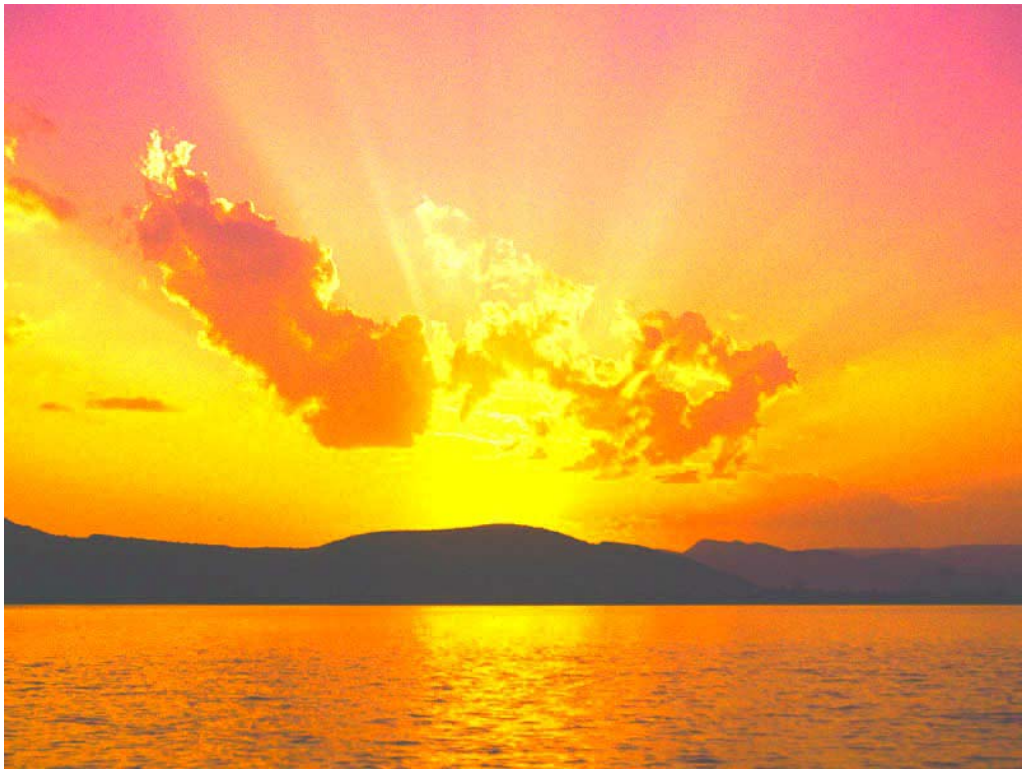
HUDSON TREND ANALYSIS



FINAL REPORT
to the
National Oceanic and Atmospheric Administration

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Preface

Hudson Institute was engaged by NOAA to examine external trends over the next 5-10 years, to assess implications of critical trends for NOAA and to provide an ongoing resource to assist NOAA in understanding and addressing future prospects.

The analysis comes at an especially important time in NOAA's evolution. Since the study started in October 2001, NOAA underwent a change in leadership, went through a major program review, was designated the lead science agency for the President's climate change initiative and began preparing a 2003-2008 strategic plan. Several important pieces of legislation are up for renewal and the Congressionally mandated U.S. Commission on Ocean Policy, a successor to the Stratton Commission that, more than 30 years ago, ushered in profound changes, has been deliberating. The private Pew Oceans Commission effort is underway, the National Academy of Public Administration is undertaking a review of the National Marine Fisheries Service and the National Research Council is examining public/private sector boundary issues with special interest in weather and climate services.

This report provides an overview of a range of trends and sources of change. The emphasis on 5-10 years is intended to encourage and support longer-range and innovative thinking about strategies, policies and programs. Some developments can be expected to be important quickly or are significant today. Others, while making their greatest impacts further out in the future, may require attention in today's decision-making. Implications for NOAA are noted in the summary section and an appendix and are shown in italics in the body of the report.

The study is not intended to make specific recommendations. Rather, it provides a context for NOAA decisions. While the study was initiated before the current strategic plan development process, an important objective is to provide analysis that can be useful in thinking about issues that will arise in the plan and in processes that will follow.

Significant attention is given to technology because of its critical role in NOAA's future. Technology issues and developments are discussed both in a separate section and throughout the study. Focuses of the study include resource management and business trends. NOAA's interest in resource management arises from its many responsibilities for measurement and management and its need to deal with changing pressures, new understanding of problems and changing approaches. Understanding of business trends can help NOAA meet demands for services, interface with evolving types of business organizations and learn from developments in the private sector that may help it to improve its own effectiveness.

The Principal Investigator is Dr. Irving Leveson, Adjunct Senior Fellow and Chief Economic Consultant of Hudson Institute. The study team includes Charles Horner, Hudson Institute Senior Fellow and Dr. Kenneth Weinstein, Vice President and Director of the Hudson Washington Office. Dongmei Zhou and Nazan Riahy provided research assistance.

Hudson Institute wishes to thank the many people inside and outside of NOAA who provided information, comments and suggestions. The study has benefited from discussions with and guidance from Scott Gudes, Tim Keeney, Scott Rayder, Jim Burgess, Jim Cohen, Margaret McCalla and participants in group discussions at NOAA. Special thanks go to Rodney Weiher who served as contract officer for his helpful suggestions and insights. A list of persons interviewed is provided in Appendix D.

The views expressed are those of the authors and need not reflect those of NOAA personnel or agencies or persons contacted in or out of government.

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Executive Summary

MAJOR TRENDS

During the next 5-10 years NOAA will face many powerful trends with far-reaching impacts on its activities and decisions. In discussing these changes, trends are grouped into seven categories. Developments in each of these areas will be critical to NOAA's future and its impact.

- Science, Technology and Communication
- Globalization
- Climate Change
- Demands for Services and Cooperation
- Economic and Business Trends
- Environment and Resource Management Trends and Policies
- Government Initiatives

Within these categories and often cutting across them are many transformational changes such as the Internet, global warming, the new economy, use of incentive and management approaches to resource management, government improvement, reliance on markets and the private sector, security imperatives and patterns of international competition and cooperation.

Helping Society Adapt

In studies ranging from the genetics of brain size in the evolutionary development of human beings to the effects of education on earnings, it has been found that increased rates of change in the environment increase the advantage of skill and cognitive ability.

These traits become more valuable with greater information and analytic tools.

At a time of extraordinary change in many areas, NOAA's services add to society's ability to adapt and succeed.

SCIENCE, TECHNOLOGY AND COMMUNICATION

Technological change has been especially rapid during the last two decades and the pace of change may even be accelerating. As more is applied and its cumulative effects are felt, technology is having increasing impacts on every aspect of society.

Dramatic gains are occurring in microprocessor speed and throughput, bandwidth, storage, compression, networking, wireless and multimedia, embodying both hardware and software. The shift from digital to analog is deepening, last miles of connections are being upgraded, mobility is ever more information-enabled and new devices are proliferating. The power of the Internet is just beginning to be realized.

Exciting developments are occurring in materials technology, biotechnology, medicine, energy, optics, chemistry and other areas along with those in information technology. Tools for creating further progress are evolving rapidly.

With fundamental knowledge expanding, and with so much knowledge being processed with modern information handling techniques, interactions among fields are flourishing. Convergence is occurring both in science and applications.

Developments in information technology will have a wide range of impacts:

- Automation.
- Miniaturization.
- Distributed and mobile activity.
- Determination of formats and other standards more often by the market rather than by government.
- "Programmed human capital" - the ability to embody knowledge in software and systems for ease of use by less skilled or narrowly specialized workers.
- Growth of information services, including bandwidth-intensive multimedia, interactivity and large data sets.
- Data mining.
- Improved sensing, integration of sensor measures and widely distributed monitoring.
- Improved modeling, model integration and resolution.
- Convergence of applications (telephone, cable TV, Internet, game controllers) leading to new services such as Internet telephony.
- Growth of R&D and changes in its nature and composition.
- High levels of capital spending (despite boom-bust cycles).
- Flatter organizational structures.
- Managing based on continuous feedback.
- Self-organizing systems.
- Great diversity of products and capabilities, tailored to diverse needs.
- Shorter life spans of products/high obsolescence and constant adaptation to changing markets.
- Intense competition.
- More frequent restructuring of organizations and their relationships to customers, suppliers, competitors and collaborators as technology and business models evolve.
- Increased difficulty of keeping information private or limiting its distribution.
- Policy challenges involving access, privacy, security, ownership and safety.
- Difficult moral issues in some areas.

The greatest challenges of technology will be social and psychological — adjusting our thinking, speed and direction of response and even willingness to respond, and learning to live in an economy and society that evolves rapidly in new and often unexpected ways.

Government can facilitate diffusion of technologies in which it has a special interest such as transmission of high-resolution images by rapidly deploying the new technologies to create a critical mass of demand. The ability to interface with government at a higher level will give the private sector a greater incentive for rapid and more complete deployment.

Technological change in NOAA has largely been evolutionary rather than revolutionary, in part because of long lead times in budgeting and acquisition for large capital investments. However, discoveries that result from use of technology can have revolutionary consequences. For example:

> The understanding of El Niño, La Niña and the Southern oscillation led to better weather and climate prediction.
>
> The discovery of the hole in the ozone layer led to more attention to global warming and to other environmental issues as well. This contributed to increases in the scale of data collection and research on global change and prospects for additional policy initiatives.

Even if technological change in NOAA systems remains evolutionary, NOAA can expect that there will be important discoveries as a result of scientific advances and persistence with existing technologies that will significantly change the nature of its understanding of the planet and the services it provides.

NOAA will have to manage complex transitions to a new technological environment. For example, expectations are for an increase in satellite data of at least five orders of magnitude or about 100,000 times as much during the current decade and possibly far more. Efforts are under way to assure that the data can be handled in computers, models, storage and communication and overconfidence is being avoided. Most of those with whom Hudson spoke do not expect extraordinary difficulties in NOAA handling the very large quantities of data that are expected, either in processing or storage capacity. Similar challenges have arisen in the past, without abnormal amounts of difficulty.

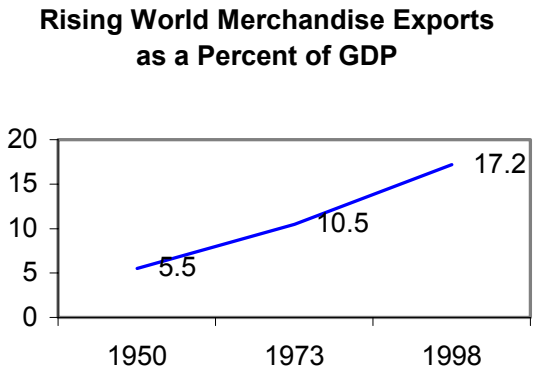
Nevertheless, NOAA will have to be prepared if increases at the high end of the range occur. NOAA also will have to assure that it can handle intervening imbalances between demand and supply of technological capabilities and skills so it can take earlier advantage of opportunities as well as assure smooth transitions in service.

With international capabilities also increasing, NOAA may have greater opportunities to take advantage of foreign efforts for launching satellites, collecting data and/or distributing information.

GLOBALIZATION

Globalization has been associated with:

- Increasing contact through travel, communications and trade.
- Development of a world market for technology.
- Cross-ownership of business and financial assets.
- Growth of reliance on markets vs. regulation, government ownership and central planning.
- Spread of democracy with pressures from exposure to ideas, rising incomes and strengthened business classes.



Beneficial interactions can significantly raise living standards and prevent or overcome problems, including problems that are byproducts of increases in incomes.

The principal implication of rising global interdependence for NOAA and other agencies is the growing importance of international cooperation in science and resource management for achieving results. The burgeoning scope of cooperation among countries and linkages among private organizations creates opportunities to transcend fragmented approaches to data collection, dissemination, research, policy and operations. It also adds enormous complexity as NOAA and constituents seek to understand each other's needs and find ways to work together across numerous geographic, organizational, scientific and cultural dimensions.

The possibility that U.S. global dominance could erode also must be considered seriously. Perhaps the most important consequence of lessened U.S. dominance from NOAA's point of view is the fragmentation that could result in data collection, research coordination and information dissemination. One critical example is European efforts to develop a competitor to the Global Positioning System.

CLIMATE CHANGE

A continuing warming trend is likely to increase public pressures for action. Public concerns may also be increased by shorter-term increases in warming or erratic weather patterns that have little or nothing to do with long run trends, especially if short-term developments are associated with widespread drought or other severe consequences.

However, the public is not likely to be willing to make great sacrifices anytime soon — such as adopting a large carbon tax or prohibiting construction in areas likely to experience extensive flooding if the sea level rises.

Under these circumstances, efforts can be expected to focus on:

- Improving the evidence.
- Developing policies that are less costly or restrictive.
- Finding ways to maintain good international relations despite differences in attitudes and policies between the U.S. and other nations.

Concerns about global climate change will have far-reaching impacts on NOAA's policies, products and operations. Consequences include:

- Accelerating attention to ecosystem approaches that transcend previously segmented areas of measurement, research and prediction. For NOAA this includes:
  - More complete observation of oceans.
  - Integration of observations and analyses of behavior of oceans, atmosphere and land.
- Support for larger scale scientific approaches and major investments that address the concerns. This includes the extensive use of more types of and more powerful sensors on remotely operated vehicles (ROV's), autonomous unmanned vehicles (AUV's) and satellites, and investments in supercomputing.
- Increased demands for both observations and forecasts, including more measurement of climate change generally, water flows, air quality and space weather and more forecasts of societal consequences of observations and analysis.
- Greater pressure for NOAA to develop "products" that can assist in understanding the nature of the threats, facilitating research and planning by other organizations and providing support to the public policy process.
- More regional and local data and management, including much higher resolution weather and climate data and more complete counts of marine species and their movements.
- Greater cooperative efforts to improve and coordinate ocean policy.
- Pressure for interagency cooperation to more effectively utilize resources and make better use of information.
- Influences of government-wide efforts to reallocate research budgets related to climate change.
- Improvements in international cooperation in addressing observed consequences of climate change.
- Continuing tension between approaches that emphasize science vs. those that emphasize precaution.

Over the next decade, advances in technology and further deployment of existing technology will make it possible for NOAA to provide a larger set of environmental data and to provide more continuous and high resolution data in all kinds of weather. Integration of disciplines will be necessary for many information products.

Climate change research will become more well-rounded, integrating considerations of glaciers, atmospheric chemistry and ecosystems, and including a capacity for ecosystem forecasts that is independent of global warming. It will take some time before a full climate model of the U.S. can be

developed.

Because of the focus in the scientific community on global warming, climate change research can be expected to give particular attention to ways in which warming impacts may be intensified, for example by causing oceans to hold less CO_2, contributing to further warming. Interest will be more heavily focused on mechanisms that can contribute to extremes of warming than on those that can modify a warming trend or produce cooling.

NOAA increasingly will be involved in assessing the potential and the after-the-fact impacts of policies to moderate the effects of climate change. NOAA capabilities could play an important role in monitoring and analyzing outcomes of international participation in the Kyoto protocol.

The U.S. will be under continuing international pressure to curb its use of fossil fuels. The debate over responsibilities of high-consumption developed countries and the leeway to be given to developing countries will never fully be resolved. The debate over use of incentive approaches vs. command and control approaches to environmental management also will be ongoing because of international differences in how the approaches are viewed.

DEMANDS FOR SERVICES AND COOPERATION

Concern over weather patterns will raise demand for weather and climate forecasts, coastal, ocean and atmospheric observations and for efforts to protect coastal communities and prepare for evacuations. It will raise issues of changing patterns of species migration, including non-native species and threats to species. It also will generate greater interest in alternative energy sources, including those from the sea.

The imperative of educating the electorate and providing the foundation of knowledge that can guide new generations, both in the U.S. and internationally, is stronger than ever. NOAA can contribute further to understanding by encouraging its knowledge relating to the environment to be made available to publics as well as to scientists in other countries.

NOAA will be called on to provide more data in support of regulation and to expand some regulatory functions as interest in climate change grows.

Air quality will be a growing effort within NOAA, involving collecting, analyzing and distributing information. Data will be collected on a growing number of subjects — such as CO_2, aerosols, nitrogen deposits and atmospheric density.

Demand for more kinds of and better environmental information such as air quality will in part be driven by the heightened concern of the large and politically important baby boom generation for matters of health and safety. Another motivating factor is the general rise in demand for comforts and aesthetics with greater affluence.

The importance of water issues and associated political/military repercussions and the interplay of water with land and atmosphere imply a need for increased attention to hydrologic measurement and analysis.

NOAA will be asked to increasingly accommodate the desire for rapid selection and automatic distribution of information in appealing forms, whether provided directly to end users or through intermediaries. The development of self-describing data sets will be an important tool in that effort.

A consequence of the use of technology by consumers is “swarming” or surges in demand from many participants. In one formulation “smart mobs” linked by high-tech communications devices act in concert to rapidly move to the same activities or destinations. The implication of swarming for NOAA is that it is necessary to be ready for very high levels of peak demand.

Many demands will come from the needs of specific industries such as energy and insurance. The telecommunications industry could become a large consumer of NOAA information in the future, with solar storms and other phenomena having a great influence and with wireless communication growing rapidly.

A large rise in energy prices would raise demand for weather and climate services from power producers and distributors and from industrial and commercial energy customers interested in managing supplies, buying before price increases, locking in prices in contracts, and hedging and trading on energy markets.

NOAA increasingly will be providing climate and environmental information for regional and local areas. NOAA may play any number of roles in processes to develop operational forecasts, directly providing information, working with universities, regional consortia and private firms and/or serving as a catalyst for local efforts. In any of these roles, NOAA will be central to the development and operation of a regional system.

NOAA has had increasing calls for information about other countries to help other Federal agencies and international organizations in relief efforts. It can expect greater demands from other agencies and requests for information that is increasingly international.

NOAA will collaborate more with the military in development of space and ocean capabilities, engaging in more joint efforts and situations where the military is the customer. It will sometimes compete with the military for resources or control of programs and more often couch requests in national security terms. Its measurement efforts will go beyond support for military operations to include assessment of environmental and commercial impacts of war.

The missile defense initiative can give a major impetus to satellite development. NOAA could be called upon for data services, monitoring and research, satellite rescue and other activities.

NOAA could face increased demands for services and play an expanded advisory role in disaster prevention and response.

- NOAA could bring to bear information, research and analytic capabilities to assess how spread of contamination would be affected by weather and ocean conditions. Valuable contributions can be made by predicting or tracking effects of winds or currents in distributing harmful substances or organisms.

- Nuclear contamination would create particularly challenging, far-reaching and long-term challenges. It would require extensive interagency and potentially international coordination.

- NOAA's skills can assist in locating the sources or origins of some contaminants as well as their impacts.

Increased demands for information to support military and homeland defense could lead to patriotic and security-motivated demands for greater U.S. self-sufficiency in data collection. Concerns about security could lead to restrictions on research, information-sharing and international collaboration at the same time as some aspects of research and collaboration are encouraged.

ECONOMIC AND BUSINESS TRENDS

Economic Trends

The bust in capital spending after the boom of late 1990s left industry with excess capacity and weakened many leading technology companies. Working off excesses will take several years. In the meantime it will be harder for NOAA to rely on the private sector for investment and technology in satellites. There also will be slower introduction of some communications technology since introduction often comes as part of new capital investment. However, slowing of the introduction of technology will be selective and temporary.

The "new economy", although tempered, remains very much alive. It is morphing into a more traditional high growth period that, when it arrives, will be more sustainable and stable.

The extended economic slowdown, bear market in stocks, telecommunications implosion and collapse of many dotcoms, along with effects of September 11, 2001 raised serious questions about how quickly and fully the U.S. and global economies would recover and whether any resumption of rapid growth could persist. However, there are strong underlying positive factors. Most significantly, despite the sharp decline in capital spending, new technologies and products continue to be introduced at an unusually rapid pace.

Economic growth and productivity are not expected to maintain the pace of the boom years. However, new economy influences of rapid technological change, intense competition and opening of global markets will bring significantly higher growth during the coming decade. Sustainable U.S. productivity is expected to be higher by about 1% per year than in the two decades prior to the mid-1990s acceleration, nearly double the earlier rate.

Implications of sustained rapid technological change and renewal for business and the economy include:

- A need for government to become more business-like — to be decisive, focused on products, performance and customers and open to many ways of getting things done.
- A need to rely heavily on resources, capabilities and the diversity of sources in the private sector to respond effectively to rapidly changing prospects and opportunities.
- Greater need for open markets, along with appropriate oversight.
- More competition among technology standards so as not to prematurely lock in one standard while others that may be superior need some time to develop.
- Intense competition and a shorter half-life of monopolies.
- Many big winners and big losers among prominent companies.

Gains from the new economy will be associated with:

- Creation of new markets, uses, customers and associations among individuals and groups through widespread use of both general and specialized information and communications systems.
- Growth of markets and demands for information through rising incomes.
- More rapid obsolescence of technology, but also more opportunities to introduce new technology rapidly as heavy investments are made to support growth.
- Expanded opportunities for scientific cooperation.
- Increased pressure on the environment if the global economy grows more rapidly, but also greater knowledge, incomes and technological opportunities for solutions.
- Improved government budget positions, albeit in the context of deteriorated levels.
- More rapid deployment of high bandwidth but also greater increases in demand.

Some of the gains from the new economy will be offset by influences of the “dis-economy.” We use the term "dis-economy" to refer to a series of recent and emerging developments that collectively exert a significant drag on the economy. These include restrictions and costs associated with terrorism, the war on terrorism and homeland security, the crisis of confidence in business ethics and its manifestations, increased interferences with the information economy (hacking, spam, viruses) and various increases in regulation.

The dis-economy operates at the same time as the new economy. It does not overshadow the new economy, but the net effect of the two forces is significantly less economic growth than would be possible if the new economy influences more fully dominated. Adverse effects are greater in the early portion of the next ten years. Adjustments will lessen adverse effects over time but many forces will be long-lasting and new impediments and disruptions from war can arise.

NOAA will face a continuously tight budget environment. Issues of NOAA's role could be more prominent as agencies compete for limited funds and government is reorganized. Overall budget stringency will require particularly effective efforts to justify expenditures. It will be particularly necessary to demonstrate the benefits to the nation and to do so quantitatively wherever possible. The links between research and development will require greater clarification and strengthening.

Energy is important for many reasons:

- Prices affect demand for weather and climate information.
- Technology and prices affect the scale of deep ocean development.
- International development can engender negotiations over rights and boundaries and environmental impacts.
- Energy can be at the center of tensions that lead to wars, with attendant demands for information and effects on the economy.
- Technologies developed for energy exploration and development, such as remotely operated vehicles, could be very useful for NOAA activities.
- Efforts to induce movement away from reliance on fossil fuels can change the nature and location of energy development and distribution. It also might lead to reduced maintenance or abandonment of facilities, with resulting environmental impacts.
- Technology and prices could eventually lead to large-scale development of undersea methane hydrates.

The long run pattern is for a gradually rising trend of energy prices and large fluctuations around the trend that last for several years. Prices are low relative to their historic range. They are likely to go a lot higher in the decade ahead because of economic growth and political and military vulnerabilities. Far less likely is the possibility of a decline in relative energy prices induced by technology and new sources of supply.

Use of the oceans may increase more rapidly than recent experience suggests. Despite decades-old suggestions for undersea mining, tourism and human habitats, wave power and other uses of the oceans, development has been limited until recently. Growth is now being fostered by technologies for deep-sea oil and gas recovery, by interest in new sources of energy and by interest in a wider array of minerals of potential commercial value. New technologies such as unmanned Slocum Gliders and improved sensors can be expected to expand opportunities for exploration and monitoring as well.

Renewed interest in oceans raises complex issues of international law and diplomacy as competing claims arise. The United States can expect to be drawn into an increasing number of boundary and jurisdictional issues relating to uses of the oceans over the next decade. NOAA will be asked to provide detailed information that can be used to delineate boundaries and chart passageways.

Business Trends

Understanding changes in private organizations can help government meet demands for services, interface with evolving types of business organizations and learn from developments in the private sector that may help it to improve its own effectiveness.

Of the forces are shaping the private sector, technology and especially the information revolution is most pervasive. Other powerful influences include globalization, deregulation and the emergence of a modern service economy, which themselves are profoundly influenced by information technology. Together, these result in extensive competition, automation and in heightened demands for information.

In this environment there is a premium on arrangements for making effective use of information to manage and operate the organization, to link the organization to suppliers, partners and customers and to provide information as a service and a basis for transactions.

For many information and software providers the cost of producing additional unit of each product is zero or near-zero after the initial fixed costs are met, facilitating rapid growth of markets.

Many information products exhibit "network externalities" or "demand-side economies of scale." Such economies arise because the value to each user of participating in the network increases exponentially with the number of participants (“Metcalf’s Law”).

Network externalities make demand for products more price-sensitive since lower prices that add customers lead to even more customers. Economies in production, especially those from low incremental costs of adding users, can interact with demand economies from network externalities to produce rapid growth in the number of users. They also can bring about major changes in ways of doing business.

New types of multi-firm organizational structures have evolved to take advantage of transaction cost efficiencies and opportunities for market growth. Configurations include the "virtual corporation" that directs activities of other entities without having its own production facilities, the focused firm that sticks to its core competencies, strictly out-sourcing for other capabilities, the networked company, in which separate entities act together to produce a result, sometimes in self-organizing systems and business-to-business e-commerce exchanges that create markets centered around an industry or large buyer.

Information technology increases the viability of many smaller organizations as lower costs of inter-firm communication facilitate participation in networks. However, information technology also creates efficiencies within larger organizations by lowering costs of coordinating people and departments. The result is consolidation of firms but at a slower pace, with larger roles for smaller firms than otherwise.

The form and function of the modern organization is evolving to embody many features that are heavily influenced by advances in information technology. Formulations emphasizing various aspects include:

Horizontal Management

> With horizontal management, as emphasized by Peter Drucker, ease of communication means there are fewer layers of management through which communication has to filter.

The Professional Service Organization

> Henry Mintzberg made the distinction between machine bureaucracies that focus on repetitive standardized tasks and professional service organizations in which individuals have greater skill and autonomy in defining and carrying out tasks.

The Network Organization

> The network organization draws extensively on resources in external organizations through arrangements under which participants can acts as a coherent whole.

The Adaptive Enterprise

> The adaptive enterprise adjusts production to information fed from its units and the external environment, increasingly in real-time. Rapid adaptation to current developments is emphasized over planning and forecasting for longer range prospects.

Mass Customization

> Mass customization flexibly allows a wide variety of products and features to be produced and tailored to the customer and at the same time benefits from efficiencies of mass production.
>
> One example of mass customization is efforts to provide localized individual weather information on demand to cars, cell phones and PDAs.

Electronic Marketplaces and Online Distribution

> Electronic distribution of information services, media and financial products facilitates direct contact, transactions and self-service.
>
> New models have begun to develop that incorporate a wider range of services — both in arrangements among the participants and through tie-ins with outside vendors.

An organization may need two kinds of business models for different activities, one for units dealing with longer term changes or more predictable environments and one for those requiring a high degree of feedback and rapid adaptability to external information and developments.

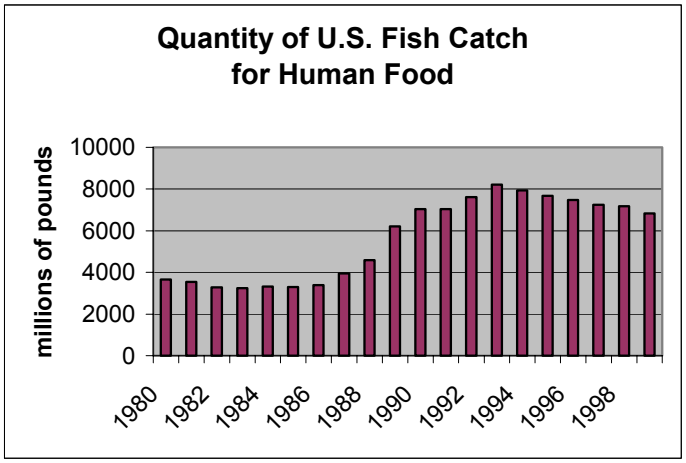
Over the years there have been many formulations of strategic and management models for improving business capabilities and strategic effectiveness. What is changing is the growing urgency of responding to market pressures and to technology through physical, organizational and human resource decisions.

Flatter organizational structures create an issue for managers of how to deal with information overload in an era when they can receive endless messages through email, cell phones and faxes. Ironically, for a decentralized world this is a problem of over-centralization. The traditional way to deal with overload is to decentralize — to delegate more decision-making authority. The ability to delegate in NOAA is closely tied to how well it can recruit personnel and how well it can develop and train the right mix of personnel to enable more decentralized decisions.

The need for managers with both technical and management skills has traditionally been handled by drawing on a mix of people with technical and managerial backgrounds. With technology more complex, the balance is shifting toward greater reliance on technical staff for management. This approach is supported by greater use of information technology and formal processes to channel management efforts.

