm-specific or patented processes**

Costs of

- (1) Converters**
- (2) Delayed standards**
- (3) Uniformity**

See Economides, Farrel, Greenstein, Katz, Saloner, and Shapiro

CONTEXT OF H_0 AND H_A FRAMEWORK

What is status quo public policy with respect to technical standards?

What is a dumb H_A ?

What is a promising H_A that is rejected due to "mistake avoidance"?

WHAT HAVE WE LEARNED THAT REDUCES THE PROBABILITY OF TYPE I AND TYPE II ERRORS?

More data points today:

- (1) Over time**
- (2) Across industries**
- (3) Across countries**

Improved understanding

- (1) Role of markets**
- (2) Role of government agencies**
- (3) Theory of technical standards**

More facts and better ideas

Q: "What are more important, facts or ideas?"

Alfred North Whitehead: "Ideas about facts."

FACTS: New technologies create opportunities for changing our information infrastructure.

IDEA: Public and private decision-makers face penalties when mistakes are made.

OBSERVATION: Public policy makers will focus on avoiding Type I errors.

CONCLUSIONS:

-- Make more Type II errors.

-- Find a good H_A .