ENVIRONMENT AND RESOURCE MANAGEMENT TRENDS AND POLICIES

Resource management encompasses the full range of policies and programs dealing with the condition of natural resources. It includes weather and climate as well as air, land and water pollution, fish stocks, endangered species, creation of new species by natural or artificial means, forest management and issues relating to energy and minerals. It addresses government and industry practices, incentives, governance, conservation and regulation.



NOAA's interest in resource management is not only in its main areas of responsibility such as weather and climate, oceans and fisheries — but also in the broader concerns about the planet and in pressures that may affect future responsibilities. Recent heightened concerns about global climate change will have far-reaching impacts on NOAA's policies, products and operations.

NOAA will have to balance concerns about resource management and the environment with those of economic development and security. While these emphases can lead to some actions that coincide, they also can involve very different priorities. Resource management can involve more regulatory functions while economic development looks more to markets and security concerns lead to particular kinds of interventions.

Trends in resource management include:

- Economic development as complementary to environmental improvement rather than as a trade-off in policy-making.
- Ecosystem approach — reflecting interactions among all parts of the ecosystem in place of separate analyses and decisions, and closely related to that,
- Global approach to measurement and science, including:
  - A global ocean observing system.
  - Integration of observations of ocean, atmosphere and land.
  - Much more extensive use of unmanned systems - including sensors in remotely operated vehicles (ROV's) and autonomous unmanned vehicles (AUV's) for ocean systems and satellites.
  - More comprehensive weather and climate modeling.
- Possible expansion of some regulatory roles for NOAA in addition to expanded science and information to support regulation related to ocean and climate change.

Ecosystem Management Implications

- Understanding ecosystem interrelationships and responses to changes.
- Effectively utilizing new technologies and information.
- Evolving newer resource management approaches for application on an ecosystem scale.
- Working extensively with other nations and NGOs.
- Assessing potential and actual outcomes of policies.

- A halting, at least temporarily, of increasing regulation and regulatory costs in society as a whole relating to resource management.

- New regulatory approaches.

    - Favoring regulatory initiatives with the highest benefits relative to costs.
    - Increased use of incentive approaches in regulation.
    - Greater use of management and governance arrangements to bring parties together.
    - Greater reliance on science for policy and regulation.
    - More regulatory reviews of agency actions.
    - The Data Quality Act potentially complicating regulation and scientific staffing.
    - Further use of the precautionary principle outside the United States.
    - Incentive approaches to resource management being adopted less widely in nations that do not place as great a reliance on markets generally.

- Technology providing important solutions to resource management problems, sometimes accompanied by regulation.

- Changing marine demands and responses.

    - Expansion of marine protected areas and marine reserves.
    - Overfishing reduced primarily by limits and only slowly by capacity reduction, while racing with increases in fishing productivity brought about by technology.
    - Limits on fishing continuing to be the main policy tool by which capacity is reduced, with resulting difficulties in moving to a more cooperative model.

- Increased attention to international issues.

    - Renewed U.S. reliance on multinational institutions and networks.
    - Growth of international participation.
    - International policy divergence.
    - Growth of NGOs.
    - Eco-consumption.
    - Increased environmental regulation through trade.
    - "Water and resource wars".
    - Addressing environmental fallout from terrorism and war.

As interest in undersea areas grows, marine regulation increasingly will involve land management, directly or indirectly controlling uses of the seabed that go beyond those prevalent today.

Major gaps will continue to exist between the state of scientific knowledge and the degree of knowledge necessary to make policy. NOAA will be under growing pressure to produce practical results and to extend its analyses to emerging issues in spite of these limitations.

As NOAA and other agencies seek to rely more on science to avoid biases in policy they will have to confront professional opinions that do not always take appropriate account of evidence. Leadership will be required to rely on the most critical evidence even when vocal scientific opinion lags or personal predilections influence conclusions of those who would be looked to for concensus. This has always been an issue in resource management, but its intensified focus in the area of climate change and its role for fisheries management are of particular importance to NOAA.

Effectively maintaining focuses on both science and complex socially-oriented resource management initiatives will present major ongoing challenges.

- Developing and implementing ecosystem approaches and making use of the rapid advances in biotechnology and related fields will require NOAA to utilize many disciplines, including giving much more attention to the biological sciences.

- There will continue to be questions of how organizationally separate science should be from regulation. Closeness can allow science to be more fully used in decisions but open science to greater political pressures. The greater the political pressure, the more important is separation. The greater the ability of science to deal objectively with socioeconomic issues behind the pressures, the more important is closeness.

- The extensive negotiation required by managers employing evolving methods of resource management will necessitate developing skills and organizational structures that go beyond the scientific emphasis that is at the heart of the agency.

- The growth of informal and electronic publication opportunities means that NOAA will have to find the right balance between goals of peer review and more rapid or administrative forms of distribution.

International cooperation carries with it complex demands. Divergent laws, regulations and interests must be reconciled. NOAA will find it necessary to deal with many organizations and to support negotiation efforts with scientific evidence and management capabilities on many issues and across vast distances.

High levels of coordination of disciplines and departments will be needed inside and outside of NOAA for:

- The evolution of management roles along with science roles in science management and regulation
- Development of ecosystem approaches
- Increased international responsibilities

GOVERNMENT INITIATIVES

Policies, Organization and Laws

The Stratton commission was instrumental in establishing U.S. ocean policy and structure more than 30 years ago. That has led to some anticipation that the new commission will have far-reaching effects, even including the possibility of a federal oceans department. Admiral James D. Watkins, U.S. Navy (retired), chairman of the Commission, has been quoted as saying: "We're already assuming that there has to be a national ocean policy coordinating body." In the cover letter to the September 2002 interim report he states: "…policy may well call for new and creative governance mechanisms."

The impact of the Commission on Ocean Policy is uncertain because of the complex climate, but a number of factors could come together with upcoming legislative reauthorizations including the Magnuson-Stevens Fishery Conservation and Management Act, the Marine Mammal Protection Act, the Coastal Zone Management Act and the Endangered Species Act, along with the influence of the Pew Oceans Commission, to produce significant change.

The Commission on Ocean Policy also has endorsed U.S. accession to the Law of the Sea Convention but more generally support has been weak. It is not clear whether the Commission, by bringing the issue of accession to the Law of the Sea convention into a larger coalition for ocean policy can significantly increase its prospects.

NOAA will have to be ready to address proposals for a range of legislative possibilities and for receiving resulting responsibilities. That will require breadth of management so that current responsibilities will not be compromised and opportunities to use legislative change to chart a course will not be foregone.

The U.S. has been seeking international recognition for the potential of economic development to enable both reduction in poverty and improvement in the environment. NOAA increasingly will be enlisted in making that case and in promoting its understanding in other parts of the world.

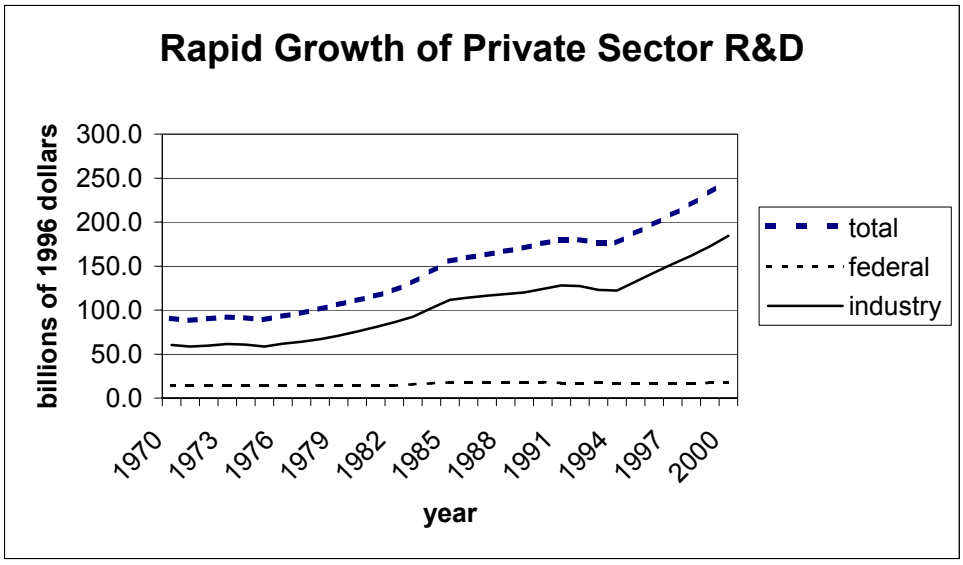
Public/Private Roles and Business Models

Rapid technological change and the evolution of sophisticated organizations and networks are creating growing opportunities for NOAA and government generally to build on the capabilities of firms, research organizations, universities and/or other government agencies.

Increasingly, the question is not what government should do, but what government should take responsibility for. There are many ways in which that responsibility can be provided for.

NOAA can work with new types of organizations in many ways. It can be a catalyst, organizer, partner, owner, member, customer or supplier. NOAA will want to explicitly determine appropriate roles in each circumstance and define ways of managing those roles. Through the many possible forms of involvement, government can facilitate efforts of private organizations to fulfill functions previously performed by government.

Increasingly, the question is not what government should do, but what government should take responsibility for. There are many ways in which that responsibility can be provided for.



Privatization has been limited in the U.S. because of the much smaller role of government enterprises and greater reliance on the private sector generally. The U.S. generally is privatizing "from the bottom up" through detailed reviews of activities, rather than rather than by "top down" efforts that lead to disengaging from entire industries.

Boundaries between the public and private sectors will be shifting as a result of the increasing capabilities of the private sector, its technological sophistication, access to risk capital and the growing scale of firms.

NOAA will be engaged in continual negotiation with the private sector over where boundaries of public activities should fall and how interactions should take place.

Weather services will continue to be a principal area of controversy regarding public/private roles. Similar issues may arise with climate information services. The role of industry self-regulation will continue to be prominent in fisheries management. Other areas, particularly measurement of the local environment such as air quality, will become sources of tension as NOAA expands its activities and as the potential size of the private market becomes more interesting.

Private commercial firms that wish to process and redistribute information will increase pressure on NOAA to provide data in basic forms through automated processes in real time.

NOAA will face growing competitive challenges from the private sector in providing information-related services as government advantages from scale economies are reduced by declines in price and increases in capabilities of equipment and software, and by the continued evolution of large technology firms that can mount sizeable efforts.

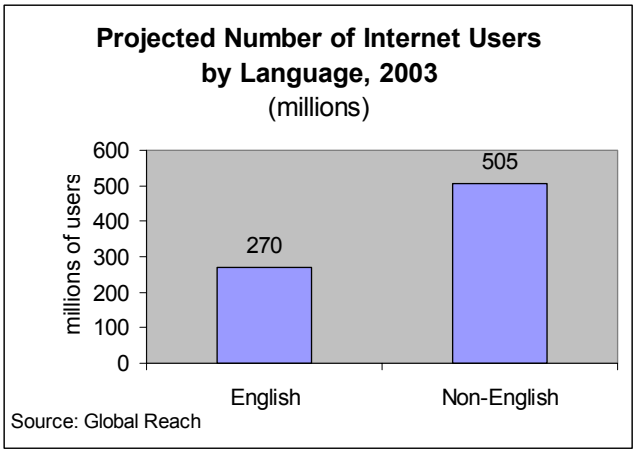
The structure of the business community is being profoundly influenced by the information revolution, with some functions being performed by interlinked specialized organizations rather than being integrated within large organizations. Such networks add to competitive pressures and demands for greater private roles in enhancing and distributing information.

Under these conditions, cooperative discussions of plans and services become essential to avoid contentious and counterproductive relationships as well as to find ways to work together.

NOAA increasingly will have to consider opportunities to work with the private sector where that offers an avenue for modernization and innovation. A tight budget environment could put pressure on NOAA to contract more with the private sector, especially if there are potential costs savings and/or if that is a way to get adequate capital investment and keep up with technology.

NOAA could face more difficult choices between drawing further on resources of the private sector to extend its and the nation's capabilities vs. trying to do more on its own for tighter security.

Electronic Government



NOAA has demonstrated excellence and continued progress in electronic government. Additional possibilities include:

- Moving beyond early stages in developing transaction capabilities.
- Evolving more extensive interagency capabilities for Web and other applications.
- Developing cooperative arrangements with universities, research institutions and private firms to offer the user packages and choices with seamless navigation on the Web.
- Finding additional ways to communicate with international constituencies.

More will have to be done to take advantage of extensible markup language and other Web services capabilities. The development of extensible markup language (XML) creates a challenge because

participation in setting standards and structures must be done well in advance of use. The federal government has tended to lag and risks losing the ability to easily build on systems in their early years.

The long lead time in increasing the capacity to provide IP addresses in the United States could mean an important bottleneck for NOAA by mid-decade. Contingency planning for issues that could arise would be appropriate.

The trend has been toward increasing availability of government information in response to greater consumer sophistication, populist demands and technological opportunities. The Post-September 11 environment, the Data Quality Act and computer security concerns are likely to lead to temporary and selective slowing of the trend. Nevertheless, the long-term trend of providing more information will remain intact and may even be enhanced by increased interest in civic issues after 9-11.

* * * * *

In this effort a 5-10 year period of interest was indicated. For some NOAA issues it will be important to consider longer time frames.

Hudson Trend Analysis

Science, Technology and Communications

ACCELERATION AND BREAKTHROUGHS

The rate of technological change and innovation in products and methods has increased during the last two decades and the consequences of that increase are everywhere. In many areas improvements in performance by orders of magnitudes are taking place in only a few years.

Dramatic gains are occurring in microprocessor speed and throughput, bandwidth, storage, compression, networking, wireless and multimedia, embodying both hardware and software. The shift from digital to analog is deepening, last miles of connections are being upgraded, mobility is ever more information-enabled and new devices are proliferating. The power of the Internet is just beginning to be realized.

Exciting developments are occurring in materials technology, biotechnology, medicine, energy, optics, chemistry and other areas along with those in information technology. Tools for creating further progress are evolving rapidly. With fundamental knowledge expanding, and with so much knowledge being processed with modern information handling techniques, interactions among fields are flourishing. Convergence is occurring both in science and applications.

If technological change becomes rapid enough, for most planning it won't matter if it is accelerating further. It will take all we can do to deal with the consequences of the rate of change we see before us.

The greatest challenges of technology will be social and psychological — adjusting our thinking, speed and direction of response and even willingness to respond, and learning to live in an economy and society that evolves rapidly in new and often unexpected ways.

If all of this sounds familiar, it is because that is the way public policies, business planning, markets and personal decisions have been moving in the U.S. and globally for more than a decade. *The challenge for NOAA is to fully adapt to the*

Technological Change May Be Accelerating

The pace of technological change may be accelerating. Indications of this are evident in such diverse areas as miniaturization, computing power (e.g. Moore's Law), information storage, communication, genomic scanning, brain scanning, automated medical diagnosis, the use of intelligent weapons, and investment programs based on pattern recognition, according to noted inventor Ray Kurzweil (2001). The interaction of the information and biotechnology revolutions will bring even more astounding gains, in his view.

This is not just a ride up a wave of rapid technological change of the kind that would be followed by a slowing. It is not even a rise to a new level in the rate at which new technologies are introduced and performance factors improve. Rather, Kurzweil sees a constantly increasing rate of technological change. The implications of extraordinarily rapid technological change are dramatic for products, production and distribution even over periods of five or 10 years an even if the pace is not accelerating.

rate of change that is evident already and to be ready for the possibility of even more rapid change.

A high rate of innovation is continuing despite a recession and a collapse in capital spending. The scientific foundations of those changes and the potential for powerful applications signify that high rates of technological innovation and with it business innovation will continue for a long time.

> "The nice thing about technology is it has the shelf life of a banana."
>
> Scott McNealy, CEO Sun MIcrosystems

INFORMATION TECHNOLOGY AND APPLICATIONS AND THEIR INFLUENCES

Information technology will continue to experience many powerful trends:

- Improvements in performance and prices of computing and telecommunications equipment and software.
- Advances in high performance computing.
- Shifts from analog to digital.
- Growth of modular and integrated software.
- Trends in distributed computing, networking, broadband, wireless, miniaturization, functional integration (e.g. replacing the need for several specialized types of chips).
- Growth of the Internet.
- Grid computing that uses the power of many dispersed computers.
- Growth of bandwidth, compression and storage.
- Growth of wireless.
- Nano scale and near nano scale processes for chip making and other applications.

These and related trends will have a wide range of fundamental impacts:

- Automation.
- Miniaturization.
- Distributed and mobile activity.
- Determination of formats and other standards more often by the market rather than by government.
- "Programmed human capital" - the ability to embody knowledge in software and systems for ease of use by less skilled or narrowly specialized workers.
- Growth of information services, including bandwidth-intensive multimedia, interactivity and large data sets.
- Data mining.
- Improved sensing, integration of sensor measures and widely distributed monitoring.
- Improved modeling, model integration and resolution.
- Convergence of applications (telephone, cable TV, Internet, game controllers) leading to new services such as Internet telephony.
- Growth of R&D and changes in its nature and composition.
- High levels of capital spending (despite boom-bust cycles).
- Flatter organizational structures.
- Managing based on continuous feedback.
- Self-organizing systems.
- Great diversity of products and capabilities, tailored to diverse needs.
- Shorter life spans of products/high obsolescence and constant adaptation to changing markets.
- Intense competition.
- More frequent restructuring of organizations and their relationships to customers, suppliers, competitors and collaborators as technology and business models evolve.
- Increased difficulty of keeping information private or limiting its distribution.
- Policy challenges involving access, privacy, security, ownership and safety.
- Difficult moral issues in some areas.

Many of the most important developments that will take place in the next several years are ones that are known today. For example, important improvements in sensors and in unmanned vehicles and satellites to deploy them are at early stages and will come into extensive use. They offer exceptional opportunities for

improved measurement of oceans, weather and climate. Technological opportunities also are constantly emerging, with potential uses in development of data, research, processing and dissemination. NOAA, which in many ways is in the business of providing information, will benefit from growth of demand for its data and services, as they become more useful and are available in more convenient ways.

> "…NOAA is fundamentally in the information business, including production, analysis, and dissemination of information."
>
> Charles S. Colgan and Rodney Weiher, "Linking Economic and Environmental Goals in NOAA's Strategic Planning," p.3.

Over the decade, NOAA will have to plan not only for the wealth of technologies that are newly becoming available but also for a very high rate of innovation and product introduction and even a further acceleration in the rate of technological change. At the same time NOAA increasingly will have to consider opportunities to work with the private sector where that offers an avenue for modernization and innovation.

NOAA will face increasing demands from private sector users and intermediaries for information in forms that facilitate private provision of enhanced services.

NOAA will experience growing competitive challenges from the private sector in providing services as government advantages from scale economies are reduced by declines in price and increases in capabilities of equipment and software and by the continued evolution of large technology firms that can mount sizeable efforts.

SOME DEVELOPMENTS WITHIN NOAA

Evolutionary Technology, with the Possibility of "Disruptive" Discoveries from the Use of the Technology

Technology in NOAA is more evolutionary that discontinuous, in part because of long lead times in budgeting and acquisition for large capital investments.

The weather industry has not been vulnerable to disruptive technologies because developments have been more evolutionary, depending on many technologies and advances.

However, discoveries that result from use of technology can have revolutionary consequences. For example:

> *The understanding of El Niño, La Niña and the Southern oscillation led to better weather and climate prediction.*
>
> *The discovery of the hole in the ozone layer led to more attention to global warming and to other environmental issues as well. This contributed to increases in the scale of data collection and research on global change. More regulation also could result, and in tern lead to more demands for NOAA information and services.*

Even if technological change in NOAA systems remains evolutionary, NOAA can expect that there will be more important discoveries as a result of scientific advances and persistence with existing technologies that will significantly change the nature of its understanding of the planet and the services it provides.

Modeling

Component-based software design, with its modular approach, allows large groups of scientists to work on different components of the same code so integrated models can be developed. For example, components of previously separate models for cloud surface and for radiation could be changed without reprogramming the whole model. Some component-based software is in use in climate modeling and more is being developed at GFDL under the "flexible modeling system."

While a flexible modeling system facilitates integration of models and speeds development and modification, it requires more scientists to act as managers. Many do not adapt easily to that role, potentially hampering recruitment and retention. This raises issues for NOAA of selection, training and motivation.

The broader climate community is going forward with the "Earth Science Modeling Framework" which is based upon the flexible modeling system. The Earth Science Modeling Framework allows inter-organizational model sharing.

Modular approaches to software development can be expected to become widespread, well beyond the modeling community.

Handling Large Data Volumes

NOAA will have to manage complex transitions to a new technological environment. For example, expectations are for an increase in satellite data of at least five orders of magnitude or about 100,000 times as much during the current decade and possibly far more. Efforts are under way to assure that the data can be handled in computers, models, storage and communication and overconfidence is being avoided. Most of those with whom Hudson spoke do not expect extraordinary difficulties in NOAA handling the very large quantities of data that are expected, either in processing or storage capacity. Similar challenges have arisen in the past, without abnormal amounts of difficulty.

Nevertheless, NOAA will have to be prepared if increases at the high end of the range occur. NOAA also will have to assure that it can handle intervening imbalances between demand and supply of technological capabilities and skills so it can take earlier advantage of opportunities as well as assure smooth transitions in service.

NESDIS will continue to face challenges in describing data, deciding which data to retain and providing data in the forms desired. However, it expects self-describing data sets to become the norm in 10 year, making the process of retrieving information easier and more accurate.

THE INTERNET, WEB SERVICES AND ELECTRONIC COMMERCE

The Internet

Metcalf's Law

"Metcalf's Law" defines the potential for huge benefits of any type of network as more people participate — whether through telephone, automobile or Internet. It states that the value of the network increased with the square of the number of participants. For example, if a network has 10 participants its value is 10 x 10 or 100 units. If the network instead has 1000 participants its value is 1000 x 1000 or 1 million units — not 100 times the original 10 but 10,000 times as much.

The Internet harnesses the power of Metcalf's Law which generates huge increases in the value of the network as the number of participants rises. (see text box)

The explosive growth of the Internet brings with it:

- New information and services and new forms of delivery, often in real time, interactive and personalized forms.
- Great efficiencies.
- A world of linkages among participants across economic and social as well as geographic boundaries.
- The Internet effectively becoming the operating system.
- Transformation of personal and business practices, including the creation of self-selected communities and profound cultural changes.

The Internet will continue to generate extensive new services and systems. Technological changes and innovation, along with dispersed access, mean new competitors and new types of customers. Rapid changes in the ways of doing business and in the nature of markets and customers leads to displacement and decline of laggards, many failed innovators and some huge successes. Innovation can come about in successive waves that take people by surprise after the pace of "creative destruction" from previous waves has abated.

The Internet and Intranets (Internet-like arrangements within the organization) facilitate:

- Reaching large and dispersed audiences with information and analysis at very low incremental cost.
- Creation of many new "products" that combine features including information, distribution, manipulation and presentation. Products may integrate data from multiple government agencies or across public and private organizations.
- Movement to a model of "mass customization" that enables products and services to be tailored to diverse customer specifications at low cost.
- Self-service, with associated convenience and economies.
- Information sharing, group work and flexible use of teams.
- Flatter organizational structures.
- Collaborative efforts among organizations at all stages of information, development, production, distribution and consumption, including cooperation among organizations at the same stage and integration of elements in a way that appears seamless to the user.

Potential Internet-Related Cost Savings
(billions of 2000 dollars)

Sector	**Annual Cost Savings in Five Years**
Education	Not clear
Financial Services	19
Government	At least 12
Health Care	41
Manufacturing	50-100
Retailing	Not clear
Trucking	3-79
Total	**125-251**

Source: The Brookings Task Force on the Internet.

- The "adaptive enterprise" that makes decisions in real time, sometimes automatically, based on rapid feedback and assessment of developments in its operations and environment.
- New sources of competition from organizations expanding into additional stages of production, from users becoming information producers or distributors, from internalization of functions by users, and from new entrants, sometimes leap-frogging in technology.

Experimentation has been taking place with development of a next generation Internet in government under the Next Generation Internet (NGI) project and in universities under the Internet2 consortium. Neither is a replacement for the Internet but rather development of enhancements that can be applied throughout the Internet.

The Next Generation Internet project, under the auspices of the Defense Advanced Research Projects Agency of the Department of Defense, is working with government agencies, universities and corporations with a goal of achieving speeds of up to 1,000 times those available in 2000 on dial-up connections. This would allow ready sharing of high resolution images even outside of large corporations. NOAA has been making extensive use of NGI.

Maria Maeda, project officer for DARPA, sees the speed goals being achieved by the end of the decade.

DARPA also is working on "interplanetary Internet" to speed and enrich transmissions from other planets during the next 20 years.

Internet2, a not-for-profit consortium with over 180 universities, is deploying advanced application and technology and developing protocols that will allow additional capabilities and services. The consortium is collaborating closely with corporate members to facilitate deployment over the entire Internet.

Tele-immersion

According to the Internet2 consortium:

"Tele-immersion enables users at geographically distributed sites to collaborate in real time in a shared, simulated, hybrid environment as if they were in the same physical room.

It is the ultimate synthesis of media technologies:

- 3D environment scanning,
- projective and display technologies,
- tracking technologies,
- audio technologies,
- robotics and haptics [relating to the sense of touch],

and powerful networking."

http://apps.internet2.edu

Potential applications of Internet2 include digital libraries, virtual laboratories that allow dispersed researchers to collaborate, distance learning and tele-imersion.

Achieving the promised gains will require extensive deployment of new technologies at user sites so participants can use them to communicate with each other. As a result, deployment will occur gradually after the announcement of availability of technologies.

Government can facilitate diffusion of technologies in which it has a special interest such as transmission of high-resolution images by rapidly deploying the new technologies to create a critical mass of demand. The ability to interface with government more fully will give the private sector a greater incentive for rapid and more complete deployment.

Potential Shortage of IP Addresses

One potential bottleneck in the development of the Internet is the shortage of IP (Internet Protocol) addresses. The number of possible addresses under the current IP version 4 is 4 billion but only 1 billion are still available. Addresses are being used up rapidly as a result of international growth of Internet users, the proliferation of always on Internet connections, streaming multimedia, and distribution of content to mobile phones and PDAs. Some are predicting a crisis as soon as 2005 (Moore). The Asia-Pacific region will soon run short of addresses.

The problem can be solved by upgrading the Internet Protocol to version 6 (IPv6) which supports a 128-bit address space instead of the 32-bit address space of IPv4. This potentially would allow 3.4×10^{38} addresses. It also would greatly facilitate Internet telephony videoconferencing and multicasting by permitting service guarantees. IPv6 would allow true integration of voice and data over wireless networks and across services, for example enabling email to be forwarded to a cell phone and read by text-to-speech conversion. Security would be improved as well because it would be embedded in the network layer instead of in the application layer.

IP6 is expected to be available only in 2006 in Europe and Japan and in 2008 in the U.S. The U.S. is currently is running IP6 only on experimental networks like Internet2. Wireless carriers are expected to be early adopters because IP6 will overcome limitations in bandwidth in 3G wireless for voice-data integration.

The long lead time in increasing the capacity to provide sufficient addresses in the United States could mean an important bottleneck for NOAA by mid-decade. Utilizing Ipv6 capabilities will require additional efforts. Some older computer systems will not be able to handle Ipv6's more complex 128-bit addressing and business applications. Contingency planning for a shortage of addresses and for the requirements of enhanced services would be appropriate.

Growth of Web Services

Web services will be growing rapidly in the next several years. The idea behind Web services is:

- To let different computer systems and devices work together seamlessly to provide information and services to businesses and consumers.
- To provide services and software from central locations where that can avoid having to provide, maintain and update them at each location.

Web services are accessed through the Internet or through wireless devices by human users, application programs or by other Web services.

Users are managed through user profiles (Universal User Profile or UUP) rather than through security access and control, as in the client-server model. Application program interface (API)-based systems that allow applications to communicate with each other are mainly used instead of relying largely on interactions with multiple servers.

Extensible Markup Language (XML) tags digital content in standardized formats that indicate what type of information is contained (price, quantity, product description, etc.) XML has been called "the bar codes of the Internet."

XML is the foundation of Web services. It is integral to several key components (Manes):

- SOAP, the protocol for sending messages back and forth between services.

- WSDL, a mechanism for describing what a service does, how to communicate with it and where to find it.
- UDDI which is where the service is registered and advertised so others can find it.

Anjana Srikanth of Stylus, Inc. describes the potential advantages of XML as:

- "Improved efficiency as a result of a standardization in the representation and transfer of all information.
- Transformation of data from XML to outputs in various media (Web, CD ROM, paper) without the necessity of modifying and duplicating content repeatedly.
- Reuse of data at any period of time, XML being a text-based format.
- Simplifications of communication as all users at any end only need to know the common XML vocabulary that is agreed upon.
- Researching, indexing and locating data will be more accurate as all information will possesses self-describing attributes. Browsers will do most of the processing and updating of data.
- Multilingual web sites as XML supports Unicode. Customization of information.
- Accessibility to devices of any kind - desk top systems, personal digital assistants and cellular phones, without the user having to make any adjustments at his end.
- Increased reliability in software.
- Lesser time and cost to implement and market changes."

She sees a metamorphosis coming in online publishing and Web maintenance, content and knowledge management, data exchange and supply chain integration. She notes that in design, "scalable vector graphics, a multi-platform XML that can be used over extensive bandwidths and applications will save time in duplication of formats. A real time map can be made available to any user, at his desktop or on his car phone…"

Development of standards for Web services will require overcoming many hurdles. Not all applications will gain sufficient cooperation among the parties to advance. Government can play a role in fostering cooperation by using its influence as a large user to encourage agreement.

XML descriptors are designed for specific applications. That means that users have to participate actively in development of the descriptors and associated standards to be sure they are appropriate for their expected uses.

For the next five years NESDIS expects to rely on GIS systems for display of information. The move to Internet-based standards is expected to occur in the following five years. In such cases, NOAA will have to assure that it has the capability to participate early in the development of Web services in its areas of interest in order to assure that when it is ready to make the transition the standards will meet its needs.

E-Commerce

A lot of free material and services has been available to both businesses and consumers as vendors sought to develop name recognition, build customer bases and test the viability of services and business models in the marketplace. Much of the initial investment was supported in one form or another by venture and equity capital and by advertising. When those markets shrank, many firms continued to provide services in the hope of an upturn.

Business-to-business e-commerce represents 90% of paid activity over the Internet. Its most successful form is direct sales by companies to both preexisting and new customers. Efforts to develop exchanges, auctions and other multi-firm arrangements have had limited success even when maintaining a specific industry focus. The main gains have come through efforts of individual companies to link to their suppliers and customers.

Consumer market growth has been very disappointing, but continues at a rate that could become quite important over time. Again, this primarily represents direct sales of individual firms. The vast majority of Internet consumer sales have been by traditional firms that developed Internet sales capabilities. Independent sales organizations have had great difficulty becoming profitable. Even separate dotcom subsidiaries of traditional companies have faltered, with many being absorbed into the parent.

These trends can be expected to continue even as advertising revenues and equity and venture capital markets improve. They reflect fundamental advantages of firms with reputations, customers and distribution systems.

Recently there have been a growing number of efforts to charge for services over the Internet. The Online Publishers Association estimates that 12 million Americans paid for some type of digital content in the first quarter of 2002. It will take some time before large percentages of businesses as well as consumers that have become used to free services accept charges. Nevertheless, payment will become an important source of financing for Internet information and services.

Payment will be accepted more readily for costs that are absorbed by businesses, including paying for wireless information, whether or not delivered over the Internet. Payment for some services will take place in packaged form such as a monthly rate for enhanced cell phone service that includes site-specific weather information.

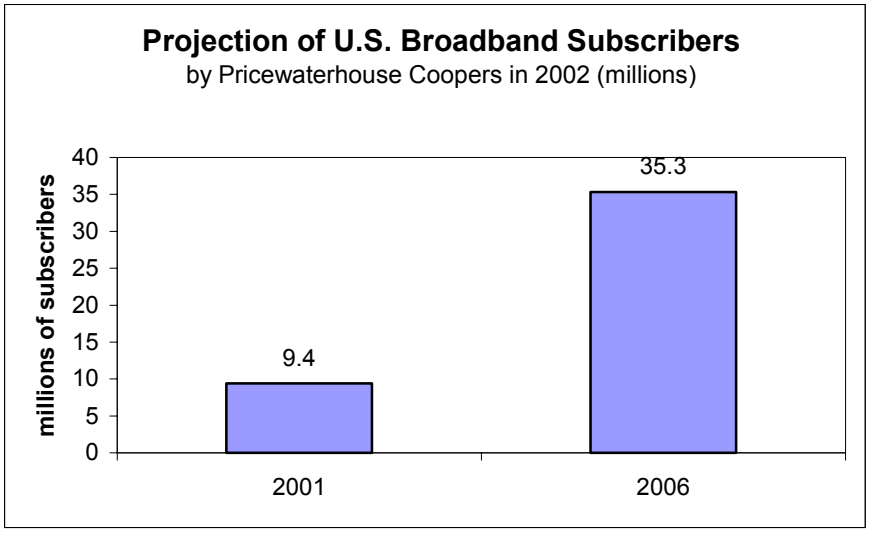
Willingness to pay for services will increase demand from intermediaries that serve customers with enhancements of NOAA information.

BANDWIDTH AND SATELLITE CAPACITY

Bandwidth

The conventional wisdom is that in 10 years bandwidth will be very wide and very cheap. The development of technologies for greater capacity, compression and transmission speed clearly supports that view. So does the emergence of alternative paths like wireless.

Even looking at the potential explosion of demand from multimedia, streaming media and vast collection of satellite data, experience suggests that bandwidth capacity will keep up. One reason it does is because higher capacity is priced so that those uses for which its value it greatest will pay to receive it first. The pricing structure and lags in reducing prices while capital investment costs for build out are high works to balance supply and demand.



However, the current oversupply of fiber optic cable among customers and suppliers and financial difficulties of telecommunications firms will delay introduction of some high-performance products. Delays also can arise from technical difficulties, resistance to altering spectrum allocation, uncertainty or delay in FCC rules and approvals, shortages of Internet addresses and local opposition to siting towers for fixed wireless.

Even if the future arrives on time, NOAA will have to manage the transition to the new environment. During that transition there may be periods where demand of particular kinds f capacity outstrips supply either because of added data or processing or capital spending delays.

Satellite Capacity and Space Development

Satellite observations will continue to become more dominant for NOAA data collection as capacity and capabilities improve to meet the challenge of global observing through the greater use of sensors.

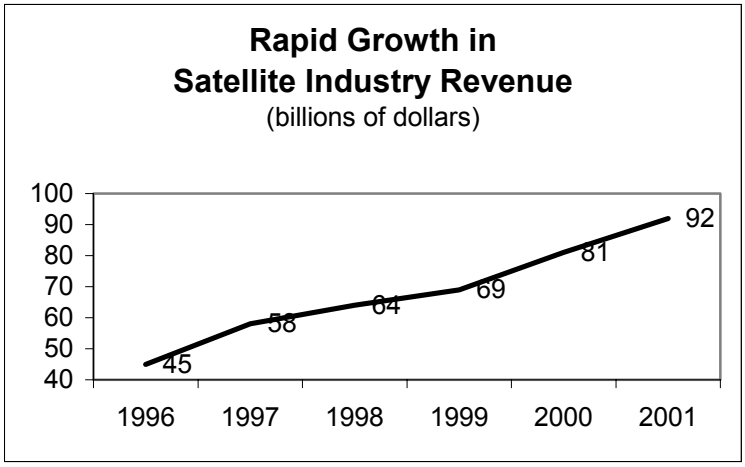
NOAA plans, if fully implemented, are expected to give it sufficient capacity in its dedicated satellites during the next decade.

Satellite Industry Revenue Components, 2000

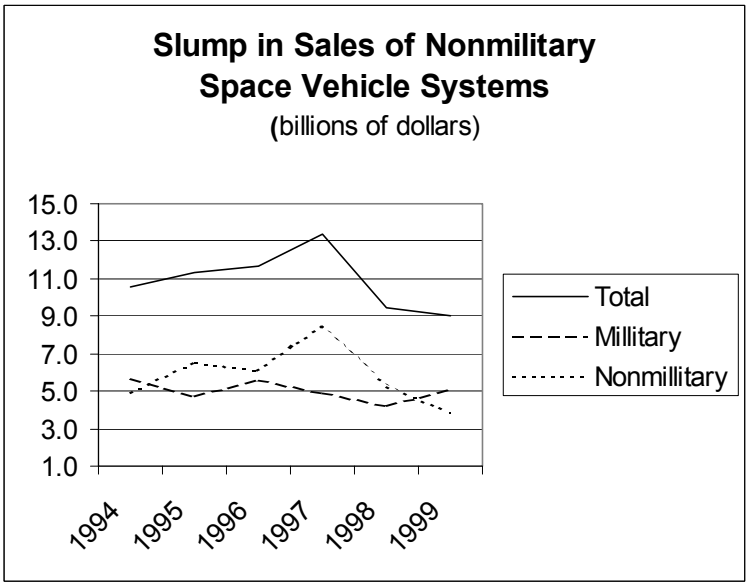
	(billions)
Satellite services	$40
Satellite manufacturing	16
Ground systems	18
Launch services and vehicle manufacturing	8

Source: Satellite Industry Association/Futron Corp.

Until recently, revenue of the private satellite industry from manufacturing, ground equipment, launches and services grew rapidly, according to the Satellite Industry Association.



However, the situation has changed dramatically.



The number of private satellite launches has been cyclical and recently has been in sharp decline. Pullbacks occurred after the huge overbuilding of telecommunications infrastructure in the late 1990s. It is exacerbated by the weakness of the economy and the telecom bust that followed overbidding for spectrum licenses, going on acquisition sprees and masking problems rather than correcting them.

The domestic private satellite industry will recover and grow over the next 5-10 years but cannot be expected to resume the kinds of surges seen in the speculative boom of the late 1990s.Until it recovers, NOAA and other agencies with which it collaborates have fewer options.

New capital spending normally would be expected to pick up with a lag after recovery of the U.S. and global economy. However, capital spending in general and telecom capital spending in particular will be held back longer than usual by the extent of overcapacity and the severe financial difficulties of telecommunications companies and their suppliers. Launches of private satellites largely will await improvements in the private economy and the gradual working off of problems.

The U.S. military has unmet needs for satellites and services and demands will continue to grow. Shortages of satellite capacity after the collapse of the commercial satellite industry led to limitations on communication between unmanned spy planes and ground forces during the 2001 pursuit of al Qaeda and Taliban fighters in Afghanistan. The U.S. will add 37 more of the aircraft in 2003 but will not be able to fly them all immediately because insufficient satellite capacity will limit bandwidth over the battlefield (Jaffe). The U.S. military buildup could help the private satellite industry recover.

The missile defense initiative would give a major impetus to satellite development. NOAA could be called upon for data services, monitoring and research, satellite rescue and other activities. NOAA's space weather would take on greater importance.

The lack of as many private alternatives in the U.S. means that NOAA is less able to rely on the private sector for innovation and capital investment. That makes it necessary for NOAA to do more itself, to partner more with other government agencies and to further consider international alternatives.

Many more satellites will be launched from foreign countries and more countries will have launch capabilities. Also, countries may more frequently launch from locations outside their borders.

U.S. Share of World-Wide Successful Space Launches, 1957-2000

	1957-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	1998	1999	2000
United States	207	279	139	126	93	61	122	161	34	30	28
European Space Agency	0	0	0	1	8	21	33	54	11	10	12
Soviet Union	82	302	405	461	483	447	283	135	24	26	35
China	0	0	2	6	6	9	15	21	6	4	5
All Other	0	5	9	13	15	12	13	13	2	3	2
Total	**289**	**586**	**555**	**607**	**605**	**550**	**466**	**384**	77	73	82
U.S. Percent of Total	**72**	**48**	**25**	**21**	**15**	**11**	**26**	**42**	**44**	**41**	**34**

Source: U.S. Census Bureau, Statistical Abstract of the United States: 2000, Table 1002 ;2001, Table 793.
Data from Congressional Research Service

In May 2002 China launched its first Marine Satellite Haiyang-1 for its State Bureau of Oceanography for the exploration of seawater color and temperature and other environmental elements. China and Brazil will co-launch their second earth resources satellite this year after the successful launch of the first, the ZY-1, in 1999. Thereafter, China and Brazil will cooperate on developing a second-generation earth resources satellite. China plans to launch the Double Star satellite jointly with the European Space Agency in June and December 2003 to take magnetosphere measurements. It also expects to launch three small multi-mission spacecraft with Iran, Thailand and other partners by 2005 with optical and infrared instrumentation for remote sensing and disaster and environmental planning, followed by five more. Two thirds of the satellites China has launched to date have been domestically produced.

NOAA may have greater opportunities to take advantage of growing foreign satellite capabilities for launches, collecting data or sharing data collected by others.

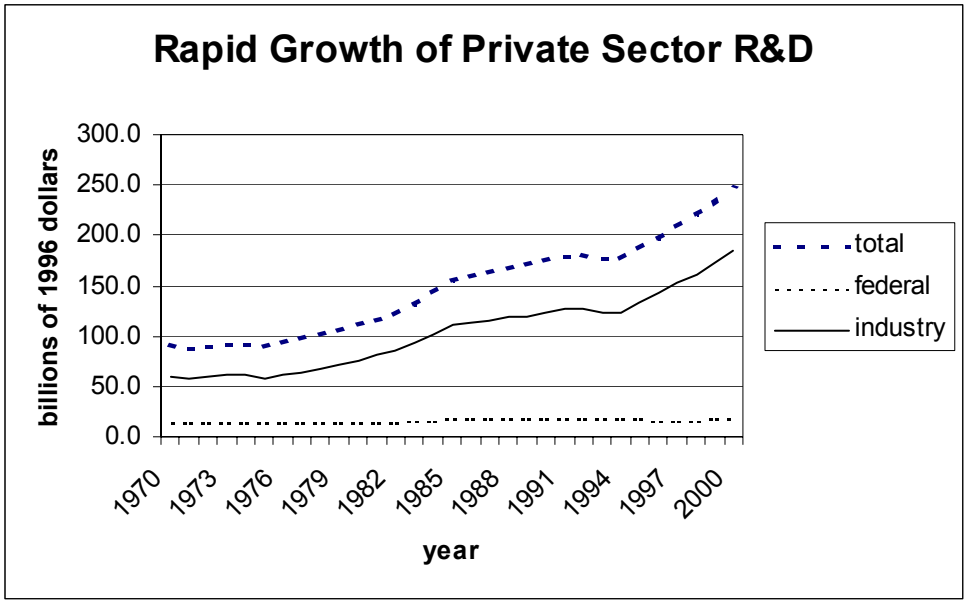
The activities of China in environmental satellites are especially noteworthy, albeit presenting difficult issues of cooperation.

NOAA space capabilities could play an important role in monitoring and analyzing effects of U.S. and foreign efforts to deal with climate change and monitoring outcomes of international participation in the Kyoto protocol.

NOAA could play an increased role in dealing with issues associated with the proliferation of falling space debris. According to NASA there are approximately 10,000 manmade objects orbiting the earth that are the size of a golf ball or larger.

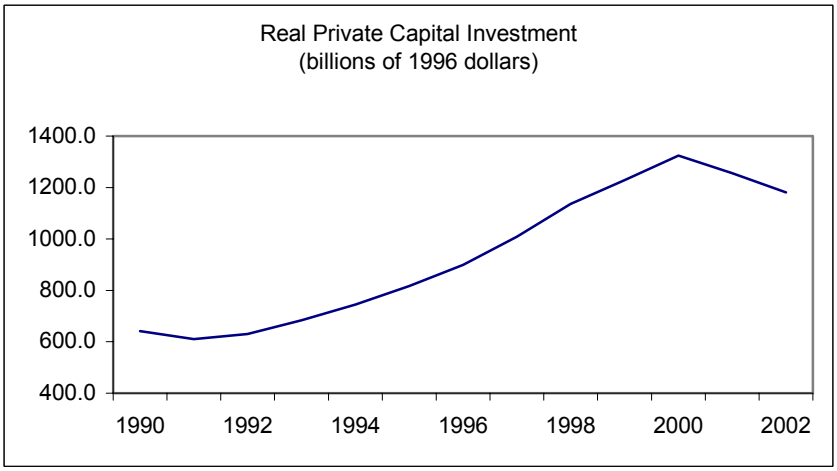
SHARES OF PUBLIC AND PRIVATE SECTORS IN SCIENTIFIC RESEARCH

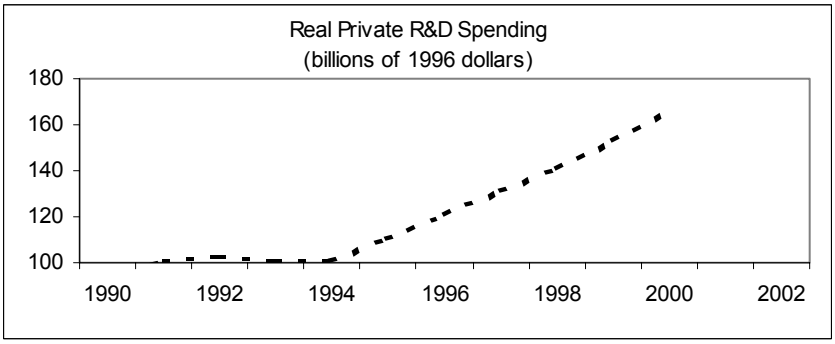
R&D, measured in dollars of constant purchasing power, has grown rapidly. All of the real dollar growth in R&D in the United States has been in the private sector. Growth was particularly rapid in the late 1990s, paralleling the boom in capital spending. The economic slowdown restrained spending subsequently and the rate of growth of the boom years is not expected to continue. Nevertheless, growth will be substantial.



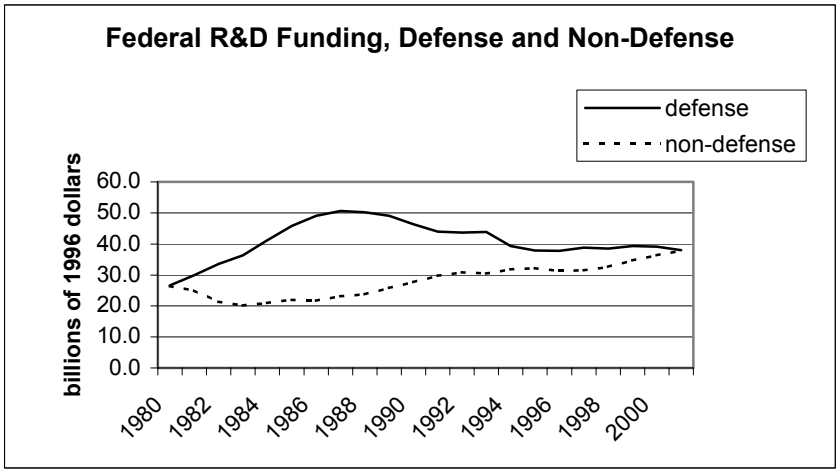
Emphasis on private sector growth also has been associated with increased instability of R&D spending, as it has with instability in investment, even while spending has reached much higher levels.

R&D and Capital Spending Surged Together in the Late 1990s





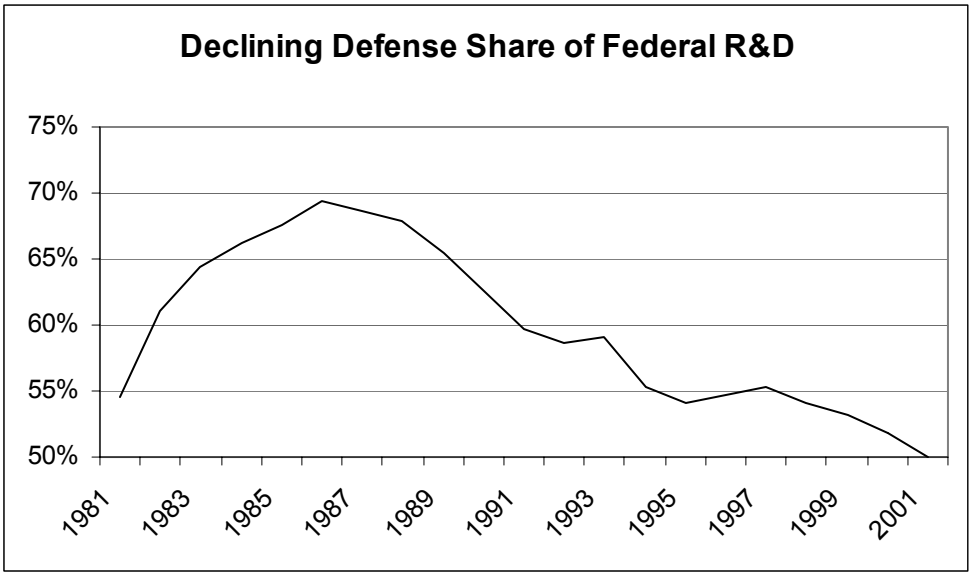
Federal R&D spending change has been composed of modest growth in real non-defense spending while defense R&D declined.



Defense R&D can be expected to rise to take advantage of new technologies and strategies and support post 9-11 initiatives. There will be increases in R&D spending associated with the war on terrorism, to develop information technology, information systems and other security measures and to develop understanding of

diseases and defenses against bio-terrorism. Non-defense R&D should continue to rise with increases in spending for health and energy security, areas for which spending also will grow in defense.

With these developments, the share of Federal R&D for defense can be expected to stabilize or rise after a long decline.



Basic research, while much smaller than applied research or development, has grown more rapidly, even while all research spending growth has been in the private sector. This may be largely because of growth that is concentrated in health.

With strong competition for federal research dollars, NOAA will be required to make highly explicit the ways it can further practical objectives through research. The links between research and development will require greater clarification.

There will be interest in R&D that leads to products that facilitate domestic and international anti-terrorism activities and support warfare, and that enables provision of atmospheric and space data and analysis that support missile shield development and deployment.

FORMS OF PUBLICATION OF SCIENTIFIC RESULTS

The Web is changing scientific publication in profound ways. More research is privately published, available on Web sites and distributed by email. Material may be used before going through formal peer review. However, there can be much more extensive and more rapid informal review by a greater number of peers. In some cases easier distribution may improve quality and accelerate collaboration and rapid building of knowledge. In others it may lead to poor quality work being distributed or work being distributed prematurely, or it may facilitate plagiarism.

Issues of this kind arise with regard to announcements by companies as well. In January 2002, the Scottish firm PPL Therapeutics issued a press release on the birth of five specially cloned pigs two days before the publication of similar results in the journal *Science* by scientists from Immerge BioTherapeutics of Boston. On another occasion PPL announced what would have been an important achievements and had not yet published a scientific paper on it a year later. In the meantime the company benefited from a rise in its stock price. Situations of one-upmanship by taking advantage of the Web and other media and efforts to tout stock prices with insufficiently documented results can be expected to become more common in an environment where news travels fast and markets react strongly.

NOAA's Geophysical Fluid Dynamic Laboratory in Princeton makes ocean models available on the Web to a broad user group so that interested parties can run their own simulations. The process will be expanded to more user groups and model areas. Under this arrangement, scientists develop documentation to assist other users. The lab also is integrating models using component-based software design to facilitate development and modification.

In both situations the staff is often asked to forego publication in journals prior to model availability and to translate their knowledge into Web documentation and model capabilities for use by competitors. This creates issues for staffing and retention.

NOAA will have to find the right balance between widespread distribution to facilitate innovation, maintaining quality through internal and external formal and informal peer review and preserving professional incentives of scientists through formal publication. While there may be some general principles, the balance may vary among parts of NOAA according to functions.

Globalization

THE GLOBAL ECONOMY AND TRADE

Globalization *means* increased global interaction and interdependence.

Globalization has been associated with:

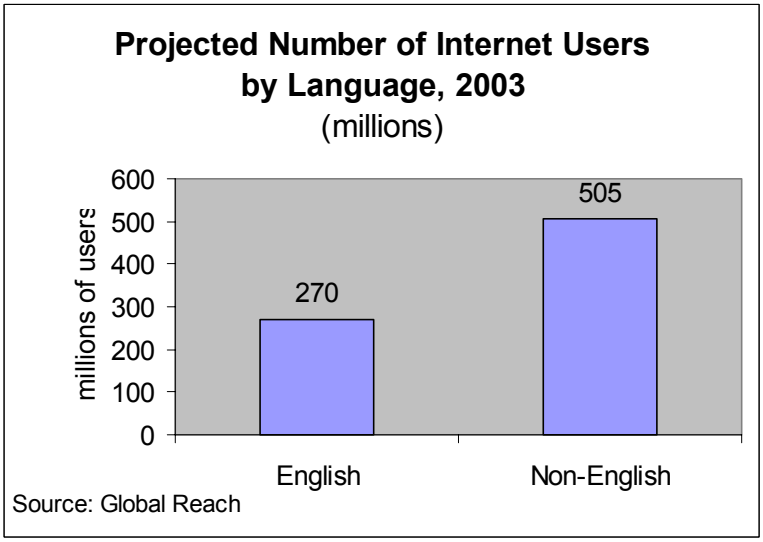
- Increasing contact through travel, communications and trade.
- Development of a world market for technology.
- Cross-ownership of business and financial assets.
- Growth of reliance on markets vs. regulation, government ownership and central planning.
- Spread of democracy with pressures from exposure to ideas, rising incomes and strengthened business classes.

Beneficial interactions raise living standards and prevent or overcome problems, including problems that are byproducts of increases in incomes.

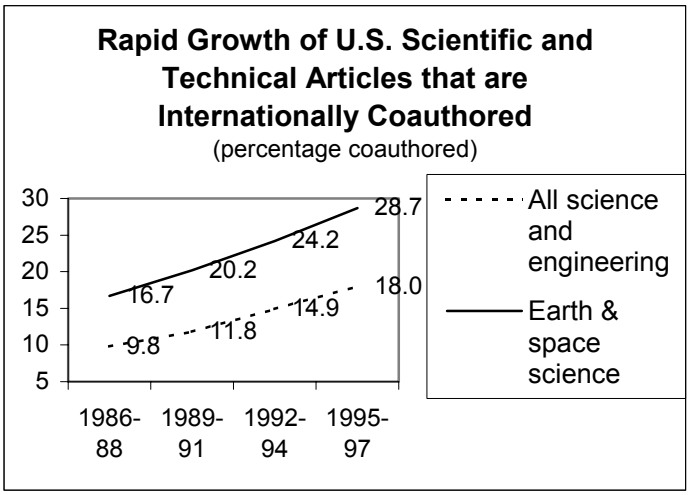
Manifestations of globalization include:

- Several decades of trade growing considerably more rapidly than GDP.
- Progress in agreements on more open trade.
- Vast international capital and increases in international securities ownership.
- Many countries with high levels of R&D spending as a percent of GDP.
- Renewed U.S. reliance on international organizations (UN, NATO, IMF, World Bank, etc.).
- Increased international company sourcing and distribution of goods, services and intellectual property.
- International mergers, acquisitions and financing.
- Increased recognition of global interdependence in weather, climate and the environment.
- Problems with invasive species and transfer of diseases (HIV/AIDS, hoof and mouth, mad cow, West Nile-like virus).
- The U.S. as a target for terrorism.

By the end of 2002, a majority of Web sites will no longer be in English. By 2007, the most common language on the Web will be Chinese, according to the World Intellectual Property Organization.



The rise of global interchange is reflected in the growth of internationally co-authored scientific articles. Co-authorship across national boundaries is especially high in earth and space science.



The principal implication of rising global interdependence for NOAA and other agencies is the growing importance of international cooperation in science and resource management for achieving results. The burgeoning scope of cooperation among countries and linkages among private organizations creates opportunities to transcend fragmented approaches to data collection, dissemination, research, policy and operations. It also adds enormous complexity as NOAA and constituents seek to understand each other's needs and find ways to work together across numerous geographic, organizational, scientific and cultural dimensions.

The challenge is to build truly global networks for collecting, analyzing and disseminating information and knowledge. Components will vary with institutional factors. Some foreign activities will be more sophisticated or better coordinated. Some may have more centralized operations or differ in roles of the public and private sectors. Some nations will already be cooperating extensively. Hence, arrangements for cooperation and opportunities to expand cooperation will vary.

The answer to complexity often is decentralization. However, when responsibilities cover many interacting areas and diverse actors it is frequently necessary to have a mixed and sometimes changing balance between decentralization and central guidance. The complexity of a globalized environment requires finding such a balance.

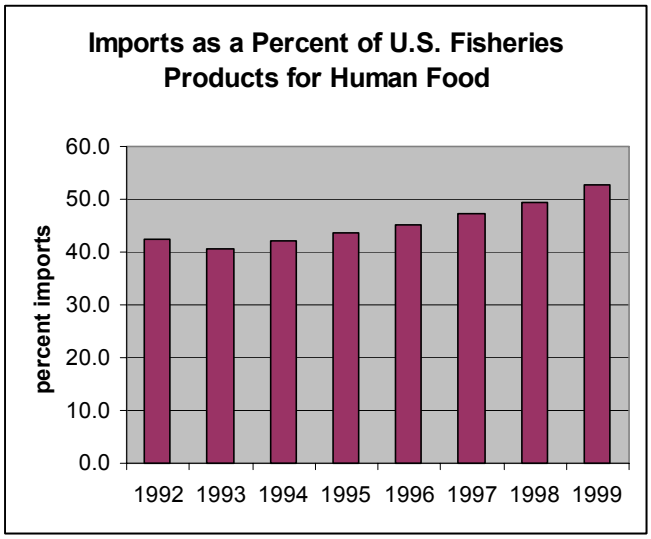
Aspects of Growth of Trade

Before World War II sustained economic growth was limited to no more than 20 countries. Continued growth in developed countries and the spread of growth to less developed countries have been associated with many key trends:

- Trade has grown substantially more rapidly than overall production (GDP) over extended periods of time as countries have become increasingly interdependent.
- The growth of multinationals has meant that a large share of international trade is among affiliates of the same company.
- Growth of trade in services has been especially rapid as financial, information and business services and licensing of intellectual property have expanded across geographic boundaries.
- Movement of goods, skills and intellectual property have created a world market for technology.
- The United States has maintained a substantial surplus in trade in services in large part because of its leadership role in technology and information industries.
- Foreign companies control a small but growing share of U.S.-based businesses. The large U.S. trade deficit has been associated with reduced U.S. ownership of assets abroad relative to the size of the economy and increased foreign ownership of assets in United States.

All of these trends can be expected to continue.

In any given period the growth of trade can be slowed by recession or economic crisis, protectionism, war or increased security restrictions. In fact, some of the rapid growth of trade in the post World War II period represented catch-up from low levels of trade that had been compelled by the war and depression, and is not part of a longer term trend. Reactions to terrorism are clearly impacting international movement of people and goods. This, along with military and political uncertainty and the threat of violence can put a damper on international activities, but not indefinitely.



Much of the trade that takes place in information services and technology occurs electronically or is of limited bulk. While it is less subject to physical impediments it could be slowed by heavy security requirements. The much more likely prospect is that international communications, dissemination of information and spread of intellectual property will grow rapidly in spite of vulnerabilities because the technology and applications are too beneficial and powerful to contain.

Brain Circulation

Internationally, the flow of information and knowledge have accelerated the development of a world market for technology in which countries and companies undertake more research and development to serve world markets and borrow and learn more from one another.

The resulting flow of people and ideas to where the opportunities are has resulted in a change in the nature of technical personnel immigration. In the view of Prof. AnnaLee Saxenian of Berkeley, the 'brain drain" model is no longer correct. It has been replaced by a model of "brain circulation" in which people trained in the United States periodically go back to their native countries, sometimes contracting with firms in those countries and sometimes returning to start companies.

POSSIBLE EROSION OF U.S. DOMINANCE

The worldwide dominance of the U.S. in size and influence has given the nation a prominent role in setting standards and in shaping the economic and political climate. Today, recognized as the only superpower, the United States enjoys position not seen since the days after World War II. Yet the U.S. has less than 1/4 of world GDP compared to about 1/2 in the earlier period, a consequence of the spread of development throughout the world. Many U.S. views are being challenged.

A Widespread View of U.S. Dominance

"The United States not only prevailed in the cold war, but also ensured the spread of its language, culture, and products worldwide. The U.S. dollar became the international medium of finance; English became the lingua franca of world business; American culture and consumer products dominated world media and world markets. As a result, the United States is now the sole global power."

Walter Russell Mead, p.167

A powerful position does not disappear easily but it can erode significantly over time. What happens if the U.S. dominance is reduced, whether by increases in abilities of other nations, actions of other nations that resent U.S. dominance or drains of war? This is a long-term possibility that cannot be ignored.

Perhaps the most serious consequence of lessened U.S. dominance from NOAA's point of view is the fragmentation that could result in data collection, research coordination and information dissemination.

During the next decade the United States faces the greatest risk of fragmentation from challenges from the European Union. Consider three examples:

> In March 2002 the European Union transport ministers approved funding to launch Galileo, a satellite navigation system to rival the Global Positioning System of the U.S. The first of 30 planned satellites are to be placed in orbit in 2006 with the objective of having Galileo operational in 2008. The challenge raises many questions ranging from 1) Pentagon concerns about interference with next generation GPS signals for military use, to 2) interruption and security of data flows, to 3) the ability to effectively and continuously integrate overlapping and sometimes disparate information from competing systems operated by rival organizations.
>
> Many European nations are more restrictive than the U.S. in their release of weather information. As capabilities grow and they develop more integrated systems it could become more difficult for the U.S. to negotiate data flows based on U.S. standards and distribution initiatives.
>
> The share of non-U.S. satellite launches can be expected to decline. Growing capabilities of other countries offer opportunities to diversify risks, share costs and take advantage of innovations and efficiencies developed elsewhere. However, they also mean loss of self-sufficiency and independence. They challenge U.S. dominance in setting the framework for international participation. Where foreign subsidies are involved, they also can reduce the prospects for development of successful private sector launch capabilities in the United States.

The greater role of state owned and operated information dissemination organizations in other nations is a barrier to competition in those nations from U.S.-based private firms. Differing roles can make U.S. government efforts at coordination more difficult.

Perhaps the most serious consequence of lessened U.S. dominance from NOAA's point of view is the fragmentation that could result in data collection, research coordination and information dissemination.

Moreover, the role of government ownership, operation and subsidies of data collection, analysis and distribution in other countries could eventually pose a threat of competition within the United States market. Whether successful or not, foreign public or publicly subsidize entities, often with significant scale, entering U.S. markets can weaken entrepreneurial U.S. firms.

The Anti-Globalization Movement

Anti-globalization protests come from a loosely knit agglomeration of radical and disenchanted groups with greatly varied agendas. From the point of view of resource management policy the most important are extreme environmentalists and those that are hostile to private corporations.

The anti-globalization movement has been disorganized since September 11, 2002. Nationalism and concerns for security have weakened support among the general public. Recently demonstrations have picked up some protesters against policy in the Middle East. Protests continue to disrupt international meetings and grab press attention away from the purposes of those meetings.

The anti-globalization movement will gain strength and voice if public concern for the environment increases relative to concern for economic security as the U.S. and world economy recovers, if terrorism is considered under control, and if governments, especially the government of the United States, are not seen as sufficiently responsive to the people.

Political leaders in the U.S. are only likely to be responsive to demands of the protesters in resource management areas if the grievances are perceived as reflecting heightened concerns of the general public. Even so, they will not reach out to the protesters themselves. Leaders will foster relationships with more adamant environmental organizations that represent well-organized constituencies.

Political leaders in other countries may be more likely to respond to pressures from protestors, especially where they have to contend with challenges from green parties. In a period as long as a decade a green party or one that includes its constituents could become more important in the U.S., but a green party or wing of a third party would have to overcome concerns about blocking economic progress.

At the moment the trend is the other way. Right wing parties have made gains in Europe. The Greens became part of the governing coalition and moderated their positions in Germany. The U.S. Green Party failed in the last presidential election and faces hostility from Democrats for dividing the vote and costing it the election.

If the anti-globalization protesters were to become successful, that could make it more difficult to implement incentive approaches and approaches that balance business with environmental interests in governance of self-regulatory and resource management councils.

Economist Martin Feldstein has argued that the Internet is greatly strengthening anti-globalization protesters. Thomas Friedman in *The New York Times* has bemoaned the ability of the Internet, with emanation through the few that participate, to spread rumor and misinformation in isolated societies and poor and illiterate populations.

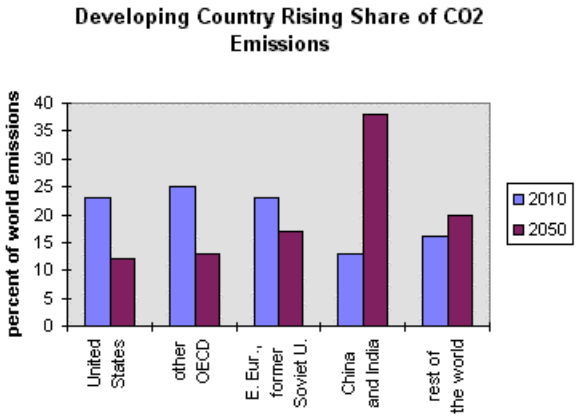
However, it also is clear that the Internet and associated developments are greatly increasing the advantages of globalization. They are doing so in a way that is often highly visible and that reinforces recognition of the advantages globalization can bring. If globalization is understood to be producing improvements in efficiency, incomes and well-being, then protests, even though loud and sometimes well-organized, will not carry as much weight.

While those with the most radical views may never listen to reason, the imperative of educating the electorate and providing the foundation of knowledge that can guide new generations, both in the U.S. and internationally, is stronger than ever.

Climate Change

PRESSURES AND RESPONSES

There is widespread agreement that the earth is warming and that human activities are at least in part responsible. Knowledge about the underlying processes has been advancing steadily and evidence is accumulating. However, considerable uncertainty remains as to the forces responsible and the magnitudes of their effects. Uncertainty about long-term changes, plus the presence of shorter-term phenomena, has caused some discussions to define the issue as climate change or global change rather than global warming.



Some models imply warming of 1-2 degrees Fahrenheit over the century while others imply a rise in average temperatures of 8 degrees or more. Some mechanisms can produce cooling. Sources of carbon dioxide absorption can turn into sources of release in other circumstances. Results are sensitive to the time period and type of data. Model results differ from trend observations. Differences in consequences are enormous.

There also are great differences in views as to how much various interventions could change the prospects and, given the uncertainty and intrusion required, whether they are worth the cost.

If a warming trend continued it would be likely to increase public pressures for action. Public concerns may also be heightened by shorter-term increases in warming or erratic weather patterns that have little or nothing to do with long run trends, especially if associated with widespread drought or other severe consequences.

However, the public is not likely to be willing to make great sacrifices anytime soon — such as adopting a large carbon tax or prohibiting construction in areas likely to experience extensive flooding if the sea level rises.

Under these circumstances, efforts can be expected to focus on:

- Improving the evidence.
- Developing policies that are less costly or restrictive, but skewing the costs of policies away from consumers to industry.
- Finding ways to maintain good international relations despite differences in attitudes and policies between the U.S. and other nations.

The U.S. will be under continuing international pressure to curb its use of fossil fuels. The debate over the responsibilities of high-consumption developed countries and the leeway to be given to developing countries will never fully be resolved. The debate over use of incentive approaches vs. command and control approaches to environmental management also will be ongoing because of international differences in how the approaches are viewed.

PUBLIC ATTITUDES TOWARD THE ENVIRONMENT IN THE U.S.

The large, influential baby boom generation has become more conservative with age. That conservatism includes individualism, and with it, recognition of the importance of individual initiative and market processes. After becoming more family oriented, attention has been turning to the requirements of retirement and meeting health costs. As occurred with earlier influences, these attitudes have spilled over or reinforced those of other generations as well.

At the same time, however, the environment has received great media coverage and the public has paid attention to warnings and criticisms of policy. While not taking on radical tones, expressions of concern for the environment can be expected to grow and gain influence.

The overall environment is a mid-level concern relative to other issues according to U.S. public opinion polls, although local environmental issues are often a matter of intense concern. For example, a Gallup poll conducted April 3-9, 2000 with 1004 national adults found environmental protection 8th in a list of 12 issues considered extremely or very important in voting for president. Even so, the percentage considering the environment extremely or very important was 66% (Saad and Dunlap).

Attempts at understanding longer-term trends in thinking about the environment are made difficult by the varying dates of surveys and by cyclical fluctuations. Interest in the environment appears to be greater when the economy is strong and to fall off during periods when economic concerns increase. Thus, some measures show a decline in concern in the early 1990s and a rise in the late 1990s. In some data the late 1990s increase is smaller than the early 1990s decline, suggesting the possibility of some longer-term tapering off of concern. In any case, in view of the cyclical patterns, recent increases in concern should not be interpreted as a long-term trend.

A decline in concern might reflect a rise in the percentage that felt progress had been made in dealing with environmental problems. There *was* a rise in those who saw a great deal of progress, but the rise was a moderate one — from 14% in 1992 to 26% in 2000. An additional 64% believed that "only some progress" had been made as of April 2000. Moreover, 17% of the public continued to feel that environmental problems were extremely serious, 38% felt they were very serious and 39% felt they were somewhat serious. Only 5% believed they were not serious and only 1% had no opinion.

The poll found that 58% thought the U.S. government was doing too little about the environment while only 10% thought it was doing too much. However, this was a change from January 1992 when 68% thought the government was doing too little and only 4% thought it was doing too much.

The Gallup Poll of March 5-7, 2001 (PollingReport.com) asked the question: "Right now, you think the quality of the environment in the country as a whole is getting better or getting worse?" While 36% said it was getting better, 57% believed the environment was getting worse. Five percent said it was the same and 2% had no opinion. These views are inconsistent with some objective measures of improvement (see text box). They may especially reflect increased attention to and concern about global warming.

One question that is not answered by these polls is

Progress on Air Quality

The Environmental Protection Agency reports that U.S. emissions of carbon monoxide, sulfur dioxide, particulate matter, ozone and lead have declined significantly during the last two decades. Of the major air pollutants, only nitrogen oxides have increased absolutely and they have declined as a ratio to GDP. Additional progress has been made in other environmental areas and in other countries.

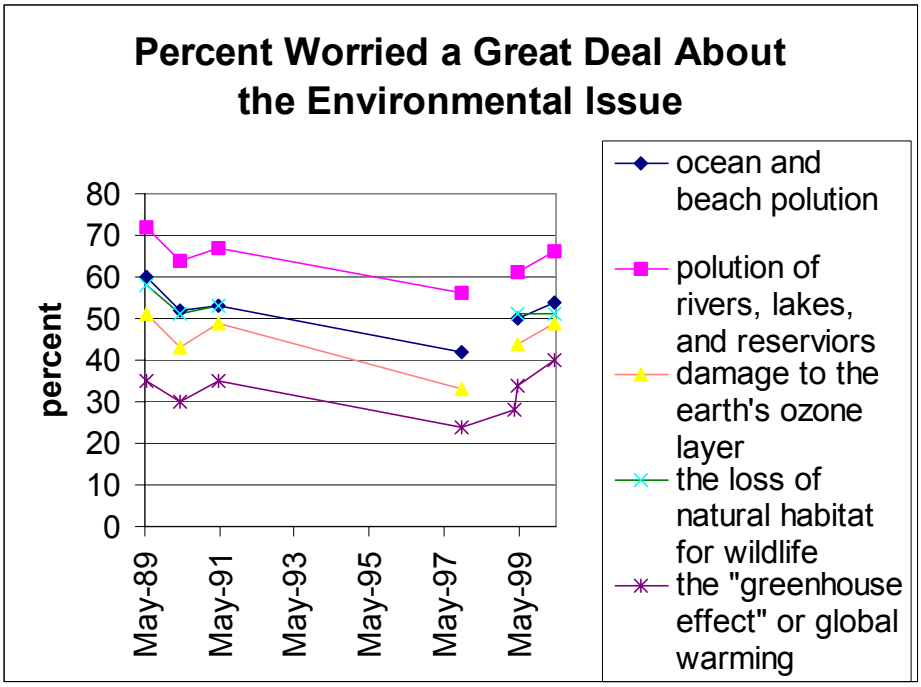
Source: U.S. President, *Economic Report of the President, 2002*, Chapter 6.

whether the public accepts the argument that large improvements in amount of pollutants *relative* to production represents a major success. A decline in the ratio of pollutants to output can occur even when economic growth is associated with stable or rising *total* amounts of pollution.

To the extent there was a trend in the strength of public attitudes toward the environment during the 1990s, it was one of somewhat reduced concern for many aspects that are of particular interest for NOAA's work.

Observations of changes over time are made possible by the Gallup Poll for the years 1989 through 2000 (Saad and Dunlap) are displayed in the accompanying figure. The data show:

> The percentage of people who worry a great deal about ocean and beach pollution declined from 60% in May 1989 to 42% in October 1997 and rose to 54% in April 2000. The percent who worry a great deal about pollution of rivers, lakes and reservoirs fell from 72% in may 1989 to 56% in October 1997 and rose to 66% in April 2000.
>
> A similar pattern is observed in worry about damage to the earth's ozone layer. Here the percentage who worry a great deal fell from 51% in may 1989 to 33% in October 1997 and rose to 49% in April 2000, in this case nearly reaching its earlier level. Concern for the loss of natural habitat or wildlife fell from 58% in May 1989 to 51% in April 1990 and remained at 51% in April 1990 and April 2000.
>
> The most notable exception is the percent that worry about the "greenhouse effect" or global warming. Here the concern fell from 35% in May 1989 to 24% in October 1997 but then rose, reaching 40% in April 2000, above its May 1989 level. There also was a rise in concern for the loss of tropical rainforests and pollution of drinking water. Questions about extinction of plant and animal species and about urban sprawl and loss of open spaces were first asked in April 2000.



The data show broad concern and not eco-phobia, exaggerated reactions to overall trends. But reactions to individual environmental events can be strong, especially at the local level. Such intense responses could arise with broader developments if the changes were extreme enough. For a while, however, sustained extreme reactions are unlikely in the broad population.

CONCERNS OF ENVIRONMENTALISTS

Environmentalists have been broadening the number of issues with which they deal, addressing issues at both local and international levels. Examples of issues receiving growing attention include the introduction of non-native species, potential effects of genetic intermixing, and the impacts of selective breeding and biotechnology on biodiversity, issues that arise with fish farms and in other contexts. There also are concerns about the movement of fish between fresh and sea water and the effects of climate change on fish.

Environmentalists have been trying to make more offshore areas into wilderness and to protect marine species, going beyond the "wise use" of conservation to more outright restriction and prohibition.

At the moment there is an emphasis largely on practical environmentalism, with more moderate groups tending to have the ear of government. Many environmentalists accept that as only a temporary situation and long for government leadership more supportive of their positions.

Environmentalists usually will lead broad public opinion on only a few issues, but they will have considerable direct influence on policy and occasionally will successfully promote a broad agenda when there are opportunities for fundamental political change.

The intensity of political pressures relating to climate change, including the strong feelings of some scientists and the resistance to unpopular evidence or opinions in parts the scientific community, mean NOAA will find it more important than ever to maintain scientific integrity in producing and characterizing results.

DIFFERING PERSPECTIVES BEHIND EFFORTS AT MANAGING THE ISSUES

Attitudes toward the environment and resource management vary greatly. This is most true for the issue of climate change for which there are intense disputes about the evidence and for which responses vary greatly around the world.

Many Europeans see the environment as a moral issue because of potential consequences for the fate of the planet. Some countries are particularly vulnerable to the elements. Some in developing and poor countries view resource use by developed countries as reducing their opportunities while others struggle to survive with little regard for resource use and the environment.

Some in Asian nations are irate at the U.S. and other developed countries for consumption patterns that they blame for the 2001-2002 Asian drought. Those who are antagonistic to the United States or wish to deflect attention from domestic issues can manipulate such views.

Long Lead Times Are Needed to Improve Environmental Outcomes

"There can be significant delays between human actions, including policy decisions, and associated impacts on the environment, specifically:

- Much of the environmental change that will occur over the next 30 years has already been set in motion by past and current actions.
- Many of the effects of environmentally relevant policies put into place over the next 30 years will not be apparent until long afterwards."

United Nations Environment Programme, *GEO 3*, p.395.

The United States has often had policies that sought to balance objectives of resource management and environmental health with economic development. The balance has been fostered by a more individualistic culture that relies heavily on markets. It also reflects understanding that in important circumstances technological change can reduce or overcome adverse environmental impacts. And internationally it reflects the view that income growth can allow more environmentally desirable consumption patterns in poorer countries.

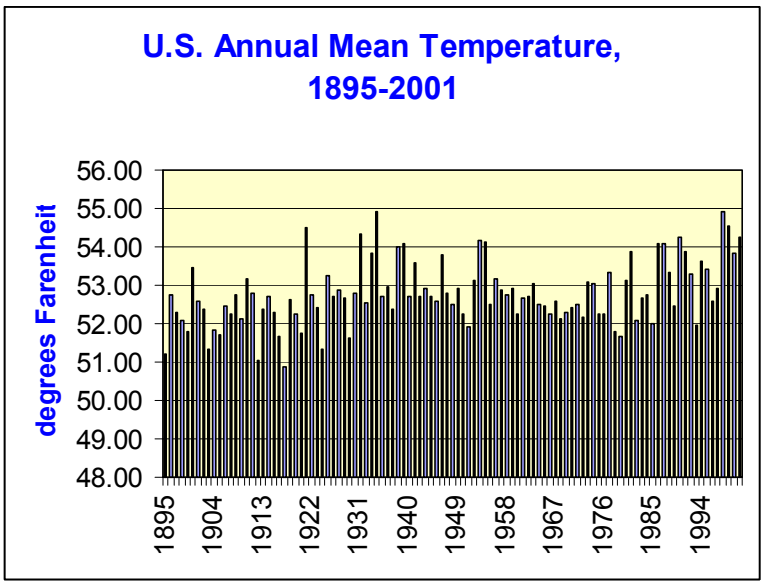
While interest in resource management and the environment has increased, these attitudes are not likely to change fundamentally in the next decade in the absence of major changes in the environment itself.

Differing views among nations will be a continuing source of tension in efforts to address issues. However, some convergence in positions can be expected as policy-makers look for ways to cooperate in dealing with a complex and growing agenda in an uncertain world.

Responses to resource issues have always been tempered by scientific uncertainty. Over the years studies have alternately predicted that the nation or the world was running out of resources or assured that sufficient resources would be available. Alarms were quelled by a sharp decline in commodity prices to levels that have persisted, but the debate has not ended.

An equally strong debate now rages over global warming. Dimensions of the debate include how much warming is occurring, the role of human activity and the importance of processes that could lead to cooling or greater warming in the future.

Scientific uncertainty will continue to make it easier for climate change issues to be politicized. That will intensify shifts in policy with elections and court rulings.



During the next decade, if major global warming problems appear likely to arise over time, and especially if some manifestations present themselves quickly, the pressures could cause the U.S. to begin to take strong action to protect populations. Scientific data will be in increasing demand to provide detailed understanding of effects of weather on localities, industries, and plant and animal life as a basis for decisions. There also will be interest in understanding and predicting the ways weather patterns affect the movement and impact of pollutants.

The ability to rely on science has been questioned based on uncertainties of knowledge and attitudes of the scientific community. The range and intensity of the scientific debate is evident in the research of Danish statistician Bjorn Lomborg and the reaction of scientists to his work.

Lomborg examines the basis of big environmental fears, including population explosion, running out of natural resources, species extinction, air and water pollution and global warming. In his December, 1991 book *The Skeptical Environmentalist: Measuring the Real State of the World*, Lomborg takes aim at ""the Litany of our ever deteriorating environment" and views of impending catastrophe.

After an extensive examination of the quantitative evidence, Lomborg (Chapter 1, p.4) concludes:

> "We are not running out of energy or natural resources. There will be more and more food per head of the world's population. Fewer and fewer people are starving. In 1900 we lived for an average of 30 years; today we live for 67. According to the UN we have reduced poverty more in the last 50 years that we did in the preceding 500, and it has been reduced in practically every country.
>
> Global warming, though its size and future projections are rather unrealistically pessimistic, is almost certainly taking place, but the typical cure of early and radical fossil fuel cutbacks is way worse than the original affliction, and moreover its total impact will not pose a devastating problem for our future. Nor will we lose 25-50 percent of all species in our lifetime - in fact we are losing probably 0.7 percent. Acid rain does not kill the forests, and the air and water around us are becoming less and less polluted.
>
> Mankind's lot has actually improved in terms of practically every measurable indicator.
>
> But note carefully what I am saying here: that by far the majority of indicators show that mankind's lot has vastly improved. This does not, however, mean that everything is good enough. The first statement refers to what the world looks like whereas the second refers to what it ought to look like."

The response of the scientific community to Lomborg's book has been vehement. An 11-page critique of leading environmental scientists was published in the January 2002 issues of *Scientific American* magazine.

While some discrepancies have been found in the book, others errors were made in the critiques. The attack focused as much on the weight of scientific opinion and the newcomer status of the author as on the scientific evidence. There was no interest in synthesis. (See http://www.lomborg.org/) Science has had equally notable reactions against revision in its long history and at times has been very been slow to adapt to new evidence.

As NOAA and other agencies seek to rely more on science to avoid biases in policy they will have to confront opinions that do not always take appropriate account of evidence. Leadership will be required to rely on the most critical evidence even when vocal scientific opinion lags or personal predilections influence conclusions of those who would be looked to for consensus. This has always been an issue in resource management, but its focus in the area of climate change and its importance for fisheries management are of particular concern to NOAA.

There is an equal emphasis on employing approaches to resource management that provide incentives and governance arrangements for parties to engage in more socially desirable behaviors. These approaches are being used more extensively in the United States but are slow to take hold elsewhere. Incentive approaches to resource management will be adopted less widely in nations that do not place as great a reliance on markets generally.

IMPLICATIONS OF CLIMATE CHANGE FOR NOAA

Concerns about global climate change will have far-reaching impacts on NOAA's policies, products and operations. Consequences are expected to include:

- Accelerating attention to ecosystem approaches that transcend previously segmented areas of measurement, research and prediction. For NOAA this includes:
  - More complete observation of oceans.
  - Integration of observations and analyses of behavior of oceans, atmosphere and land.
- Support for larger scale scientific approaches and major investments that address the concerns. This includes the extensive use of more types of and more powerful sensors on remotely operated vehicles, autonomous unmanned vehicles and satellites and investments in supercomputing.
- Increased demands for both observations and forecasts, including more measurement of climate change generally, water flow, air quality and space weather and more forecasts of societal consequences of observations and analysis.
- Greater pressure for NOAA to develop "products" that can assist in understanding the nature of the threats, facilitating research and planning by other organizations and providing support to the public policy process.
- More regional and local data and management, including much higher resolution weather data.
- Greater efforts at comprehensive improvement and coordination of ocean policy.
- Pressure for interagency cooperation to more effectively utilize resources and make better use of information.
- Improvements in international cooperation in addressing observed consequences of climate change.
- Continuing tension between approaches that emphasize science vs. those that emphasize precaution.
- Influences of government-wide efforts to reallocate research budgets related to climate change.

Concern over weather patterns will increase demand for weather and climate forecasts, coastal ocean and atmospheric observations and for efforts to protect coastal communities and prepare for evacuations. It will raise issues of changing patterns of species migration, including non-native species and threats to species. It also will generate greater interest in alternative energy sources, including those from the sea.

Over the next decade, advances in technology and further deployment of existing technology will make it possible for NOAA to provide a larger set of environmental data and to provide more continuous and high resolution data in all kinds of weather.

Air quality will be a growing effort within NOAA, involving collecting, analyzing and distributing information. Data will be collected on a growing number of subjects — such as CO_2, aerosols, nitrogen deposits and atmospheric density. Interest will be strengthened by changes in weather patterns and concerns about health.

Air quality initiatives will have to go beyond basic measurement to include measures that reflect impacts and analysis of interrelationships with weather patterns. For example, cities are much hotter than surrounding areas. How do “heat islands” affect the intensity of air quality problems? When heat from cities affects the weather of surrounding areas, how does that translate into movements of air of different qualities? How would the patterns change with further warming?

Integration of disciplines will be necessary for many information products. For example, NWS is a partner with the U.S. Department of Agriculture on a drought monitor that collects observations and integrates resolutions from 122 local weather offices over the Internet.

Climate change research will benefit from efforts to strengthen global observing, scientific infrastructure and computing.

Climate change research will become more well-rounded, integrating considerations of glaciers, atmospheric chemistry and ecosystems, and including a capacity for ecosystem forecasts that is independent of global warming. It will take some time before a full climate model of the U.S. can be developed.

Because of the focus in the scientific community on global warming, climate change research can be expected to give particular attention to ways in which warming impacts may be intensified, for example by causing oceans to hold less CO_2, contributing to further warming. Interest will be more heavily focused on mechanisms that can contribute to extremes of warming than on those that can modify a warming trend or produce cooling.

NOAA will have a crucial role in improving understanding of the mechanisms of change and how they combine to produce trends and variability. NOAA will increasingly be called on to predict the consequences of those changes, develop systems to measure consequences and gauge responses to them.

Possible Climatic Consequences of Higher Global Temperatures
Extreme weather events
Increase in frequency of heat waves; higher risk of summer droughts over continental areas at midlatitudes; more intense precipitation. (Likely to very likely)
Tropical storm intensity
Higher peak wind speeds and more intense precipitation in cyclones, hurricanes and typhoons. (Likely)
Patterns of precipitation
Increase in average global evaporation and precipitation, but with substantial regional variability.
Midlatitude storm intensity
Changes cannot be determined from current climate models.
Atlantic thermohaline circulation
Differences in water temperature and salinity produce the Gulf Stream and other currents that bring warm surface water to the North Atlantic. Without these currents, the climate in northern Europe would be significantly colder. Current climate models show that this circulation is likely to weaken over the next 100 years, but not enough to cause a negative net temperature change in Europe: the increase due to global warming exceeds the reduction due to changes in currents.
Decomposition of methane hydrates
Deep ocean sediments contain an enormous reservoir of methane in the form of frozen deposits called hydrates. If ocean temperatures warm enough to allow these deposits to thaw, there would be a dramatic increase in atmospheric greenhouse gas concentrations. However, recent studies indicate that the temperature changes expected from global warming over at least the next 100 years will be too small to trigger such an event.
Source: McKibben and Wilcoxen, p.113.

Demands for Services and Cooperation

MANY KINDS OF SERVICES AND ARRANGEMENTS

Greater demands for services will include:

- Providing information and analysis on weather and climate patterns
- Monitoring and research
- Interagency demands and cooperation
- International information and cooperation
- Educating the public and disseminating scientific information and models

Growing interagency and international demands will include those related to:

- Military, missile defense, domestic security, origins and spread of contamination
- Economic development, relief efforts
- Disputes over use of the oceans, delineating boundaries of the outer continental shelf, charting passageways for navigation, global developments in fish stocks and other marine life

Major gaps will continue to exist between the state of scientific knowledge and the degree of knowledge necessary to make policy. NOAA will be called upon to develop more research and information that is policy-relevant.

Demand for more kinds of and better environmental information will in part be driven by the heightened concern of the large and politically important baby boom generation for matters of health and safety. Another motivating factor is the general rise in demand for comforts and aesthetics with greater affluence.

The importance of water issues and associated political/military repercussions and the interplay of water with land and atmosphere imply a need for increased attention to hydrologic measurement and analysis.

Many demands come from the needs of specific industries such as energy and insurance. The telecommunications industry could become a large consumer of NOAA information in the future, with solar storms and other phenomena having a great influence and with wireless communication growing rapidly.

NOAA increasingly will be providing climate and environmental information for regional and local areas. NOAA may play any number of roles in processes to develop operational forecasts, directly providing information, working with universities, regional consortia and private firms and/or serving as a catalyst for local efforts. In any of these roles, NOAA will be central to the development and operation of a regional system.

Information-sharing will tempered somewhat by security considerations. However, in some instances there will be greater sharing between agencies and between government and other entities or internationally to facilitate coordination in a world concerned about its future ability to "connect the dots."

Sen. Kerry has noted that NOAA is the fourth largest source of federal regulatory actions. As issues of ocean policy and climate change increase in importance NOAA may become more involved in regulation in addition to its role in providing information and analyses that support regulation.

Universities and research centers will contribute to NOAA's goals by supplying talent and tools for analysis. These and private companies will help NOAA with access to advanced technology and, by funding their own operations, will provide some of the capital needed to modernize the overall network.

The private sector will expand in meeting the demands of industry and consumers for tailored products and distribution, drawing heavily on NOAA's databases and research.

The White House calculates that the research budget aimed at understanding big issues related to climate change, including energy and other issues, is $4 billion. An effort is underway to reallocate some of that budget to place more emphasis on taking action. NOAA has always been an applied science agency. That protects it from cutbacks aimed at a shift from basic to applied research. So does its emphasis on products.

However, it is possible that NOAA will later face both a stringent budget environment and also major shifts of R&D toward investments such as solar power and expensive new types of energy facilities that recycle greenhouse gases. Such activities could divert funds from more basic research. One response to such a situation would be for NOAA to provide measurement, analysis and prediction of the impacts of large-scale use of the new technologies.

INCREASING TECHNOLOGICAL SOPHISTICATION AND EXPECTATIONS OF CONSUMERS

The U.S. has a more educated population, not only with formal education but also through a wide range of media and interactions that permit a wealth of lifetime learning.

The large baby boom generation has grown up with information technology, learning it as it evolved.

Younger generations take technology for granted. They learn it at an early age and are comfortable with it.

The Internet has raised expectations that information can be obtained instantly and in convenient form.

Consumers of information have come to expect instant access and easy manipulation, often with capabilities for visualization, requiring such features as photos, full motion video, animation and streaming media. There is growing demand for pre-selection and automatic notification.

At the same time as expectations have risen, people have become impatient. TV and movie scenes changing frequently, people change channels often and they do not wait long for Web sites that are slow to load or inconvenient to navigate.

Impatience rises both because of changes in customer behavior and because of a changing mix of customers. For oceanographic information there is a movement away from traditional academic users whose needs are not time-sensitive.

NOAA must increasingly accommodate the desire for rapid selection and automatic distribution of information in appealing forms, whether provided directly to end-users or through intermediaries.

Another consequence of the use of technology is "swarming" or surges in demand from many participants. In the formulation of Howard Reingold, "smart mobs" linked by high-tech communications devices act in concert to rapidly move to the same activities or destinations. *The implication of swarming for NOAA is that it is necessary to be ready for very high levels of peak demand.*

CHANGES IN MILITARY STRUCTURE AND FORCE POSTURE

The U.S. military is in early stages of a far-reaching transformation to meet new challenges and utilize modern technology. As Secretary Rumsfeld stated:

> "Our challenge in the twenty-first century is to defend our cities, friends, allies, and deployed forces — as well as our space assets and computer networks — from new forms of attack, while projecting force over long distances to fight new adversaries. This will require rapidly deployable, fully integrated joint forces, capable of reaching distant theaters quickly and working with our air and sea forces to strike adversaries swiftly and with devastating effect. This will also take improved intelligence, long-range precision strike capabilities, and sea-based platforms to help counter the "access denial" capabilities of adversaries….
>
> As we change investment priorities, we must begin shifting the balance in our arsenal between manned and unmanned capabilities, between short- and long-range systems, between stealthy and non-stealthy systems, between shooters and sensors, and between vulnerable and hardened systems. And we must make the leap into the information age, which is the critical foundation of all our transformation efforts."
>
> Donald H. Rumsfeld, pp.28 and 29

The changes will include extensive automation and reliance on information technology to observe and guide, and increased military use of space. Some have raised questions about a new arms race, including an arms race in space (Hitt).

NOAA will collaborate more with the military in development of space and ocean capabilities, engaging in more joint efforts and situations where the military is the customer. It will sometimes compete with the military for resources or control of programs and more often couch requests in national security terms. Its measurement efforts will go beyond support for military operations to include assessment of environmental and commercial impacts of war.

TERRORISM, DISASTER PREPAREDNESS AND RESPONSE

Disaster Preparedness and Response

The possibility exists of one or more major catastrophes at one time, resulting from:

- Terrorism or military actions
- Industrial or military accidents
- Natural disasters

Terrorism is of particular concern because deliberate actions could be designed to magnify the impact of an attack. Magnification can come not only because of public fears and reaction but also because attacks themselves could have spreading impacts. For example, detonation of an energy facility near a nuclear facility could do massive damage if it were located close to explosives, polluting matter, strategic facilities or a major city. Terrorism aimed at the industrial base could take new forms, for example damaging oil pipelines to create environmental contamination as well as disrupt energy supplies, or the introduction of aquatic diseases or invasive species. Imagination and boldness have been a hallmark of recent terrorist incidents.

Disasters associated with climate change are of high concern because climate can affect wide areas in numerous and powerful ways, and both a trend and more erratic climate can cause massive and unpredictable change.

NOAA could face increased demands for services and play an expanded advisory role in disaster prevention and response. NOAA's skills in assisting with oil spills and marine disasters, monitoring weather, overseeing habitats, researching conditions and disseminating information could contribute to a broad program of preparedness.

NOAA could bring to bear information, research and analytic capabilities to assess how spread of contamination or airborne diseases would be affected by weather and ocean conditions. Valuable contributions can be made by predicting or tracking effects of winds or currents in distributing harmful substances or organisms.

Nuclear contamination would create particularly challenging, far-reaching and long-term challenges. It would require extensive interagency and potentially international coordination.

NOAA's skills can assist in locating the sources or origins of some contaminants as well as their impacts.

War on Terrorism

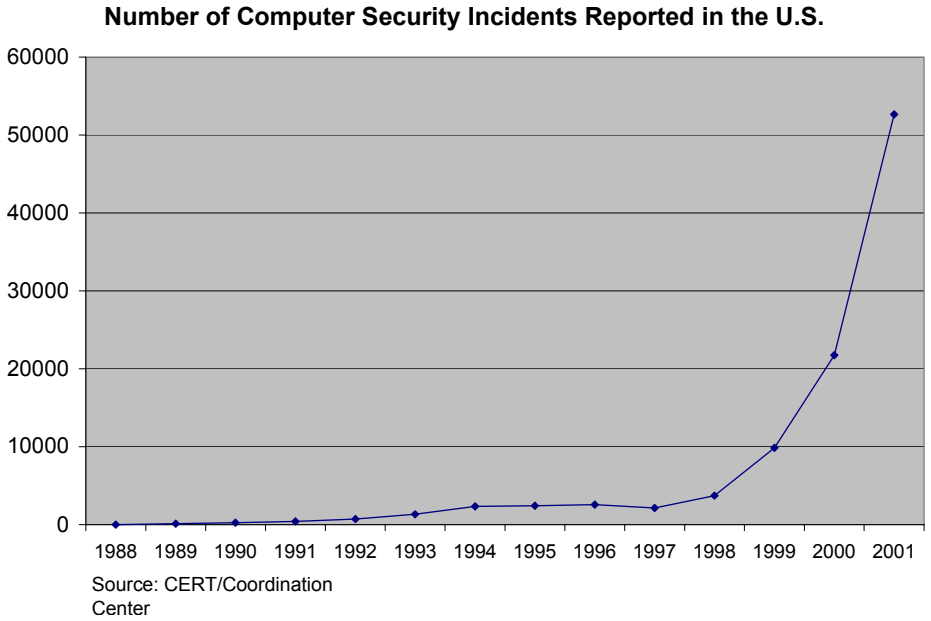
The war on terrorism has three components:

- Military actions.
- Tracking and foiling terrorists domestically and internationally.
- Homeland security.

Its consequences include:

- Demands for information.
- Increased role of the military.
- A catalyst producing accelerated changes in military strategy, force posture and departmental structure.
- Possible impetus to missile defense.
- Direct NOAA responsibilities (including protecting its own people, facilities and systems).
- Pressures for increased interagency cooperation.
- Increased public-private cooperation.
- Screening of release of government-generated information.
- Increased government influence on telecommunications, immigration and financial services.
- Lessening of anti-globalization activities that may be seen by the public as adding to disorder.

Increased demands for information to support military and homeland defense could lead to patriotic and security-motivated demands for greater U.S. self-sufficiency in data collection.



The role of the military in domestically has been expanded under the Northern Command that begins operations October 1, 2002 and further expansion is under consideration. Responsibilities include guarding the waters up to 500 miles off the coast and responding to major terrorist attacks, unifying several existing military domestic security activities. The Northern Command's s*urveillance functions and military responses to terrorism and natural disasters will have to be coordinated with NOAA and many other nonmilitary agencies.*

NOAA could face more difficult choices between drawing further on resources of the private sector to extend its and the nation's capabilities vs. trying to do more on its own for tighter security.

The extent and duration of changes associated with the war on terrorism will depend on the severity and persistence, both of developments and of national resolve. At the very least the war on terrorism will be an important catalyst for longer-term change.

WARS AFFECTING POPULATION MOVEMENTS AND ENVIRONMENTAL CONDITIONS

Wars have dislocated millions of people, causing desperation and overcrowding left hazards from dangerous materials, unexploded bombs and land mines, destroyed habitats, polluted waterways and spread disease.

Problems have been associated not only with major power actions such as the U.S. intervention in Afghanistan, but also with civil wars, wars between smaller nations and with an increasing number of regional wars in which migration occurs among several countries.

Stepped up U.S. efforts against terrorists and states with weapons of mass destruction are likely to involve even more population dislocations.

NOAA has had increasing calls for information about other countries to help other Federal agencies and international organizations in relief efforts. NOAA is asked to provide its full range of data and services, including weather and climate, ocean and atmospheric observations, analysis and dissemination of information and support in rescue efforts. Greater demands from other agencies and requests for information that is increasingly international can be expected.

Economic and Business Trends

ECONOMIC TRENDS

Delayed Recovery in Private Investment

The bust in capital spending after the boom in the late 1990s and the beginning of the new decade left industry with excess capacity and weakened many leading technology companies. The greatest impacts occurred in the satellite and telecommunications industries.

Adjustment and recovery from the intense pressures will take several years. Full recovery can be expected in a 5-10 year time frame, although a return to boom levels cannot be assumed. In the meantime it will be harder for NOAA to rely on the private sector for investment and technology in satellites. There also may be slower introduction of some communications technology since introduction often comes as part of new capital investment. However, slowing of the introduction of technology will be selective and temporary.

The New Economy and the Dis-Economy

The New Economy

During the second half of the 1990s U.S. productivity growth accelerated amid rapid technological change. The greatest productivity advances occurred in the production of capital goods, particularly in the equipment at the heart of the information revolution.

Many observers were late in recognizing the new economy. Then the euphoria of the late 1990s led to widespread assertions of a new economy in the U.S. in which rapid advances in productivity would continue to be generated by new technologies, supportive government policies and the growth of global markets.

The extended economic slowdown, bear market in stocks, telecommunications implosion and collapse of many dotcoms, along with effects of September 11, 2001 raised serious questions about how quickly and fully the U.S. and global economies would recover and whether any resumption of rapid growth could persist. However, there are strong underlying positive factors.

The “new economy”, although tempered, remains very much alive. It is morphing into a more traditional high growth period that, when it arrives, will be more sustainable and stable.

Support for a modified “new economy” paradigm comes most significantly from the continued introduction of new technologies and products at an unusually rapid pace, including an unusual number of breakthrough technologies, despite the sharp decline in capital spending.

- Spread of rapid technological advance beyond information technology to include biotechnology, materials technology and convergence among technologies.
- Global spread of technology.
- More sustainable approaches to use of the Internet, capital investment and financing.

- Increased evidence that recent technologies are associated with substantial productivity gains in both goods and service-producing industries.

Economic growth and productivity are not expected to maintain the pace of the boom years. However, new economy influences of rapid technological change, intense competition and opening of global markets will bring significantly higher growth during the coming decade. Sustainable U.S. productivity is expected to be higher by about 1% per year than in the two decades prior to the mid-1990s acceleration, nearly double the earlier rate.

It is reasonable to base decisions on the assumption that U.S. long-term economic growth will be significantly greater than the average for the last couple of decades but will not reach the level of the late 1990s on a sustained basis. Technological change could be rapid or even accelerating without necessarily producing an actual acceleration in GDP growth because of difficulties in absorbing new technologies and adapting socially and economically to change. (There also could be acceleration in GDP growth beyond what is reflected in our measurements).

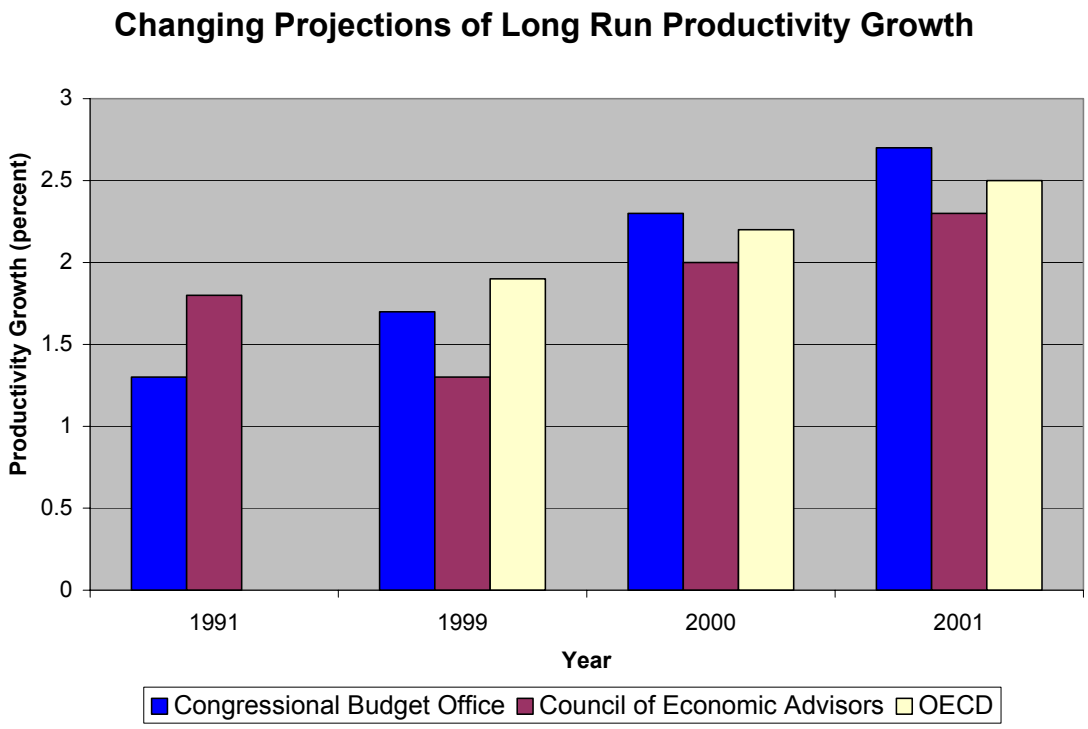
New economy influences have been evident in Europe and indeed on global scale with the growth of the Internet, telecommunications services at a host of other technologies and applications. While many countries have to go through further difficult adjustments and some have yet to begin recovery from serious difficulties, the most likely prospect for the decade is that new economy influences will be pervasive throughout both the industrialized and developing world.

Implications of sustained rapid technological change and renewal for business and the economy include:

- A need for government to become more business-like — to be decisive, focused on products, performance and customers and open to many ways of getting things done.
- A need to rely heavily on resources, capabilities and the diversity of sources in the private sector to respond effectively to rapidly changing prospects and opportunities.
- A greater need for open markets with appropriate oversight.
- More competition among technology standards so as not to prematurely lock in one standard while others that may be superior need some time to develop.
- Intense competition and a shorter half-life of monopolies.
- Many big winners and big losers among prominent companies.

Gains from the new economy will be associated with:

- Creation of new markets, uses, customers and associations among individuals and groups through widespread use of both general and specialized information and communications systems.
- Growth of markets and demands for information through rising incomes.
- More rapid obsolescence of technology, but also more opportunities to introduce new technology rapidly as heavy investments are made to support growth.
- Expanded opportunities for scientific cooperation.
- Increased pressure on the environment if the global economy grows more rapidly, but also greater knowledge and technological opportunities for solutions.
- Improved government budget positions.
- More rapid deployment of high bandwidth but also greater increases in demand.
- More rapid recovery of the private satellite industry.



New economy influences can profoundly affect the nature of business and society because technology and increases in income and market size alter the ways things are done and the kinds of activities that are carried out. That will affect the nature of NOAA's customer relationships as well as the demands placed on it. For example, in a high growth scenario NOAA might soon provide a larger share of its weather and climate information to a very small number of high tech sophisticated intermediaries or to conglomerates enhancing and distributing information on a range of subjects from a number of government agencies.

The Dis-Economy

> "Anyone who has bet against America in the last 250 years has lost."
>
> Warren Buffet

We use the term "dis-economy" to refer to a series of recent and emerging developments that collectively exert a significant drag on the economy. The dis-economy operates at the same time as the new economy. It does not overshadow the new economy, but the net effect of the two forces is significantly less economic growth than would be possible if the new economy influences more fully dominated. Adverse effects are greater in the early portion of the next ten years. Many adjustments will lessen the adverse effects over time.

Elements of the dis-economy include:

- High costs and impediments associated with terrorism and anti-terrorist measures, including slowdowns in transportation, gaps in property and casualty insurance coverage and effects of a security-oriented environment on risk-taking.

  The Council of Economic Advisors estimates that of the President's $38 billion budget request for FY 2003, $24 billion will come from reduced consumption and $14 billion from reduced private

sector investment. The Council also predicted that the $55 billion that business spent per year on security before the September 11 attacks could increase by 50%-100%. (Office of Homeland Security July 2002 National Strategy)

- The crisis of confidence in business ethics and its manifestations, including cautious behavior on the part of some companies, increased risk premiums in financial markets, and weakening of the stock market, which in turn adversely affects consumer spending, lending by financial institutions and business investment and risk-taking.

- Shortages of electric generating capacity, inadequate transmission lines and connections between regional grids, shortages of natural gas pipelines, shortages of refinery capacity, difficulties with aging equipment and delays in correcting many problems.

- The emergence of large budget deficits at the federal level and in state and local governments.

- The expansion of interference in the information economy, including the growth of highly-destructive viruses, hacker attacks and the time-consuming explosion of spam and the possible lessening of smooth functioning of systems and ability for interaction introduced by some efforts to deal with the problems.

- The new regulation: an added layer of regulation in corporate governance, homeland security and other areas — at the same time as further rationalization of some regulation — affecting a wide range of industries and activities by adding costs and impediments.

- Increases in litigation, adding costs and uncertainty, distracting business leaders and overwhelming some companies.

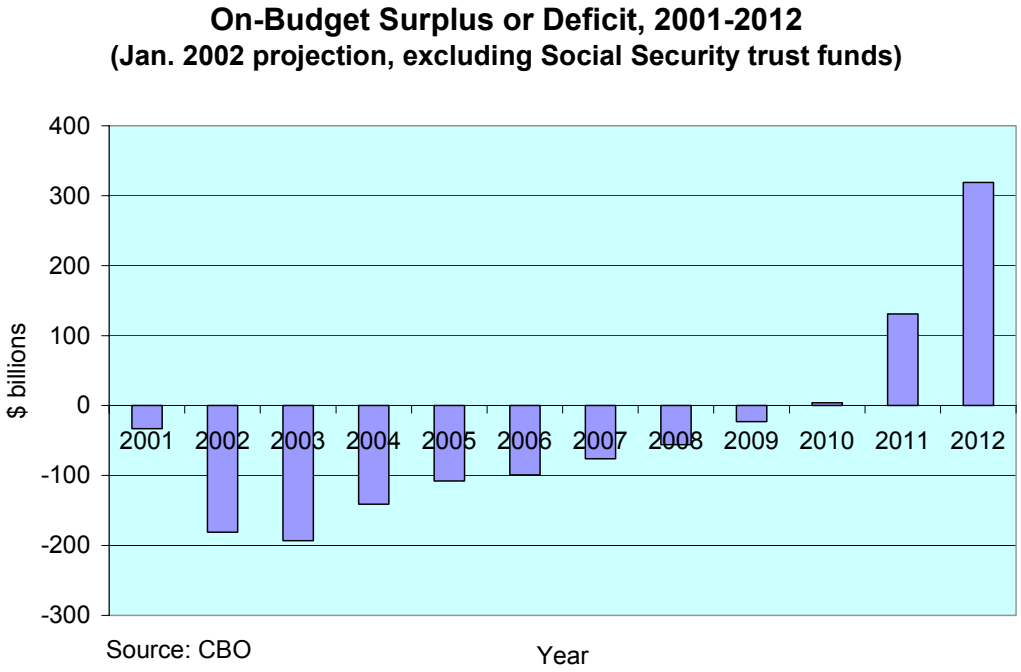
- Possible adverse economic effects of higher energy prices with future political and military developments.

Some of these impacts may be highly concentrated in the next couple of years but many forces will be relatively long-lasting. Adjustments will lessen adverse effects over time but new impediments and disruptions from war can arise.

Budget Consequences of the New Economic and Security Environment

The Federal budget has undergone rapid shifts as a result of:

- Revenue from booms in the economy and the stock market.
- The stock market correction and the economic slowdown. Costs of dealing with terrorism and its security and economic consequences.



Estimates of a large continuing surplus depend on counting temporary surpluses in Social Security and other trust funds. Yet these surpluses are grossly inadequate to meet future obligation of those programs. An ongoing surplus excluding social insurance trust funds is not credible after the large pre-9-11 tax cuts, the new strains on the budget and the demonstrated propensities to spend even an illusory surplus. Much of the growth in revenue during the late 1990s was in taxation of capital gains. Much of those gains have evaporated, reducing future revenue from capital gains realizations.

NOAA will face a budget environment that is increasingly tight. Issues of NOAA's role could be more prominent as agencies compete for limited funds and government is reorganized. Overall budget stringency will require particularly effective efforts to justify expenditures. Where possible, that will entail tying expenditures to priority objectives like national security and homeland defense. It also will require making clear that activities are appropriate NOAA roles or joint roles in which NOAA is a significant participant. It will be particularly necessary to demonstrate the benefits to the nation and to do so quantitatively wherever possible.

A tight budget environment could put pressure on NOAA to contract more with the private sector, especially if there are potential costs savings and/or if that is a way to get adequate capital investment and keep up with technology.

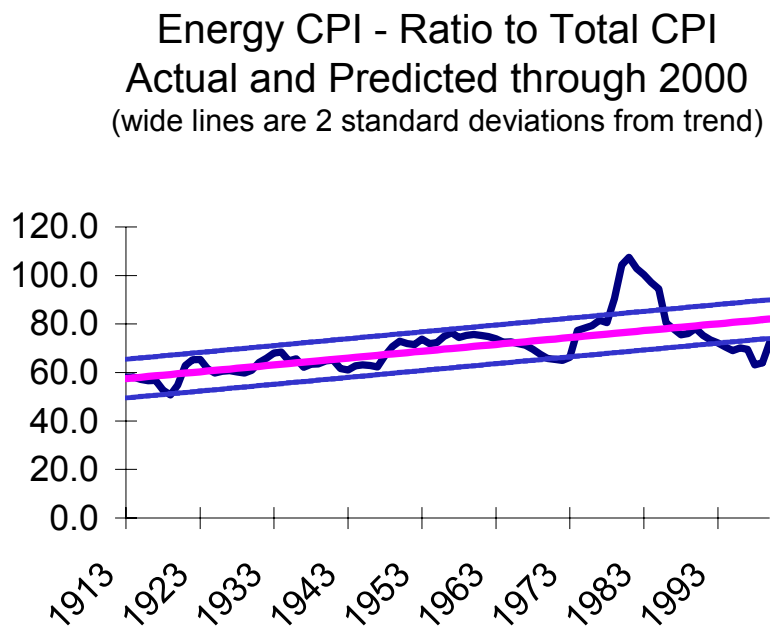
Energy

Energy is important for many reasons:

- Prices affect demand for weather and climate information.
- Technology and prices increase deep ocean development.
- International development can engender negotiations over rights and boundaries and environmental impacts.
- Energy can be at the center of tensions that lead to wars, with attendant demands for information.

- Technologies developed for energy exploration and development, such as remotely operated vehicles, could be useful for NOAA activities.
- Efforts to induce movement away from reliance on fossil fuels can change the nature and location of energy development or lead to reduced maintenance or abandonment of facilities, with resulting environmental impacts.
- Technology and prices could eventually lead to large-scale development of undersea methane hydrates.

The energy crisis of the1970s and early1980s was facilitated by decades of strong global economic growth and a ten-year war between Iran and Iraq that reduced energy supplies. The U.S. again has high levels of dependence on imported energy that makes it more vulnerable. Even a return to the middle of the historic range of oil prices would be a substantial change. Fluctuations in oil prices can be many times greater than in the overall energy prices that are shown in the graph.



Technological efficiencies and other factors could cause energy prices to stay low. However, history suggests that prices could be raised by high rates of economic growth, especially in developing countries that are less fuel efficient and more concentrated in goods production, along with environmental restrictions on production and great political instability in some resource-rich areas.

While energy prices fell precipitously in the global economic slowdown and aftermath of September 11, 2001, past extreme cyclical declines have been followed by a return to more typical prices within a couple of years. However, low prices reduce investment in exploration and construction of new facilities. Rebuilding to meet returned demand takes many years and prices are more vulnerable to increases in the meantime.

The long-term trend is for growth in energy prices above the general cost of living and for large spikes that can last for many years. While there is no reason to expect a future energy crisis to be a repeat of the last crisis, adverse forces can exert themselves in a number of ways. Military and political developments in Central Asia and the Middle East stand out as the key threats.

Some Scenarios for a Large Rise in Energy Prices

- War or terrorism that damaged oil and gas fields and/or disrupted energy transportation.
- Greater OPEC cohesiveness with a rise in Muslim fundamentalism or antagonism toward the West.
- Overthrow of Saudi Arabia by groups hostile to the U.S. and unconcerned about or profiting from effects on revenue.

Added production and new technologies would not fill the gap in time to prevent a crisis. A major upward move in world energy prices, even well above the historical range shown in the chart, could occur during the next 10 years.

Prices also could be increased by environmental and other domestic restrictions on building oil refinery capacity, natural gas pipelines and electricity transmission facilities and power grid connections.

A large rise in energy prices would raise demand for weather and climate services from power producers and distributors and from industrial and commercial energy customers interested in managing supplies, buying before price increases, locking in prices in contracts, and hedging and trading on energy markets.

Technologies are creating opportunities for development of resources and uses of energy that were hitherto impossible. While environmental considerations are limiting some development and contributing to higher energy prices, some also are inducing innovation.

Advances in technology have been impressive and will continue to evolve and be deployed rapidly to take advantage of modern information and materials technology:

- Offshore oil wells can be drilled to 10,000 feet at a cost of $100 million.
- Drilling can be done from ships with computers that keep it stable.
- Nearly 500 remotely operated vehicles are in use worldwide to assist in exploration and in construction to depths of more than 6,000 feet. Many are equipped with video cameras, multifunctional manipulators, scanning sonar, probes and sensors.
- Horizontal drilling can be extended for six miles beneath the sea.
- Bringing together the output of several wells can now be done on the ocean floor.
- Seismic and drilling advances have dramatically reduced finding costs for oil and gas.

The potential environmental benefits of using advanced oil and gas technology are becoming recognized (U.S. Department of Energy, 1999).

Natural gas will continue to increase in importance relative to oil in the U.S. and Europe.

The long-term expansion of energy production with economic growth, higher prices and advances in technology, along with concerns for energy security, will spur development of and transportation for:

- Increased use of natural gas
- Fossil fuels from new areas around the world
- Fuels from deeper and less accessible land and ocean areas
- Unconventional sources of fossil fuels such as methane hydrate
- Other sources of energy - solar, wind, etc.
- More efficient use of energy - fuel cells, hybrid cars, use of waste heat, etc.

Expanded energy development raises many issues for NOAA.

- *Understanding what information the energy industry will demand and in what forms.*
- *Assessing how deep-ocean development will affect the environment and the roles NOAA will have in promoting clean development and protecting habitats.*
- *Considering whether NOAA will be called upon to do more to respond to mishaps.*
  For example, aging of natural gas pipelines, especially of smaller and older systems creates vulnerabilities that could produce some serious environmental problems and lead to strong public reaction.
- *Determining how NOAA can address the increasingly international nature of large-scale exploration and development through services, oversight and cooperative actions.*

A sizeable shift away from the use of fossil fuels is not expected in the U.S. of globally during the next 5-10 years. It will take a long time to develop infrastructure to support fuel cell vehicles, electric cars, solar heating or other innovations. While important advance can be expected, they will not quickly reach the critical mass needed to gain widespread adoption in the marketplace.

Uses of the Oceans

Despite decades-old suggestions for undersea mining, tourism and human habitats, wave power and other uses of the oceans, development has been limited until recently. Growth is now being fostered by technologies for deep-sea oil and gas recovery, by interest in new sources of energy and by interest in a wider array of minerals of potential commercial value. New technologies such as unmanned Slocum Gliders and improved sensors can be expected to expand opportunities for exploration and monitoring as well.

The Methane Hydrates Research and Development Act of 2000 provided assistance for research through a program that is jointly controlled by the Department of Energy, the U.S. Geological Survey and the National Science Foundation. India, Japan and Canada have serious efforts underway to develop marine hydrates as an energy source.

At the most recent meeting of the International Seabed Authority, an organization established under the United Nations Convention on the Law of the Sea, the Legal and Technical Commission and the Council began considering regulations to govern prospecting and exploration for cobalt crusts and polymetallic sulfides. One request leading up to the deliberations came from the Russian Federation (Compass Publications, p.A9).

Renewed interest raises complex issues of international law and diplomacy as competing claims arise. For example:

> Russia recently submitted a claim to the Commission on the Limits of the Continental Shelf to define the outer limit of its continental shelf beyond 200 nautical miles; Russian officials said the claim would give the country sovereign rights over an additional 1.2 million square kilometers with an estimated 4.9 billion tons of hydrocarbon reserves.
>
> The overlapping claims of seven nations for energy resources in the South China Sea and their potential for leading to armed conflict are well known.

The United States can expect to be drawn into an increasing number of boundary and jurisdictional issues relating to uses of the oceans over the next decade. Increased military activity also will require more and better information. NOAA will be asked to provide detailed information that can be used to delineate boundaries and chart passageways.

BUSINESS TRENDS

Understanding business trends can help NOAA meet demands for services, interface with evolving types of business organizations and learn from developments in the private sector that may help it to improve its own effectiveness.

The Structure of Business

Patterns of Consolidation

Business has undergone long-term consolidation as firms reached from local to regional, national and global markets. Consolidation has been fostered by economies in marketing and finance as well as by scale advantages in production and distribution. In recent decades antitrust policy has been relatively weak in recognition that competition can occur more easily that in the past across dispersed geographic areas.

Mergers and acquisitions traditionally have been much more frequent during periods of stock market boom. The boom that let up to the 1987 peak was soon followed by the rapid rise of stock prices that extended to 2000. The result was an exceptionally long period during which a high level of consolidation took place.

Rapid growth of new firms and industries came with great structural change and emergence of new technologies. Creation of new firms and new winners slows the growth of concentration of business even while a high level of M&A is taking place. However, before long a shakeout occurs among the newcomers and many that survive are combined or are taken over by predecessor firms. Shakeouts intensify during periods of economic slowdown. Greater concentration in the new industries and activities even comes while overall consolidation may be slowing.

Concentration can rise again when growth resumes. A long period of high economic growth tends to be associated with the emergence of big winners that adopt the techniques of the earlier start-ups.

The consolidation of recent decades has taken on a particular character. During the 1960s there was a huge wave of conglomerate mergers in which many companies entered unrelated businesses. Over-extension proved to be a weakness and in the slowdown that followed in the 1970s many firms rushed to divest themselves of unfamiliar businesses that were losing money. Unwinding of the conglomerate mergers of the 1960s continued well into the 1980s.

In recent years companies have been very careful to expand only into closely related businesses. Of the few that continued to remain broadly diversified, most encountered difficulties. Even in new industries, combinations have been very selective. Companies increasingly emphasize focusing on "core competencies" or "sticking to their knitting."

In this environment of selective expansion, companies have both less horizontal integration — owning businesses at the same stage of production or distribution and less vertical integration — owning businesses at other stages of production.

This model of sticking to closely related businesses can be expected to continue because it is grounded in modern portfolio theory. That theory sees advantages to having the investor decide how to diversify a portfolio by choosing the mix of companies rather than relying on the packages of businesses determined by managers of companies that choose to diversify. That theory doesn't give any credence to managers'

ability to find profitable synergies with companies outside their immediate spheres.

Major deviation from this pattern could come with irrationalities of a merger-intensive speculative boom, much more mature stages of technology along with slower growth, or substantially greater opportunities for monopolistic profits.

With consolidation proceeding selectively, even though there are fewer firms, NOAA and government organizations dealing with private sector contractors and customers will find themselves having to relate to more specialized firms organized around particular technologies and markets than in a less selectively structured environment.

Increasingly specialized technology and rapid innovation strengthen the position of specialized firms. Specialization is facilitated by the ability of firms pursuing niches in which they have core expertise to link with other firms that have complementary capabilities, combining into effective systems for production and delivery.

Major Business Trends

The public sector has traditionally operated without the same degree of pressure that markets put on private sector organizations. Many efforts are under way in the federal government to apply modern management principles, employ the latest technology and improve contracting and distribution. However, without the same degree of threats to organizational survival, they have typically not reached the same depth and intensity as efforts in the private sector.

The same kinds of forces that have caused many government organizations to lag behind the private sector in utilization of information technology have become imposing barriers when large-scale changes in business processes are being introduced.

NOAA is interested in business trends to understand its customers and partners. Moreover, many of these trends reflect adaptations to the marketplace. As NOAA seeks to be more responsive to its own markets and customers it will consider which trends suggest directions that might be appropriate for NOAA's strategies and operations.

Major business trends include:

- Focusing on customers
- Focusing on core/strategic businesses
- New emphases in product development and distribution
- Consolidation/restructuring
- Strategic alliances
- Globalization

Their features are:

<u>Focusing on Customers</u>

Market orientation
Customer service orientation
Mass customization
Branding

Focusing on Core/Strategic Businesses

Concentrating on businesses in which the organization is/can be first or second in market share
Focusing on core competencies
Seeking to be low cost producer
Limiting the organization to activities that are closely related in production or distribution even within an industry of concentration
Spinning off or selling less strategic businesses or activities
Outsourcing less strategic functions

New Emphases in Product Development and Distribution

Short product cycles
Seeking technological leadership
Growth of information services, including both electronic and professional services
E-commerce — electronic purchase and distribution, sometimes integrated with production of the service

Consolidation/Restructuring

Merging with or acquiring less efficient units or those needing much more scale to create major players
Displacing weaker competitors
"Right-sizing"

Strategic Alliances

Supply chains
Marketing and distribution
Integrated products

Globalization

International sales
Overseas distribution
Overseas production

Managing Change

In 1954 Kurt Vonnegut, Jr. wrote a book with the title *Player Piano* in which an automated economy was run by computer engineers and managers. Everyone who was not needed in those roles was either in the army or the Reconstruction and Reclamation Corps, popularly know as the “reeks and wrecks.” While fictional, his view turned out to be surprisingly prescient. As a social commentary he didn’t address how automation would modernize the service industries as well as manufacturing and create jobs.

Advances in technology have led to widespread understanding of the importance of responding rapidly to technological opportunities and market and competitive conditions. Reshaping the organization so it is able to adapt and respond has become an imperative for survival as well as success.

"The speed of technological change also means you have to toss out the financing strategies, the learning curves and the obsolescence rates that are second nature to you. In their place, you need

to build a culture in which you expect to make mistakes, learn from those mistakes, and quickly apply everything you learn....

I like to say that when the pace of change outside the organization becomes greater than the pace of change inside the organization, the end is near."

John R. Walter, when Chairman of R.R. Donnelley & Sons

Over the years there have been many formulations of strategic and management models for improving business capabilities and strategic effectiveness. Approaches range from those dealing with individual units to those concerned with cross-organizational integration, to those involving relationships of the organization to its external environment and business networks. They include the 20 in the text box.

20 "Business Solutions"

Business process re-engineering
Change management
Work flow management
Enterprise resource management
Quality circles
Teams/group work
Total quality management
Continuous quality improvement
Six sigma
Customer relationship management
Lean manufacturing
Downsizing/ Right sizing
Vision
Core competencies
First mover advantage
Time to market
Just-in-time inventory management
E-learning
Outsourcing
Supply chain management

Richard Mahoney and Joseph McCue examined 50 business strategy and management big ideas of recent decades grouped into six categories:

- Corporate strategy
- Resource Allocation
- Cost and quality improvement
- Financial Engineering
- Business unit strategy
- Employee motivation and evaluation

The note that "Most of the 'Big Ideas' are really tools or processes to **carry out** strategy rather than developers of strategy." (p.3) They also point out that "Many 'Big Ideas' were intellectually interesting, but fell from the weight of bureaucratic scorekeeping." (p.2)

Emphases and labels change, and some objectives are timeless. What is changing is the growing emphasis on responding to market pressures and to technology through physical, organizational and human resource decisions.

The human equation has been profoundly influenced by technology. During the boom years of the late 1990s, too many companies acted in a hurry, throwing people into situations without training, letting them sink or swim. With the general coming down to earth, emphasis is on more sustainable human resource management which recognizes the value of company-specific training that complements more widely applicable technical skills training that may be obtained in or out of the organization.

There has always been an issue of how to deal with the need for managers with both technical and management skills. Traditionally, companies have responded by drawing on a mix of people with technical and managerial backgrounds and letting them interact with each other. *With technology more complex, the balance has been shifting toward greater reliance on technical staff for management. This approach is supported by greater use of information technology and formal processes to channel management efforts*.

It is not necessary to transform the whole organization at once. When Ford launched it "Quality is Job 1" program it bypassed much of the bureaucracy and reached down to the most qualified people to improve quality. After success was demonstrated and the company's fortunes started to improve with better quality products there was time to improve efficiency on a broad scale. This is the opposite of the usual conception of cost-cutting in advance of performance improvement.

The importance of leadership in an environment of rapid technological change creates more fundamental challenges than many of the commonly used business solutions address. Peter Drucker long ago warned companies of the futility of improving the efficiency of current activities when they should be engaged in entirely different activities. Arora emphasizes the organizational requirements of innovation and the risks of the wrong kinds of restructuring.

> ".. innovation is not simply a matter of incentives and opportunity. Firms have to organize themselves in particular ways to respond to the opportunities and incentives, and these organizational structures, once destroyed, may require lots of investments to re-create. If true, this offers more than a note of caution for the current corporate fascination with downsizing and re-engineering periodic intervals."
>
> Ashish Arora, p.805.

The company's vision is at the heart of understanding its long-term direction. Yet business leaders have sometimes dismissed the importance of vision. Lou Gerstner did so when taking over the helm of IBM but changed his view after turning the company around. Observations such as this suggests that vision is most often embraced in better times for the company and when there is an environment of strong economic growth. Vision is largely treated as a luxury.

Leaders who are preoccupied with crises often give primary attention to survival in the belief that without that nothing will come next. They also may need time to see which organizational capabilities or businesses will be retained or improved to the point that they can support a vision. And in difficult times they may want to wait to see which markets will recover. Yet vision may be crucial in deciding which businesses to retain and nurture, especially where long lead times are involved.

Planning for a changing environment involves extensive processes to build on internal capabilities, gain acceptance and move toward implementation. There are many steps in the process:

How Organizations Prepare for the Future

- Analyze the external environment.
- Understand the organization.
- Define the alternatives.
- Determined the superior options.
- Create consensus.
- Develop implementation strategies and tactics.
- Create systems for monitoring performance.
- Develop processes for strategic intelligence and response to feedback.

A formulation by Gemini Consulting emphasizes requirements for success in change management (Mehler):

Keys to Change Management

- A vision that is clearly articulated throughout the company.
- A simultaneous, integrated approach that brings together strategy, operations, technology and people
- Effective tools, methodologies and technologies.
- Committed leadership that can remove barriers to change.
- The involvement of the entire work force in cross-functional, multi-disciplined teams.
- A focus on results, as opposed to activities.

With automation so extensive, the system is becoming the firm. Real time technology is shaping the way in which the system works.

With automation so extensive, the system is becoming the firm.

Vivek Ranadivé of software company Tibco sees a changeover to the "event-driven" firm. In his model machines monitor the business and alert managers to problems in a "management by exception" process. The character of the "event-driven" company detailed in the next chart has a focus on large companies.

The Contemporary vs. the Event-Driven Company

Characteristic or Process	Contemporary Company	Event-Driven Company
Business strategy	Long-term strategic plan guides actions	Medium-to-long-term intent, but short-term planning horizon
Competitive posture	Study and understand your competition	Study and understand your customer
Management style	Consensus-oriented management	Entrepreneurial leadership, star system
Operational focus	Continuous monitoring to achieve quality	Quality is assumed, focus is on exceptional trends and events
Corporate culture	Egalitarian	Meritocratic
Recruiting	Hire tem players	Team players are good, but prima donnas bring the greatest value
Implicit company/employee contact	Promise of lifetime employment	Opportunity for lifetime employability
Employee career management	Company manages your career.	Employee manages own career
Information technology	Database-centric, passive, demand-driven	Information-centric, active, event-driven
Partnership model	Formal or informal *keiretsu*	Shifting alliances and "coopetition"
Corporate anthem	Souza march	Jazz improvisation

Source: Ranadivé

An important caveat is given by John Zipperer, technology editor of Internet World magazine:

> "…when I hear companies talk about how they want to react to information in real time…I worry that they will root out any wisdom from their decisions. Wisdom, after all, comes from time, experience, and consideration.
>
> …speed is not the most important element in getting value from enterprise systems — intelligence is. The valuable technology coming out today and tomorrow will be the applications that help humans receive, prioritize, and understand the deluge of information that comes at them at Internet speed. The executive that uses them will need to bring wisdom, not just further speed to the equation."

Business Models in the Private Sector

Of the forces are shaping private sector business models, technology and especially the information revolution is most pervasive. Other powerful influences include globalization, deregulation and the emergence of a modern service economy, which themselves are profoundly influenced by information technology. Together, these result in extensive competition, automation and in heightened demands for information.

In this environment there is a premium on arrangements for making effective use of information to manage and operate the organization, to link the organization to suppliers, partners and customers and to provide information as a service and a basis for transactions.

Consequences of an Information Economy for Business

Effects on Organizations

The growth of the information economy is associated with many powerful developments:

- Information technology can dramatically reduce the cost of some activities, among them searching for information and collaborating with partners.
- In some cases information technology makes efficient operation possible for much smaller producing units or individuals, as occurs with desktop graphics and analysis and reaching large audiences through Web sites.
- Information technology makes widespread and instantaneous communication possible, involving speech, documents, video and transactions. This facilitates many kinds of interaction.
- Information technology can speed up business processes and let organizations react quickly to changes in the economy.
- Rapid technological change produces intense competition, often for a long time. If the market is growing fast enough, new competitors may be able to successfully challenge even large, well-established firms.
- Rapid technological change intensifies the process of "creative destruction" in which firms are displaced by competitors that enter with understanding of the new environment and technologies and/or are better able to adapt — in an environment that requires decisive and appropriate responses for survival.

Effects on Products and Markets

- New technologies often create important new markets by offering products that make it possible to do things more efficiently or in new ways, and sometimes to do things that it was not possible to do previously.
- Information technology is making it possible to efficiently produce a much larger number of varieties of goods and services and to access niche markets that have demands for those products.

- For many information and software providers the cost of producing additional unit of each product is zero or near-zero after the initial fixed costs are met, facilitating rapid growth of markets.

- Many information products exhibit "network externalities" or "demand-side economies of scale." Such economies arise because the value to each user of participating in the network increases exponentially with the number of participants ("Metcalf's Law").

Network externalities are evident in services such as telephone, fax and e-mail. Demand increases from more people using the same product can arise because markets become more attractive to suppliers. This is evident, for example, with the growth of TV and cable programming. As viewers increased, more programming came in and led to even more viewers. Demand-related reinforcement can arise with bandwagon and other social effects as well. Network externalities are at the heart of the growth of the Internet.

Network externalities make demand for products more price-sensitive since lower prices that add customers lead to even more customers. Economies in production, especially those from low costs of adding users, can interact with demand economies from network externalities to produce rapid growth in the number of users. They also can bring about major changes in ways of doing business.

Effects on Business Structure

Traditionally, following the work of economist Ronald Coase, the strength and even existence of the firm has been viewed as based on the ability to reduce transaction costs by carrying out activities within an organization. In this view there is much less difficulty in gaining cooperation among individuals and departments within the firm that there is in letting contracts and monitoring and enforcing them, especially if a large number of independent, diverse and scattered resources are required.

In recent years the impact of information technology has turned the Coase analysis on its head. Modern information technology and especially the Internet have increasingly made it possible for disparate firms with specialized capabilities to work with one another and have low transactions costs, eliminating the need for them to be part of a single firm. This is especially true for information and knowledge-based products where electronic distribution easily transcends the boundaries of the firm.

The first cut interpretation of the effect of information efficiencies often has been to conclude that by reducing transaction costs they make it possible to have a market consisting of a large number of small firms. New types of multi-firm organizational structures in fact have evolved to take advantage of transaction cost efficiencies that have come with advances in information technology. Configurations include:

- The "virtual corporation" that directs activities of other entities without having its own production facilities.

- The focused firm that sticks to its core competencies, strictly out-sourcing for other capabilities.

- The networked company, in which separate entities act together to produce a result, sometimes in self-organizing systems.

- Business-to-business e-commerce exchanges, creating markets centered around an industry or large buyer.

On closer examination, the impact of information technology on the size distribution of firms is more complex. While small firms and individuals can take advantage of e-mail, the Web, groupware and teleconferencing systems, larger firms can take advantage of the same information technologies to reduce

transaction costs within the firm. Larger firms can create units or acquire smaller firms to internalize economies where greater specialization is important. Moreover, they may be able to achieve advantages by integrating some of the activities of specialized units with pre-existing functions, such as has been happening with the reintegration of Internet spin-offs by traditional retailers.

The market share of small firms tends to rise in the earlier years of the rapid evolution of technologies and business structures and declines later. The growth in small firms is offset by the continuing consolidation of firms seeking to improve their reach into regional, national and global markets. It also is offset by consolidation that takes place during times of economic stress. Many smaller firms, networks and exchanges have turned out to be transitional and unable to survive a shakeout.

In the long run, because of the effects of information technology on transaction costs, the net impact of all of these changes is expected to be less growth in concentration along with persistence of organizational forms involving many firms, with more firms of all sizes that are specialized.

Some analysts have been concerned that the concentration of markets that results from the benefits of a large network can lead to monopoly. When technological change is strong and growth is rapid, competition may be great enough to prevent substantial monopoly effects from developing. Challengers may invest heavily in seeking to attain the efficiencies of large size and preserve competition in the process — what Hal Varian calls "competing for monopoly." Eventually, however, as a technology becomes mature and/or growth slows down, and as less successful competitors are weakened, the possibility of monopolistic effects increases.

In a period of rapid technological change, several technologies often emerge that can perform some of the same functions, such as a use of telephone, cable and wireless for Internet connections. Competition among technologies can greatly lengthen the period of time during which strong competition persists.

Rapid technological change has been associated with pressures to reduce regulation and lower trade barriers to increase competition and efficiency. A rise in competition tends to make cross-subsidies unsustainable, so that regulated industries are less often required to assist a designated group with charges that are below cost, such as occurs with universal telephone service.

In the larger picture, rapid technological change, especially in information technology, has been a major contributor to the global increase in reliance on markets. With that has come changes in the relationships of firms to governments and movement toward international convergence in the structure of firms.

Rapid change will continue in the nature and location of activities, the structure of organizations and relationships among organizations as new products and methods of production and distribution evolve. More and more will be done through collaboration to integrate capabilities and solutions of multiple organizations.

NOAA can work with new types of organizations in many ways. It can be a catalyst, organizer, partner, owner, member, customer or supplier. NOAA will want to explicitly determine appropriate roles in each circumstance and define ways of managing those roles.

Evolving Organizational Forms

Trends in the form and function of the modern organization can be looked at from a number of perspectives, each of which emphasizes somewhat different aspects. The impact of information technology is pervasive.

Horizontal Management

With horizontal management, ease of communication means there are fewer layers of management through which communication has to filter.

The idea of horizontal management was introduced by Peter Drucker as far back as 1985. He used the metaphor of a symphony orchestra to describe the way information-based businesses would emerge when information no longer had to filter up but could go directly to higher levels of management.

Drucker notes that in the symphony orchestra the score is given to both players and conductors. However, in business:

> "To know what the score is, everyone in the information-based organization has to manage by objectives that are agreed upon in advance and clearly understood."
>
> Peter F. Drucker, "Playing in the Information-Based Orchestra"

Drucker also foresaw the nature of work changing, with greater reliance on teams.

> "Traditional departments will serve as guardians of standards, as centers for training and the assignment of specialists; they won't be where the work gets done. That will happen in task-focused teams."
>
> Perter F. Drucker, "The Coming of the New Organization," p.47.

Flatter organizational structures create a problem for managers of how to deal with information overload in an era when they can receive endless messages through email, cell phones and faxes. Ironically, in a decentralized world this is a problem of overcentralization.

The traditional way to deal with overload is to delegate more decision-making authority. The ability to delegate in NOAA is closely tied to how well it can recruit personnel and how well it can develop and train the right mix of personnel.

Business has long had to deal with a need for managers that have skills in both technology and management. In the past some firms tried to solve the dual need by having some managers that knew the technology and others that came from the ranks of management, and letting them learn from each other. *The balance has been shifting to having more technical people serving as managers in a high tech world where much of the system is automated or determined by technology.*

The Professional Service Organization

Henry Mintzberg made the distinction between machine bureaucracies that focus on repetitive standardized tasks and professional service organizations in which individuals have greater skill and autonomy in defining and carrying out tasks.

Either model could apply to service or information industries — telemarketers or customer service representatives reading from scripts are in machine bureaucracies. However, standardized and repetitive tasks lend themselves more easily to automation. Growth of automation creates new cadres of skilled professional and technical workers to operate and manage the systems. Of even greater quantitative importance is the many new job configurations the technology makes possible for users. Thus, the information-age organization is increasingly a professional service organization or a hybrid with units of each kind.

The Network Organization

The network organization draws extensively on resources in external organizations through which participants can acts as a coherent whole.

Management consultants widely recognized the emerging importance of networking among companies in the early 1980s. Business responded more rapidly and fully in developing network forms once advances in computers and telecommunications and competition from upstarts relying on them created a growing imperative of transformation. Today the evolution of the network organization is well-advanced and ongoing.

Ralph Kilmann, professor at the University of Pittsburgh, foresaw the emergence of the network organization in 1989. The model carries strong implications both for external relationships and internal management.

> "The perfectly competitive organization of the future will be an elaborate network of people and information, each exerting an influence on the other. The diagram of this network organization might show a small hub at the center surrounded by a widely dispersed and elaborate array of resources that I call the network....
>
> Outside the hub, the network organization will carry on its functions of providing products and services by entering into a number of different negotiated arrangements to extend the influence of the company. Network organizations — which will be rich with information — will recognize that certain functions can be better done elsewhere. As a result, these companies will enter into joint ventures, partnerships, associations, informal cooperation agreements, consortiums and temporary deals that will stretch today's traditional definitions of where one company ends and another begins....
>
> But for exactly this reason, the challenge for each company will be to nurture its own unique culture and develop the quality of its human resources. That is because competitive advantage will rest increasingly in the way each network organization gathers and assesses information, makes decisions and then carries out those decisions."
>
> Ralph H. Kilmann, "Tomorrow's Company Won't Have Walls"

The Adaptive Enterprise

A modern view is that of the adaptive enterprise that adjusts production to information fed from its units and the external environment, increasingly in real-time.

Stephan Haeckel of IBM's Advanced Business Institute makes a distinction between the "sense and respond" organization and the traditional "make and sell" organization that tries to create or anticipate demand rather than respond to it.

An organization providing information services or transactions on the Internet is a "sense and respond" organization since action is triggered by information from the customer. So is the Department of Defense, with its move to "network centric warfare" which makes extensive use of sensors. Another example is NOAA's use of vessel monitoring systems to receive real-time catch data and assure compliance with domestic and international fishing regulations.

A "sense and respond" organization does not try to forecast. Rather, it reacts to signals that reflect or anticipate changes in its environment or market. It is continuously adaptive, unlike an organization that needs long lead times to adjust and must plan ahead.

An Example of Use of an Adaptive Enterprise Approach in NOAA

An example of development of a "sense and respon\d" organization is the Analytical Response Team of NOAA's National Oceanic Service. The group responds nationwide to unusual mortality events associated with harmful algae blooms.

In 1997 John Ramsdell read an interview with Scott Gudes urging NOAA managers to think more like business people. He began reading business literature and encountered Steve Haeckel's book. To apply this business model he designated early event listeners to anticipate events through communication with resource managers and focus groups, such as the NMFS marine mammal mortality working group. The listeners feed a multidisciplinary management team that directs event-driven assemblages of scientists to provide a customized time-valued result back to the customer.

The results have been definitive data in time to resolve unusual marine mortality events and awards for the team's achievements.

Haeckel notes that a "sense and respond" organization requires core competencies such as:

> Dispatching capabilities from the customer request back, rather than scheduling them from the firm's plan forward.
>
> Designing a business as a system, rather than as a collection of vertical authority hierarchies linked by processes. System designs specify the interactions between, rather than the actions of, organizational components.

A "sense and respond" model requires changes in strategy, structure and governance. Organizations need to design external systems as much as internal systems. Without emphasis on responding to external signals they can have high transaction costs from internal conflicts. In Haeckel's view, many technologies are available to help the organization become adaptive that don't make sense in a "make and sell" model.

Kuznic and Owen compare the traditional decision process with the adaptive decision process:

Traditional vs. Adaptive Decision Processes		
	Traditional Decision Process	**Adaptive Decision Process**
Frame	• Strawman solution • Selective, known facts • Assumptions about the future	• Broad range of alternatives • Identification of unknowns • Range of uncertainty
Result	• "pitch" showing detailed evaluation of recommended course of action	• Shared learning about the sources of value and risk in each alternative
Purpose	• Justify the recommended course of action	• New "hybrid" course of action combining most valuable ad risk in each alternative
Culture	• Adversarial • Distrustful	• Cooperative • Open and inquisitive
Quality	• "Inspected" in after the fact • Reviews	• "Built into" the process • Dialogues
Micheal Kuznic and Daniel Owen, "Collaborative Decision-Making in Adaptive Enterprises," Appendix B, *Adaptive Enterprise: Creating and Leading Sense and Respond Organizations,* buy Stephan H. Haeckel p.226.		

An organization may need two kinds of business models for different activities, one for units dealing with longer term changes or environments that require prediction and one for those requiring a high degree of adaptability to external information and developments.

Mass Customization

Mass customization flexibly allows a wide variety of products and features to be produced and tailored to the customer and at the same time benefits from efficiencies of mass production.

More than two centuries ago, economist Adam Smith proclaimed that specialization is limited by the extent of the market. With modern information technology, specialization is no longer limited by the extent of the market.

The ability to reach a large audience with media and the Internet enables companies to aggregate customers with similar interests into niche markets that are large enough to be profitable.

At the same time, mass customization retains the advantages of mass production because of "flexible manufacturing" and electronic production systems that allow creation of numerous varieties to meet customer needs.

When it is efficient to serve niches, the producer no longer has to choose between serving mass markets with uniform products at low cost and serving specialized needs of more profitable, but smaller niche markets. Moreover, a large number of niches can be served by the same producer.

One example of mass customization is the efforts to provide localized individual weather information on demand to cars, cell phones and PDAs.

Electronic Marketplaces and Online Distribution

Electronic distribution of information services, media and financial products facilitates direct contact, transactions and self-service.

Private sector firms are being forced to respond rapidly to pressures created by the Internet and other online opportunities and by the intense competition that often results. Universities and research organizations are expanding collaboration. Traditional firms are integrating e-commerce into their businesses. Business-to-business e-commerce models are evolving in new ways.

Models of Business-to-Business E-Commerce

The first B2B e-commerce efforts were through the direct channel model in which companies try to directly sell their services directly to many potential buyers over the Internet. Large buyers then began to set up their own e-procurement systems and custom auctions. Buyer/seller-oriented auctions and exchanges evolved quickly. Other forms included demand aggregators that consolidate purchase requests of small buyers and integrated catalogs that aggregate product information from numerous sellers.

New models have begun to develop which bring together many buyers and many sellers, incorporating a wider range of services — both in arrangements among the participants and through tie-ins with outside vendors for services such as shipping, international trade assistance, financing and credit information.

Richard Wise and David Morrison, writing in the November-December 2000 *Harvard Business Review*, see exchanges and auctions becoming commoditized over time and specialized services and information becoming profit centers, often run by organizations other than the exchanges. They draw analogies to developments in the financial services industry and suggest that:

> ".. counter to the common wisdom about B2B today, exchanges are not the primary source of value in markets that are information intensive. Rather, value tends to accumulate among diverse groups of specialists that focus on such tasks as packaging, standard setting, arbitrage, and information management."

In Wise and Morrison's formulation there are five types of players in the emerging B2B landscape (see chart below). Mega-exchanges are central hubs for the execution of most transactions and for buyer-supplier communication. Specialist originators standardize and automate the buyer decision-making process for more complex products. E-speculators participate in or run exchanges and take positions in product or derivative markets. Solution providers produce services that may be embedded in product sales over open exchanges. Sell-side asset exchanges swap and resell orders among closed supplier networks to improve positions in production, inventory, transportation or warehousing.

The importance of these associations will vary among industries and countries and will certainly undergo rapid change.

Emerging B2B E-Commerce Models				
Type of Organization	**Role**	**Key Enabling Characteristics**	**Source of Competitive Advantage**	**Sources of Profit**
Mega-exchange	Act as central hubs for the execution of most transactions and for buyer-supplier communication.	• Maximum liquidity • Common transaction standards	• Scope and liquidity • Standard setting	• Profits are slim or exchange is nonprofit
Specialist originator	Standardize and automate the buyer decision-making process for more complex products and then send the transactions to the exchanges for execution.	• Complex products • Relatively expensive products	• Deep knowledge of product category • Effective use of decision-support software • Access to qualified suppliers • Ability to bundle transaction volume	• Transaction commissions • Slotting fees from vendors, exchanges
E-speculator	Participate in or run exchanges, gaining real-time information in order to take direct or derivative market positions.	• High degree of product standardization or fungibility • Moderate to high price volatility	• Timely market information • Transaction scale • Alignment with a major buyer or seller	• Playing the spread • Selling hedging instruments to participants
Solution provider	Operate separately from open exchanges by embedding the product sale in a suite of unique, valuable services.	• Product costs a small portion of overall costs • Product-related issues impact other costs	• Brand strength • Rich set of offerings • Customer lock-in	• Higher product margins • Valuable add-ons and refills
Sell-side asset exchange	Gain efficiency by swapping and reselling orders among a closed set of suppliers.	• High fixed costs • Relatively fragmented supplier and customer base	• Liquidity • First mover with key suppliers	• Selling ancillary products/services to members
Source: Richard Wise and David Morrison, "Beyond the Exchange: The Future of B2B," *Harvard Business Review* (November-December 2000), pp.93-95.				

Impacts of the Terrorism Threat and the War on Terrorism on Business Models

The terrorism threat and the war on terrorism could affect business models in a number of ways:

- Control for purposes of security could reduce company flexibility and adaptation.
- There may be less reliance on just-in-time inventory management systems and reliance on a smaller number of less vulnerable suppliers.
- Precautions and loss of some competitors due to higher costs and risks could lessen competition in some markets.
- Facilities may more often be located away from potentially targeted areas and some countries may be avoided.
- High costs of insurance and more limited availability of coverage could inhibit arrangements that involve strategic partnerships and interdependencies among large groups of firms.

The magnitude of the effects will very much depend on how long and how deeply the problems persist.

With its emphasis on information products, NOAA will be able to avoid many of the difficulties associated with production and distribution of physical goods. However, NOAA will still have to:

- Screen purchasers of some data that may be used for hostile purposes, devising systems that do not interfere unnecessarily with other goals such as open access and scientific collaboration.

- Confront the vagaries, costs and vulnerabilities of travel without losing too many of the benefits of internal and external interaction.

- Protect against the threat of cyber-terrorism as it seeks to expand and enhance its network of suppliers, partners and customers and operate more extensively on a global basis.

Environment and Resource Management Trends and Policies

ENVIRONMENT, DEMOGRAPHICS AND SOCIETY

Population and Economic Forces

Pressures on Resources

World population growth slowed dramatically since the 1970s as birth rates declined with economic growth in many developing countries. Substantial further slowing in population growth is expected. Even with lower percentage rates of growth, population is growing at about 78 million a year. While estimates range widely about future population growth (Singer), differences in global population take a generation to start to become substantial.

Virtually all population growth is expected to come in countries that presently have low incomes and to be concentrated in urban areas that often are very densely populated. Populations often are concentrated in coastal regions.

Value of the Services of the Ecosystem

Robert Costanza and others estimated in a 1997 article in *Nature*: "The Value of the World's Ecosystem Services and Natural Capital" estimated the value of 17 ecosystems including marine environments, terrestrial systems and forests and wetlands for nutrient flows, storage and purification of water, atmospheric regulation of gases, assimilation and processing of waste and other functions at $36 trillion annually and the discounted value of future services at $500 trillion (Baglini, p.148).

A study by Don Hinrichsen and his associates at the Johns Hopkins University School of Public Health Illustrates the strains on resources. The study projects that by 2025, 2.8 billion people with 35 percent of the world's projected 8 billion people will face water shortages. Many of them would be in growing cities of developing countries. The number of countries facing water stress or water shortage is predicted to rise from 31 to 48 (Hinrichsen).

Strains also have increased attention to biodiversity. Attention has varied among countries and species.

Number of Endangered Wildlife and Plant Species, 2001

	Mammals	Birds	Reptiles	Amphibians	Fishes	Snails	Clams	Crustaceans	Insects	Arachnids	Plants
United States	63	78	14	10	70	20	61	18	33	12	592
Foreign	251	175	64	8	11	1	2	-	4	-	1

Source: U.S. Fish and Wildlife Service.

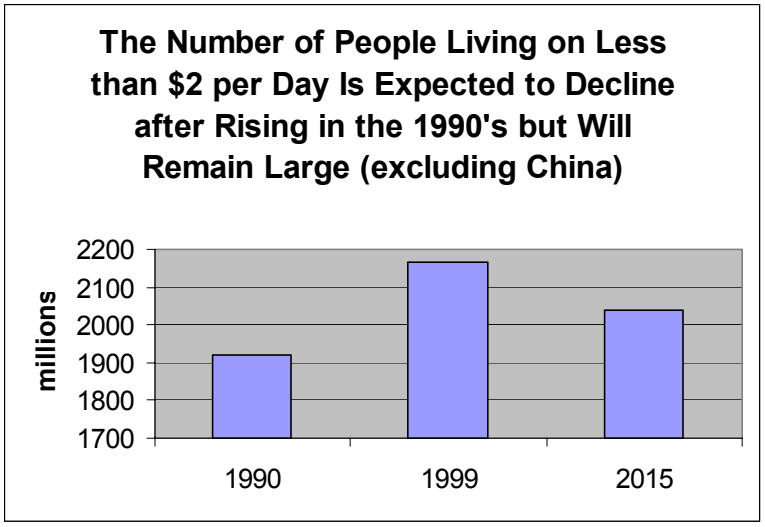
With rising population and higher incomes leading to greater use of resources, there is an ongoing debate over the carrying capacity of the planet. A wide range of estimates of carrying capacity has been made over the last century. In a leading book on the subject: *How Many People Can the Earth Support?*, Prof. Joel E. Cohen of Rockefeller University emphasizes that carrying capacity depends on a great number of not only natural constraints, but also human choices and the societal contexts within which those choices are made (Cohen).

Vast increases in the consumption of energy, materials and food have had broad and growing impacts on the environment.

- If using air conditioning, driving cars and eating red meat occurred as often in the rest of the world as in the countries with the highest incomes, the world would be able to support far fewer people than it could at existing levels of consumption.
- If consuming more means more pollution even if using more environmentally efficient technologies, if new forms of pollution become important, or if global changes in the environment restrict human activity, then a rise in world consumption will reduce carrying capacity.

Conversely, if population growth slows rapidly and population levels off, if technologies make it possible to produce more food and other basics and at the same time economize on resources, and if social changes, market pressures, or deliberate individual and publicly-induced responses reduce the harmful impacts of actions on the environment, the limit will be higher and will be reached less rapidly, if at all.

More than two billion people live on less than $2 per day even excluding China, according to the World Bank. This widely cited figure is in dollars of 1985 purchasing power and would be only one billion people at $2 of today's purchasing power. (The $2 per day standard corresponds to a per capita annual income of about $1,000 today (Barro).)



The percent of the world's population that is poor has been declining. Xavier Sala-i-Martin, an economist at Columbia University, calculates in an unpublished study "The World Distribution of Income" that the percent of the world's population living below $2 of 1985 dollars per day fell from 41% in 1970 to 19% in 1998 (Coy). Poverty, by this measure, is expected to decline in the next decade, both as a percent of world population and in absolute numbers.

A global measure of *inequality* has been declining since 1970 (Dollar and Kraay). Interestingly, this corresponds to the period when fertility rates started to fall off sharply. The great majority of global inequality is attributable to differences in average income among countries rather than to inequality within countries. As such it is highly dependent on the pace of economic development.

In spite of improvements, the number living on less than the $2 of 1985 dollars per day will remain above two billion. The priority of meeting basic needs of people in poor countries creates pressures on resources and increased the importance of attention to resource management.

Thinking about the impact of development on resources has been exemplified by the issues of deforestation and pollution.

Population and development pressures are evident in the United States in many ways.

> Over half of the people live in coastal counties, which have less than 20% of the land area. The population of coastal counties is expected to increase by 27 million over the next 15 years (Pew Oceans Commission, *Coastal Sprawl*).
>
> Competition between states for water will take on increasing importance. Growth of recreation, which has been a driving force behind interest in the environment, will manifest itself in rising competition for water between population and fishing uses, with fishing interests concerned about limits on recreational use and effects of withdrawals on salinity.
>
> The competition for water from the Colorado River and the tensions between Alabama, Florida and Georgia over sharing water from the Apalachicola-Chattahoochee-Flint River System are illustrative of the kinds of battles that could emerge with population growth and economic development. Drought caused by changing weather patterns and/or global warming could make water allocation even more contentious.

As population and use of resources increase there will be more pressures to make adjustments. These pressures will be great across the spectrum and include:

- The poorest countries.
- Developing countries that have ignored environmental and resource problems while pursuing growth.
- Developed countries with increased consumption and with a rising ethic of conservation and environmental protection.

NOAA will be under increasing pressure to provide scientific evidence that can improve understanding of the ways changes in population and development are affecting the conditions under which people live.

Environmental Issues Surrounding Military Facilities and Operations

Military facilities may face growing environmental issues. Species tend to migrate to unleased military land from areas where there is development. This has occurred, for example in the Channel Islands National Marine Sanctuary below Vandenberg Air Force Base in California. Training requirements can conflict with environmental considerations. There was an incident with Navy experiments with submarines in which a whale was killed. The recent protest against target practice on the island of Viecas make clear how contentious such issues can become.

Barry W. Holman of the General Accounting Office testified in May 2002 that there are eight "encroachment" issues hampering military training:

- Endangered species' critical habitat.
- Unexploded ordinance and munitions.
- Competition for radio frequency spectra.
- Protected marine resources.
- Competition for airspace.
- Air pollution.
- Noise pollution.
- Urban growth around military installations.

The military is seeking an exemption from the Endangered Species Act.

The issues can be expected to become more heated whether or not an exemption is granted.

Roles of Technology

Technology has had a dual role. In some cases technological change has improved or shifted the use of resources sufficiently to prevent environmental degradation. The rise in income that accompanies advances in technology at times has made beneficial choices possible. In other cases such as the loss of endangered species, pressures have continued to exert themselves except where tempered by resource management policies.

One example of the effects of economic growth on resources is the shift from mechanical to electrical technologies. The shift has reduced the demand for power, including coal for use in steel-making and for handling the great weight of some materials. At the same time it has created new concerns, such as arsenic waste in Silicon Valley and disposal of toxic chemicals in discarded computers and cell phones.

The dual role of technology is no more apparent than in management of the fish stocks. Improved technology greatly expanded the U.S. fish catch in the 1980s and early 1990s and reduced the price of fish to the consumer. The result of the high rate of fishing, however, has been the depletion of many fish stocks, with the result that the catch has declined.

Environmental Change

The "Kuznets Curve" and Changes in the Environment with Economic Development

Analysts have speculated that poor countries tend to go through a long stage of development during which they allow the environment to be degraded to make rapid economic progress. After a few decades, the theory goes, they reach a level of affluence at which a better environment becomes more of a value. From then on the environment tends to improve with further development, at least in relative terms (e.g. pollutants per unit of GDP). This expectation of deteriorating and then improving environment has been called the "environmental Kuznets curve" after the economist Simon Kuznets who pioneered in quantitative studies of economic development. (The Kuznets curve from which it borrowed the name deals with the rise and fall of income inequality with development. Kuznets himself did not examine the relationship of environment to development.)

In recent years there have been a number of attempts to test the validity of the environmental Kuznets curve for pollution. The evidence, albeit with important gaps in data and variations in interpretation, does not show conclusive patterns of decline followed by rise in environmental conditions with development. Certainly there are highly visible examples of polluted industrial areas and congested cities, but these may owe themselves as much to population as to income, and they may reflect policies in some countries that change little with development. The outcomes in the coming years are not inevitable, governed by some inexorable tendency of the development process or public attitudes, but rather depend on the policies and actions of each nation.

In a comprehensive review of the evidence, Dasgupta *et. al.* (p.152) note:

> "The theme that emerges from this research is that it is quite plausible for developing societies to have improvements in environmental quality. It also seems likely that because of growing public concern and research knowledge about environmental quality and regulation, countries may be able to experience an environmental Kuznets curve that is lower and flatter than the conventional measures would suggest. That is, they may be able to develop from low levels of per capita

income with little or no degradation in environmental quality, and then at some point experience improvements in both income and environmental quality."

Many examples have emerged of improvements in the environment with economic advancements for the lowest income countries and of ways in which gains can be made in ways that are beneficial to the environment.

The U.S. has been seeking international recognition for the potential of economic development to enable both reduction in poverty and improvement in the environment. NOAA increasingly will be enlisted in making that case and in promoting its understanding in other parts of the world.

Determining the State of the Environment

Statistics on the state of the environment are fragmented and widely scattered. Different groups emphasize aspects with large gains or losses. New areas of concern will continue to grow, whether because of greatly increased problems like invasive species, fears of the unknown such as genetic intermixing, or heightened recognition of longstanding occurrences such as mortality events of marine mammals.

A number of efforts are underway to develop more complete and integrated sets of measures. For the purposes of this study, developments in the availability of information are noted while the results of more complete analyses of trends in the environment are awaited.

The Council of Economic Advisers summarized trends in air quality in the Unites States in its 2002 report (Economic Report of the President, Chapter 6). It found marked improvement over recent decades, especially for some of the most damaging pollutants. While gains in ratios of pollutants to GDP were greater, there also were important gains in absolute levels of some pollutants.

Other currently available measures include the EPA Office of Water Quality annual report, the EPA toxic release inventory and the Forest Service indicators of sustainability.

Efforts to pull together measures are underway at the Heinz Center and other environmental organizations, the EPA Office of Policy Innovation, the White House Council on Environmental Quality and, in an overview capacity, the White House Office of Science and Technology Policy. EPA has announced its report “State of the Environment” will be released in November 2002 as a draft for public review and comment.

It will take some time before anything like an integrated assessment of environmental trends can be developed, and any overall assessment is likely to be controversial.

Data are likely to remain somewhat fragmented for the United States because of differences in methods and interpretation. Adding up greatly varied and fact-specific local conditions always will pose difficulties in interpretation. Cross-national development of comprehensive measures is a lot more difficult and progress is likely to be slow.

NOAA will continue to expand basic knowledge about changes in the climate on a global scale. Over time, NOAA may be asked to bring together data on global developments in fish stocks that include changes largely beyond the EEZ.

NEW APPROACHES TO ENVIRONMENTAL AND RESOURCE MANAGEMENT

Government efforts to improve the environment and resource management have grown dramatically over the years. They have been manifested in commissions, extensive legislation, regulations, agency practices and legal proceedings. During the Reagan era there was a concerted effort to rationalize regulations that were perceived as ineffective, excessively costly or overly intrusive. With the election of George W. Bush a new comprehensive effort to change the balance and nature of regulation has begun. The focus is on:

Company Environmental Reporting

Almost half of the top 250 of the Global Fortune 500 companies issued environmental, social or sustainability reports in 2002, nearly double the number in 2001, according to a survey by KPMG and the University of Amsterdam released in June 2002.

1. Favoring initiatives with the highest benefits in relation to costs.

2. Using incentives that can achieve cost-effective results.

3. Using management and governance arrangements to bring parties together.

4. Relying more heavily on science in decision-making.

The second and third approaches often are used together to provide incentives within a structure for implementing them

1. With regard to balancing benefits and costs, Freeman (p.126) notes that:

> "In the first two major environmental laws of the early 1970s - the Clean Air Act and the Federal Water Pollution Control Act - Congress explicitly rejected the economic approach to goal setting. With regard to clean air, it emphasized protecting human health. With regard to clean water, it emphasized achieving fishable and swimable water quality. However, more recently, Congress has written implicit or explicit economic efficiency criteria into three major environmental laws: the Toxic Substances Control Act of 1976, the Federal Insecticide, Fungicide and Rodenticide Act of 1976 and the Safe Drinking Water Act Amendments of 1996. Moreover, as a result of a series of executive orders by presidents of both parties stretching back to the Nixon administration, there has been an expanding set of requirements for federal agencies to perform economic assessments of major proposed regulations, including an assessment of the benefits and costs."

In some cases it has been pointed out that a small proportion of the regulations produce a large share of the benefits or are accountable for a large share of the costs and that better targeting would produce more desirable results.

Despite efforts to take into account the relationship between costs and benefits in regulatory impact assessments it has not always been possible to obtain adequate information. Agencies have not always had an incentive to develop the requisite data. Estimates are at times skewed to favor preconceived conclusions or meet other objectives.

The rationale given for regulatory reform is not only that there are more efficient ways to regulate. It also is that while large gains have been achieved, additional gains could be more limited or more costly. The 2000 Economic Report of the President states:

> "Now that most of the largest and most glaring environmental problems have been tackled, however, the gains to be expected from further measures have become less obvious and more

contentious. As the environmental issues we address become ever more complex, research and careful analysis of both benefits and costs are required to formulate responsible policies that will improve Americans' well-being and are cost-effective."

U.S. President, Economic Report of the President together with the Report of the Council of Economic Advisors, February 2002, p.215.

The report goes on to say:

"As a society becomes more affluent, it is likely to demand a cleaner and safer environment. Prosperity also allows us to commit ever-increasing resources to environmental protection and to the development of science and technology that will lead to both future growth and a better environment."

Ibid, p. 218.

2 & 3. The incentive and management approaches have been expanded under the George W. Bush administration with the intent of improving the effectiveness of regulation (and in the views of some critics of reducing regulation even when it might be effective). The approach, laid out extensively in the 2002 Economic Report of the President, seeks to develop administrative arrangements under which better balance can be achieved. Some methods build on the experience with tradable permits and fee programs, tradable performance standards and emissions charges for pollutants. Others attempt to put costs and benefits under the same umbrella by defining constituents and geographic areas for decision-making more appropriately, bringing together participants and encouraging private sector agreement on quotas and permits. Examples of successes cited in the President's report include tradable quotas in the Alaskan halibut and sablefish fisheries and informal trading of fishing permits in the Tar-Pimlico River Basin.

Such techniques are starting to come into wider use. In May 2002 the Environmental Protection Agency proposed a system of trading credits for water pollution using quotas based on "total maximum daily loads" or pollution limits. Several pilot projects with similar approaches are in existence, including one in Connecticut to reduce nitrogen-bearing pollution levels in Long Island Sound.

Administrative approaches, particularly those involving organizational and governance structures, often require extensive negotiation to put into practice.

4. The fourth approach, detailed by the White House in March 2002 (U.S. Office of Management and Budget, March 19, 2002), involves assuring that agencies promulgate rules based on more scientific evidence than they have in the past. Relying heavily on science, with more extensive gathering of evidence, is seen as a way to target regulation and reduce bias.

"The notion of executive or presidential regulatory review is now well established. It's been used in republican administrations and democratic administrations for a variety of purposes. It's there; it's there to stay. I can't imagine it disappearing. If someone took it away, they would have to reinvent it."

Sally Katzen, President Clinton's Deputy Director of the Office of Management and Budget

The administration also is attempting to reduce the use of agency "guidance" that often has the impact of regulation but does not go through the same for review process (Schlessinger). Insisting on more science can result in expanding the use of cost-benefit analysis where it has been lacking.

The new tools recognize the interagency nature of environmental assessment and response. However, OMB reviews of regulations do not adequately address many interagency overlaps that make regulation costly and make new initiatives more difficult.

The number of regulatory reviews fell dramatically during the Clinton years. During 1982-1993 there were more than 2000 reviews each year while the number of reviews averaged 591 from 1994 through 2000.

The Office of Management and Budget's Office of Information and Regulatory Affairs (OIRA) has revived the use of the "return letter" which sends a proposed regulation back to the initiating agency for reconsideration. Eighteen return letters were issued in 2001 vs. none in the preceding three years. The 18 return letters were out of a total of 700 reviews. (U.S. Office of Management and Budget, March 19, 2002, pp.21-22) To implement its initiative, OIRA also is seeking to build a staff of scientists and engineers and is forming a scientific advisory panel.

Critics argue that the intent of the administration is to reduce regulation rather than to reform it, especially where favored constituents are involved. They maintain that scientific data often cannot be obtained and when it can it can take a long time to develop. Regulation should not wait until it is available. In their view, the scientific approach shifts the burden of proof to those who would regulate when precautionary actions would be appropriate. (See the later discussion of the precautionary principle.) OMB (Graham, January 15, 2002) responds that it adds regulations as well as reducing them and that only a very small percentage of regulations are ever rejected in its reviews (although of course regulations are sent up for review with recognition of the requirements for approval).

THE NEW REGULATION

Recent efforts at "smart regulation" represent the halting, at least temporarily, of a trend toward increasing regulation and regulatory costs, particularly in the resource management area. The shift is much less intense than the effort to reduce costly regulation during the Reagan years, which itself largely proved to be temporary. Moreover, there are forces producing increases in regulation.

While some additions are well justified, the effects of regulation that has recently been added and further increases that can be expected as society responds to a variety of perceived problems will be felt for a long time. These do not represent a reversal of efforts to reduce the adverse effects of regulation but they do add an additional layer of regulation.

The new regulation is particularly evident in the rules and procedures affecting homeland security and the push for greater financial disclosure and accountability.

Increased regulation shows up in many other areas as well, including greater antitrust enforcement, trade restrictions (U.S. use of the safeguard agreement, antidumping measures and countervailing duties but possible benefits later from "fast track"), patients' rights legislation, limitations on drug prices by Medicare and Medicaid and increased localism, such as when communities block natural gas pipeline construction or rezone land to prevent development.

Some states have enacted legislation where Washington has not done so or challenged federal positions in court. Counter-reactions to "smart regulation" and regulatory rollbacks at the federal level could come with congressional and presidential elections.

The many embedded regulations at both the federal and state and local levels will not easily be changed. While improvements may be made in some areas, public concerns about issues such as global warming could lead down the road to a new round of intense regulation, spilling over into other environmental issues as well.

Typically, during periods of economic weakness concern shifts to jobs and incomes while during prosperity interest in quality of life rises and regulation strengthens. At present, economic weakness, along with the popularity of the president, is reinforcing the regulatory reform direction of policy. While economic improvement may be expected, that by itself will not cause the new emphasis to disappear.

Nevertheless, rationalizing regulation has staying power. The large, aging baby boom generation has become more economically conservative and is increasingly concerned about adequacy of income for retirement. Moreover, a growing cadre of economists and practitioners will keep up momentum for the "smarter" approaches. Pressure from the White House will continue for at least a while. As agencies expand their involvement with newer approaches to resource management they will become more comfortable with them and find more situations in which they can be applied advantageously. As a result, major aspects of the "smart regulation" initiatives can be expected to transcend administrations.

…major aspects of the present initiatives can be expected to transcend administrations.

New approaches continue to evolve with varying degrees of cooperation and coercion. For example:

> "Adaptive management" is based on the idea that complex systems are inherently unpredictable and complex problems need to be managed through a collaborative process in which everyone agrees to try new measures when things don't turn out as expected. The approach is being used in the Grand Canyon Dam (Blakeslee).

> In June 2002 members of the Pacific Fishery Management Council, using an approach based on water depth and fishing gear, recommended rules that would force many commercial fishermen to go far out to sea, increasing danger and cost while reducing catch. The recommendation, following reduced assessments of populations of three series of rockfish, would affect other species as well.

NOAA has undertaken many major initiatives such as the increased use of large marine-protected areas and coastal zone management areas and efforts to reduce the number of lawsuits in fisheries management (Hogarth, January 15, 2002).

NOAA will place increasing effort on understanding the new approaches to resource management and determining where and how to employ them. These approaches are equally applicable to NOS and NMFS and to other parts of the agency with regulatory and related management functions.

The issues involved in resource management will involve NOAA heavily in dealing with social and economic considerations. That, and the extensive negotiation required by many of the methods, will necessitate developing skills and organizational structures that go beyond the scientific emphasis that is at the heart of the agency. Effectively maintaining focuses on both science and complex socially oriented resource management initiatives will present a major ongoing challenge.

THE DATA QUALITY ACT

Additional pressures are being created by the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 - Public Law 106-554). The Act was signed in the last days of the Clinton Administration and goes into effect on October 1, 2002. The measure requires the government to set standards for the quality of scientific information and statistics used and disseminated by federal agencies.

Procedures must be developed "insuring and maximizing the quality, objectivity, utility and integrity" of the information. More influential data must meet higher standards. Successful complaints could result in expunging of data from government Web sites and publications.

NOAA's Information Quality Guidelines were placed on NOAA's Web site for comment on May 31, 2002 (Submission of Comments on NOAA's Information Quality Guidelines). Complaints against NOAA will be examined within the agency at the Assistant Administrator level. Appeals from component agencies will not be required to go to the Department of Commerce.

There will be a transition during which public comment on pending regulations will have been collected under the preexisting rule-making process while new comments are obtained under the Data Quality Act. Moreover, OMB has been allowing agencies to use preexisting measures. Nevertheless, complexity, uncertainty and lack of resources to meet what is an unfunded mandate, together with a backlog of past complaints and efforts to test the system, could slow rulemaking considerably during a long transition period.

The larger question is whether complaints and efforts to deal with them will dramatically slow rule-making on an ongoing basis — whether the complaints are justified or not. The impact will depend on the number and complexity of complaints. Many complaints will be that the agency did not follow its own rules.

Another serious possibility is that the Act will cause bureaucratization of scientific processes and make it more difficult for government to attract and retain scientists. Such effects, even if modest, would be unfortunate when more emphasis is being placed on use of science in decision-making and attracting technical people to government is a major concern.

NOAA products that are subject to peer review do not have to undergo review under the Data Quality Act. Research units in NOAA may expand peer review as part of their quality-control processes to reduce the need for Data Quality Act reviews.

The law has already been used by the Center for Regulatory Effectiveness in a February 11, 2002 letter to the White House Office of Science and Technology Policy. The Center requested withdrawal of a report on global warming on the grounds that a government assessment of the regional impacts of climate change is alarmist and is based on flawed computer models (Revkin).

It is too early to tell how the process will really work or how it may be modified. Positive benefits in assuring quality may be important or some of the fears of negative consequences may turn out to be well founded. In any case it will impose significant complications.

Each agency is required to report by January 2004 on how many complaints it has received, what type and how they are being handled. However, modifications of the process will begin to be considered as soon as it begins on October 1, 2002.

THE PRECAUTIONARY PRINCIPLE

Many environmentalists advocate strong regulatory action as insurance against the possibility that environmental degradation will be severe. Reactions against environmental risks have been especially strong in Europe.

The "precautionary principle" has evolved as a means of introducing risk aversion into environmental and resource decisions. The precautionary principle is less a principle than a desire to err on the side of prudence. Saying one favors the precautionary principle does not provide assurance that the risks are sufficiently large, their consequences great enough or the adverse impacts of responses manageable enough to justify proposed actions. In the debates over policy the precautionary principle clashes with approaches that rely more on science or cost-benefit analysis. The latter efforts place more of the burden of proof on those who would impose costs or restrictions on society and risk compromising other uses of resources and economic growth.

In fact, there is no single precautionary principle but many. Some versions are more rigid while others represent efforts to balance broader considerations. Stronger forms often have been part of policy-making in Europe where the precautionary principle is the basis of environmental law under the 1992 Treaty of the European Union. Foster, et. al. note:

> "Despite its seemingly widespread political support, the Precautionary Principle has engendered endless controversy, in part because critics have interpreted 'precautionary' decisions as veiled forms of trade protectionism.
>
> But its greatest problem, as a policy tool, is its extreme variability in interpretation. One legal analysis identified 14 different versions of the principle in treaties and non-treaty declarations. The Treaty on European Union merely refers to the principle, without defining it. Despite a growing body of case law, including

Many Varieties of the Precautionary Principle

The 1992 Rio Declaration of Environment and Development stated that:

> "…to protect the environment, the precautionary approach shall be widely applied by states according to their capability. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

A much stronger formulation was used in the 1990 Third Ministerial Declaration on the North Sea, which requires governments to:

> "…apply the precautionary principle, that is to take action to avoid potentially damaging impacts of [toxic] substances … even when there is no scientific evidence to prove a causal link between emissions and effects."

The UN has adopted the principle for widespread use but has shown understanding of the complexities involved in defining what is meant. In a recent major report it noted that formulations of different strengths vary in at least six elements:

- Consideration of benefits and risks in current technology
- Cost-effectiveness of prevention
- Certainty of harm or certainty of safety
- Burden of proof
- Optional or obligatory action
- Locus of decision-making

United Nations, *Human Development Report, 2001*, p.70.

> important decisions by the (European) Court of Justice, the legal community remains divided about the meaning and applicability of the principle."

Bailey argues the precautionary principle "seeks to stop innovation before it happens."

The United Sates has rejected adoption of the precautionary principle for its resource management and environmental decision-making. John Graham, head of the Office of Management and Budget's Office of Information and Regulatory Affairs (OIRA), states:

> "As you know, the US government supports precautionary approaches to risk management but we do not recognize any universal precautionary principle. We consider it to be a mythical concept, perhaps like a unicorn."
>
> (Graham, January 11-12, 2002, p.2).

Fundamental differences in policy approaches such as manifested in the U.S. handling of the Kyoto accord and different attitudes toward specific measures such as tradable permits will continue to profoundly shape the success and structure of international cooperation. The divergent stands of the U.S. and Europe on the precautionary principle will complicate efforts to coordinate policies and reach agreement on multinational issues. They also will make it more difficult for the U.S. to gain acceptance for new approaches to improve the effectiveness of regulation by other nations and then to obtain the support of those nations for embodying the approaches in international agreements.

INTERNATIONAL ASPECTS OF RESOURCE MANAGEMENT

International trends in resource management include:

- Economic development being seen as complementary to a sound environment and effective resource management rather than in conflict with it.

  This view reflects recognition that the resources provided by economic development can be used to embrace lifestyles and policies that protect and improve the environment and that countries can begin earlier in development to institute desirable policies. The view has been widely accepted only recently. It can be expected to grow stronger and lead to much more cooperation between environmental and development constituencies.

  The view gained support at the World Conference on Sustainable Development in Johannesburg in August 2002. The U.S. is promoting a version that emphasizes conditions necessary for a high level of investment in developing countries.

- Renewed U.S. reliance on multinational institutions and networks.

  Over the last two decades the U.S. has gradually returned to acceptance of the role of international agencies after attempting to shift to bilateral approaches. The recent payment of UN dues reflects the tail end of a process in which questioning of the effectiveness of various agencies and the degree to which they serve U.S. interests has been replaced by a greater move toward international cooperation. At the same time, networks of nations for particular purposes have become recognized as essential for getting some things done.

  Of course, the George W. Bush Administration has refused to participate in some treaties and there is heavy criticism of the IMF and World Bank. But over the next 5-10 years these developments are likely to have the effect of forcing improvement in arrangements rather than thwarting them, and as a result furthering reliance on them.

- Ecosystem approach

  The ecosystem approach is receiving widespread support and will grow as interdependencies in nature are more fully recognized. The approach includes all aspects of the environment from fish migration to land-based sources of ocean pollution. NOAA is developing the ecosystem approach through efforts such as comprehensive ocean, atmospheric and land measurements and through establishing Marine Protected Areas. It is working with many U.S. agencies and organizations and international agencies. Much more of this kind of activity can be expected. New skills will have to be developed to support it and disciplines will have to work closely together.

  The Rio conference led to the Kyoto Protocol and the accelerated growth of grass roots efforts and NGOs. Similarly, the World Conference on Sustainable Development in Johannesburg from August 26-September 6, 2002 may have long-lasting impacts on the direction and impact of environmental policies. The conference achieved agreement on greater use of the ecosystem approach in policy-making.

- International policy divergence

  A sharp divergence in policies has intensified with refusal of the George W. Bush Administration to sign the Kyoto protocol and with the growing use of incentive methods of resource management in the U.S. vs. use of the precautionary principle outside the United States.

The differing views of the U.S. and Europe on major issues, including invasion of Iraq, trade, the death penalty and the Middle East, along with the U.S. unsigning of the treaty creating the international criminal court and abandonment of the 1972 antiballistic treaty with Russia have raised tensions to a high level.

Differences will moderate over time, tempered by the many common interests. Countries will soften positions and reach for agreement. The U.S. has taken some initiatives that are viewed favorably in Europe, such as the recent arms treaty and admission of Russia into NATO. However, antagonisms over some actions, added to differing views, will slow and complicate cooperation in resource management.

Differences in views, particularly between the U.S. and Europe, also are likely to encourage efforts at greater self-sufficiency in science infrastructure to support resource management policies and operations. The costs, complexity and interdependent nature of science and technology, however, will mean that cooperation will continue and grow, even if not as rapidly.

International Policy Differences: Not All Black and White

"But is Europe really more concerned with sustainability? The environmental penal code of the Council of Europe has existed since 1998, but not a single country has ratified it so far. The Rio Convention on Biodiversity of 1992 has been ratified so far by a dozen countries world wide;…At the beginning of 2002, ITTO [International Tropical Timber Organization] has admitted that less than 1% of the international trade of tropical timber fulfils its conditions."

Walter R. Stahel, The Geneva Association, p.2

- Growth of Non-Governmental Organizations (NGOs)

  Recent years have seen an explosion in the number of NGOs and in their importance in directly providing services as well as advocacy in developing countries. NGOs have the potential to overcome some of the difficulties associated with providing assistance through governments in those countries, including costs, over-centralization and problems of distribution. Their growth will be helped by a trend toward greater democracy and also will depend on how effectively they realize their potential.

  In developed countries NGOs are more mature and beyond their most rapid growth in membership. Their impacts will vary over time, particularly with election outcomes, if there are no major changes in attitudes of the general public toward the issues.

- Eco-consumption

  Concern about the environment has started to have a significant influence on consumption patterns. Eco-tourism has become an important industry and environment has become more of a factor in choices of other tourist destinations. Consumers are being asked not to eat seafood from unregulated sources or species that are viewed as endangered. They are asked to demand documentation and boycott restaurants that cannot provide it. Opposition to use of genetically modified organisms has grown, especially in Europe.

  Eco-consumption can be expected to continue to grow and to take on new forms (e.g. virtual reality tours and games, undersea tours and hotels) along with those that are evident today. U.S. consumers are likely to continue to largely accept genetically modified seafood during the next several years.

- Increased resource regulation through trade

  Fishing issues have been part of trade negotiations as nations seek to protect domestic industries and use trade restrictions to preserve species. Considerable attention to seafood issues has been given by APEC, whose member nations are large consumers as well as global fishermen.

  Some issues have come onto the radar screen in unusual ways. In 2002 Congress tried to extend trade preference to Andean nations to provide an alternative to coca production in the fight against drugs and their link to terrorism. The effort ran into opposition because it would displace thousands of Muslim workers in the Philippine tuna industry and work against efforts to counter terrorism there.

  WTO negotiations on a new round of global trade agreements, as well as on regional agreements such as a Free Trade Area of the Americas will give increasing attention to agricultural subsidies and to the environment, along with potential commercial benefits of reduced tariff and trade restrictions. The agricultural subsidies issue is focused on the impacts of subsidies on access to markets in developed countries for developing nations along with competition among developed nations. In some negotiations environmental issues may be handled in side agreements. Both subsidies and environmental issues will include discussions of the seafood industry. Negotiations and phasing of implementation will take place over the entire decade and beyond.

- "Water and resource wars"

  Tensions will develop over water supplies in several parts of the world. Areas of dispute include the U.S.-Mexican border, Turkey and its neighbors, and Israel's dependence on water from the Sea of Galilee.

  Some disputes will involve resources, such as the potentially dangerous overlapping claims of seven nations to oil in the South China Sea.

  Some disputes will be at the center of wars or peace negotiations. Solutions will vary greatly among circumstances, sometimes involving the immediate parties and other times requiring extensive involvement of other countries and international organizations to protect resources and/or maintain stability.

- Environmental fallout from terrorism and war

  Environmental damage resulting from war and/or terrorism will be significant during the next decade. It may take many forms — attacks on oilfields, refineries, chemical plants, or energy or chemical storage facilities, release of chemical or biological agents, or attacks on water supplies. Nuclear attacks on critical resources would render them unusable indefinitely.

  Targets can be anywhere in the world and be associated with terrorism, anti-terrorism conflicts or local or regional wars or related accidents. Some attacks could have important economic consequences and/or create mass migrations that exacerbate environmental impacts, impede response or change the nature of response.

  New technology could help contain fish and other smugglers and reduce piracy, which is a serious problem in Asia. However, unless there is an effective cooperative effort, technology could help the smugglers and pirates far more. The war on terrorism may build capabilities and mechanisms that ultimately are used to provide safeguards against smuggling and piracy.

International cooperation creates many challenges. There is less faith in science in some parts of the world. Divergent laws, regulations and interests must be reconciled. NOAA will find it necessary to support

negotiation efforts with scientific evidence and management capabilities on many issues and across vast geographic and cultural distances.

International Comparisons of Attitudes Toward Science and Technology
(percent that agree)

Attitude	**U.S.** (2001)	**U.K.** (2000)	**Japan** (1995)
S&T are making our lives healthier, easier, and more comfortable	86	67	51
The benefits of science are greater than the harmful effects.	72	43	64*

*Those disagreeing with the statement, "I can't find any value in the activities of scientists and engineers.
Source: National Science Foundation, Science and Engineering Indicators 2000, text table 7.3.

Since NOAA has many responsibilities it has to deal with multiple counterparts in other governments. Many resource management bodies are regional, requiring interaction with many organizations. Issues are addressed in venues for international trade and development assistance as well as those specializing in resource management.

NOAA will be asked to take on increasing international roles in fisheries issues, providing scientific and technical support to international negotiations and treaties. Examples of areas of involvement include:

Cooperation with Russia in the Bering Sea

Management of highly migratory species under the Multilateral High Level Conference with the Western Pacific Regional Fishery Consortium.

NOAA staffing and organization will have to evolve to reflect the scale of activity and the level of leadership required for effective participation in international venues.

Resource Management Issues in NOAA

SOME OVERALL ISSUES

NOAA will face a growing number of issues arising out of the increasing complexity of requirements of science and management. Challenges of complexity take many forms, among them:

- Requirements for cooperation of many disciplines in development of data and analyses and implementation of resource management approaches.
- The need to deal with "systems of systems" in interagency, interdisciplinary and international venues. This is encouraged by developments in networks of information networks, in national security, and by the evolution of ecosystem approaches that integrate knowledge across ecosystems.
- Growing attention to international measurement, research, and management.

Effectively maintaining focuses on both science and complex socially oriented resource management initiatives will present a major ongoing challenge.

- Developing and implementing regional and ecosystem approaches and making use of the rapid advances in biology and related fields will require NOAA to utilize many disciplines, including giving much more attention to the biological sciences.

- There will continue to be questions of how organizationally separate science should be from regulation. Closeness can allow science to be more fully used in decisions but open science to greater political pressures. The greater the political pressure, the more important is separation. The greater the ability of science to deal objectively with socioeconomic issues behind the pressures, the more important is closeness.

- The extensive negotiation required by managers employing evolving methods of resource management will necessitate developing skills and organizational structures that go beyond the scientific emphasis that is at the heart of the agency.

NOAA will continue to face challenges in developing skills and management capabilities for interfacing with private industry and dealing with universities and not-for-profit organizations. There is a growing need to develop and foster regional and local organizations and consortia in areas ranging from fisheries management to providing applied regional climate information and services.

Some Parallels between NWS and NMFS

While most discussions emphasize the differences between NOAA's weather and climate operations and its fisheries activities, there are important parallels between NWS and NMFS.

- Both have a need to manage people in scientific and in management roles. While scientific thinking and knowledge are important for many program and policy functions, people with science backgrounds are not always comfortable in or effective with management responsibilities.

- Both need to promote positive relationships with other organizations. This is a particular issue for NMFS because of its regulatory roles, but it also is an issue for NWS in its relationships with the private weather services industry, which has interest in greater cooperative planning.

Recognition of similarities as well as differences is useful in understanding successful activities inside and outside of NOAA and adapting them to other situations.

Contrasting Environmental with Economic Development and Security Emphases

NOAA's programs are a mix of imperatives of science and technology and adaptation to policy emphases in the broader society. The main policy emphases competing for attention are economic development, environment and security, broadly defined.

The table below illustrates some of the implications that come to the fore with each of the emphases. For example, a focus on economic development is likely to entail rapid introduction of technology and information services, more interactions with the private sector and greater involvement of industry to set and enforce regulatory parameters. Emphasis on the environment would be expected to give special attention to global climate change in data collection, modeling and analysis, with increasing local detail. It also would be expected to involve increased regulation of fishing, both at the local and coastal zone levels. Security, with its focus on antiterrorism actions, military engagements and their consequences, would be expected to involve extensive interagency activities, with more initiatives determined by requirements of other agencies.

Three Emphases and Their Implications

Economic Development	Environment	Security
Accelerated use of new technology	Greater investment in long term global climate change data collection	Greater protection of personnel, assets and systems
Making more information available, faster, more widely and in more desirable forms	Provision of more local environmental data	Developing data and research for use in antiterrorism activities and military engagements
More efforts to learn from successful private sector approaches	Increased modeling and analysis	Increased joint activity with military and other agencies
Increased partnering with the private and academic sectors, including licensing and contracting for production and distribution of information and analysis	Increased regulation of fishing	Pressure for research with practical and/or more immediate results
More industry self-regulation	More coastal zone analysis and regulation	More research and data collection decisions dictated from outside NOAA
	Development and use of new approaches may be embraced as a way to achieve better results or sidetracked by impatience	

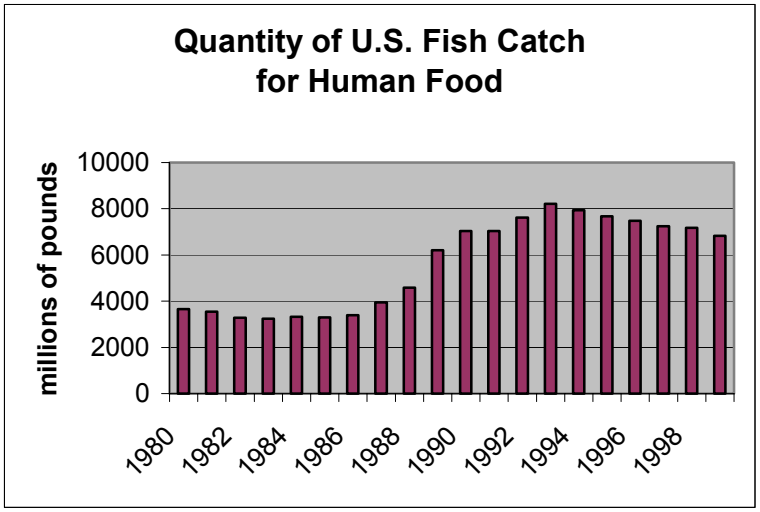
The consequences of the three emphases will sometimes be in concert and other times will go in competing directions. Broad policy emphases can shape the balance but will not always provide sufficient guidance for reconciliation. Many choices will be resolved at the individual program level.

RESOURCE MANAGEMENT FOR FISHERIES AND OCEANS

Overcapacity

The Nature of the Overfishing Problem

The case for regulation is often described as a straightforward problem in the economics of public goods. No individual has an incentive to take care of the resource. The "Law of the Commons" applies. "Overfishing occurs because the fish are free." The true nature of the concern is more complex.



In industries where the cost of the natural resource is a small part of the cost of the end product, variation in the cost of the resource does not greatly affect the full cost of the end product. In the case of seafood, the end product includes costs of storage, processing, transportation and time and resources used in preparation in restaurants or by consumers at home.

Since the cost of seafood is a small portion of the full cost, the extent of fishing overcapacity should not be large. If it were, one would expect harvesters to expand until the price was driven so low that excess capacity would be worked off as less efficient harvesters went out of business. But in fishing the concern is that supplies will dry up if not restricted because depleted fish stocks will not bounce back if fishing beyond certain levels persists.

U.S. Overfishing

The extent of overfishing has declined recently but remains high. In 2001, according to the NOAA 2002 annual report to Congress:

- 81 stocks out of 244 or one third were classified as overfished.
- 65 stocks out of 295 or 22% were classified as experiencing overfishing.

Society cares both about the existence of each species and the population of all fish. Overfishing reduces biodiversity both directly and because it exacerbates bycatch. And overfishing globally is seen as threatening supplies for future generations.

That is quite different than the concern in agriculture where new supplies can easily be created. However, like agriculture there also is an interest in protecting jobs and incomes. And like agriculture, reducing excess capacity can take generations as people hold on to traditions and communities.

In agriculture, technological change, stimulated by technical assistance, price supports and subsidies, has enabled rapid growth in supplies and development of new breeds with desirable properties. In fishing,

technological change has improved harvesting and contributed to overfishing. Can't technology also produce more fish?

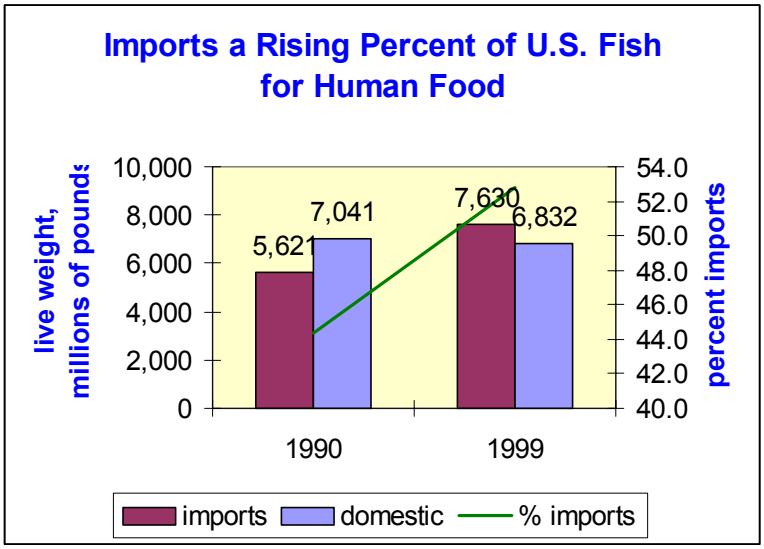
Efforts at fish farming have been extensive. The FAO predicts that most of the increase in world fish production to 2010 will be in aquaculture because it is growing rapidly. While fish farming is large and will continue to grow, it will take a long time before its growth is large enough to overcome the possible effects of a pessimistic scenario for production of capture fishing on total fish supply.

Moreover, growth of fish farming may be kept moderate because objections are raised to potential reductions in biodiversity through breeding, the intermixing of species that can result when fish escape and about the impact of genetic engineering when species are introduced into the wild. In developed countries, where high costs and issues of water availability already greatly limit fish farming, these concerns can be especially potent. However, such concerns would have to spread to developing countries to have a large impact on global fish farming production.

FAO Projection of World Fishery Production in 2010
(million tons)

	1999	pessimistic scenario	optimistic scenario
Capture fisheries	92	80	105
Aquaculture production	33	27	39
Total production	125	107	144
Food and Agriculture Organization			

U.S. fish consumption has increased while annual fish catch has been declining since the mid-1980s. Imports have filled the gap.



Prospects for Overcapacity

U.S. overfishing will remain a great concern. Capacity reduction will be long and gradual because:

- People respond to new conditions slowly, with the least productive often leaving first.
- Technology can sharply raises the productivity of harvesting.

Payment to fishermen to reduce capacity will only affect a small portion of the productive capacity in the industry because it is expensive, and it may tend to remove only the least productive resources.

Limits on fishing will continue to be the main way in which capacity is reduced. Those restrictions:

- Target rebuilding of fish stocks while often adversely affecting the economic health of the fishing industry for many years.
- Do not provide compensation for the fisherman's losses of income and assets that result from the concern for biodiversity of the society as a whole.
- Create difficult issues of how losses should be distributed.

As a result, the use of restrictions will remain highly contentious and subject to extensive negotiation and litigation. That will slow the introduction of restrictions and increase the frequency of rules changes. A more cooperative climate would both facilitate effective regulation and improve the economic health of the industry.

Incentive and governance approaches can increase cooperation, improve allocations and create more desirable behavior. While they will become more prevalent, they will take a great deal of effort at the local level and their effective use will be highly selective.

Marine Management Trends and Issues

The growing ecosystem approach is particularly evident in international efforts to protect highly-migratory species, especially those with long times to maturity. There is growing evidence and recognition that migration patterns can be greater than previously thought.

Alongside the emphasis on broader geographic areas with the evolving ecosystem approach, NOAA will be doing more at the regional and local level to develop incentive approaches such as quotas and permits and management and governance structures to support them.

NOAA's local approaches will involve greater reliance on the private sector in quasi-self-regulation settings.

In spite of the flexibility of the new tools, there has been a trend toward placing more areas off limits. Marine Protected Areas are being widened domestically and developed internationally. Marine reserves, which prohibit development entirely, have become more prevalent and environmentalists are pressing for many more. Only 12% of the U.S. offshore area – out to the 250 miles of the EEZ – is available for energy leasing. Vast areas have been locked up either by annual congressional moratoria or by executive order. Such developments reflect a move beyond the "wise use" of conservation to protectionism.

The use of science in regulation and the impact of regulation on science comes to the fore in fisheries management. NMFS has had a program of science quality for several years. Efforts are underway to establish a science quality assurance program that will build on the efforts of marine science centers to develop measures. The process is at an early stage and can be expected to become much more extensive

and operational. However, there will continue to be questions of how organizationally separate science should be from regulation.

Technology is providing solutions to a number of major problems. For example:

- Mapping software is helping to design marine reserves in ways that are that are more politically acceptable and ecologically effective, using it to test thousands of possibilities for viability.
- New net designs that take advantage of fish behavior to let unwanted species escape are available for reducing bycatch.
- Multibeam data sets, developed by Canada's Seabed Mapping Program, provide an almost photographic image of the bottom and sharply reduce the impact of dredging by limiting coverage to the desired area. The technique can be used to bolster international jurisdictional claims.
- Scientists at the Woods Hole Oceanographic Institute, funded by NOAA's Coastal Oceans Program, are finding ways to use clay to smother algae that produce red tides (Fairfield).
- Work is nearing completion on a computer model of New York Harbor that will help in planning the dredging of more than 65 million yards over the next decade by the Army Core of Engineers to make room for a new generation of supercargo tankers. By identifying locations and movement of pollutants the project seeks to dramatically cut the cost of disposal.

Use of these particular technologies is limited thus far. Much more will be done to apply recently developed methods. Some will become widespread because they will be used to meet regulatory requirements. The use of new technologies raises the issue of whether NOAA's regulations, e.g. on matters like bycatch and trawling, rather than requiring specific technologies will apply to results — so the parties can be free to chose the best means as technology changes.

The use of new technologies raises the issue of whether NOAA's regulations, e.g. on matters like bycatch and trawling, rather than requiring specific technologies will apply to results — so the parties can be free to chose the best means as technology changes.

As interest in undersea areas grows, marine regulation increasingly will involve land management, directly or indirectly controlling uses of the seabed that go beyond those prevalent today.

Government Initiatives

POLICIES, TREATIES AND LAWS

Ocean Policy Review

The U.S. Commission on Ocean Policy was created by Congress in the Oceans Act of 2000. An interim report was released in September 2002. The Commission expects to issue its final report in June 2003. Within 120 days of receiving the Commission's report and after consultation with states and localities, the President is required to submit to the Congress "a statement of proposals to implement the Commission's recommendations for a coordinated, comprehensive policy for the responsible use and stewardship of ocean and coastal resources."

The Commission on Ocean Policy's responsibilities are to provide:

- "An assessment of existing and planned ocean-related facilities and technologies.
- A review of existing and planned Federal ocean and coastal activities.
- A review of the cumulative effect of Federal laws and regulations governing ocean and coastal activities to identify and resolve inconsistencies and contradictions.
- A review of known and anticipated supply of and demand for ocean resources.
- A review of the relationship between Federal, State, and local governments in planning ocean activities.
- A review of opportunities for development of ocean products and technologies.
- A review of State and Federal efforts to enhance the effectiveness and integration of ocean and coastal activities.
- Recommended changes to U.S. law to improve management, conservation, and use of ocean resources.
- A review of the effectiveness and adequacy of existing Federal interagency ocean policy coordination."

The Stratton commission was instrumental in establishing U.S. ocean policy and structure more than 30 years ago. That has led to some anticipation that the new commission will have far-reaching effects, even including the possibility of a federal oceans department.

Admiral James D. Watkins, U.S. Navy (retired), chairman of the Commission, has been quoted as saying: “We’re already assuming that there has to be a national ocean policy coordinating body.”

Admiral James D. Watkins, U.S. Navy (retired), chairman of the Commission, has been quoted as saying: “We’re already assuming that there has to be a national ocean policy coordinating body.” In the cover letter to the September 2002 interim report he states: “…policy may well call for new and creative governance mechanisms.”

The impact of the Commission on Ocean Policy is uncertain because of the complex climate, but a number of factors could come together, including upcoming legislative reauthorizations and the impact of the Pew Oceans commission, to produce significant change.

The Pew Oceans Commission is emphasizing environmental issues and positions. It has held public meetings and has begun drafting recommendations. It is expected to release its final report in December 2002 or thereafter.

The Pew Oceans Commission could generate interest in more protective responses. Issues include coastal development, no fishing zones in marine protected areas, coastal pollution, invasive species and biodiversity.

The debate initially could focus on the emphasis to be given to economic vs. environmental considerations. The less complete the economic recovery by the time the decisions have to be made, the more the balance could be influenced by concern for jobs. However, that may only delay legislation and the eventual environmental measures could be strong.

The war on terrorism and associated changes in organizational structures and responsibilities within government could have a significant impact on the organizational paths that Congress takes when it receives the Ocean Commission report.

Magnuson-Stevens Reauthorization and other Legislative Issues

The timing and nature of reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act are uncertain because of the large number of stakeholders with varying interests. There may be efforts to reduce complex regulation and devolve more authority to local groups. Socioeconomic issues may take on greater importance. While there are important pressures for some sort of legislation, the reauthorization appears to be addressing relatively incremental changes and relying on studying some issues rather than on making major changes.

The Marine Mammal Protection Act, the Coastal Zone Management Act and the Endangered Species Act will soon come up for reauthorization as well.

Legislative efforts are being directed in other directions in the new security environment and attention is starting to shift to the next presidential election.

Some members of Congress and environmentalists may wish to wait for the retirement of Senator Stevens and others that have been seen as favoring fishing interests in order to achieve more extensive legislation later. The result could be an environment in which issues percolate but are not broadly acted upon for several years.

However, the climate of reauthorization of major legislation, along with attention from commissions, plus increasing interest in a comprehensive approach, could lead to important changes even where they are not currently expected. Moreover, the Congress does not seem to share the current Administration's penchant for reducing micromanagement.

NOAA will have to be ready to address proposals for a range of legislative possibilities and for receiving resulting responsibilities. That will require breadth of management so that current responsibilities will not be compromised and opportunities to use legislative change to chart a course will not be foregone.

U.S. Accession to the "Law of the Sea" Convention

U.S. ratification of the Law of the Sea Convention has faced sufficient opposition and lethargy to prevent Senate consideration. In fact, the emphasis of the George W. Bush Administration has been on moving away from some international treaty requirements and away from being bound by conditions associated with treaties the U.S. has not signed. On November 14, 2001 The U.S. Commission on Ocean Policy passed a unanimous resolution urging U.S. accession to the convention and the Administration weakly announced support for the treaty at that time. The Commission repeated the resolution in its September

2002 interim report. However, support has not yet grown and the Administration has not pushed for accession. It is not clear whether the Commission on Ocean Policy, by bringing the issue of accession to the Law of the Sea convention into a larger coalition for ocean policy can significantly increase its prospects.

Even if the U.S. joined, there might be little development outside EEZs for some time because the terms are often viewed as prohibitive.

It is not clear whether the U.S. or other non-parties will be able to submit claims. The Convention and the Commission's rules are silent on the subject and the issue is in dispute. If the U.S. does something different than the commission recommends, the legal status of those actions is uncertain.

Under the Law of the Sea Treaty nations are beginning to delineate the boundaries of the outer continental shelves. This includes areas that go beyond the EEZs. The U.S. will need to delineate it's own continental shelf (the "area" of the EEZA) and develop the information that will enables it to make the determinations. The oil and gas industry has an interest in knowing the boundaries with greater certainty.

NOAA can expect increased demands for assistance in delineating the boundaries of the outer continental shelves.

GOVERNMENT BUSINESS MODELS

Public/Private Sector Boundaries

NOAA has an increasing need to collaborate with other government agencies, both at the national and local level. At the same time, growth of private sector capabilities and the scale of firms, universities, research centers and networks of organizations and individuals creates opportunities for NOAA to rely more on the private sector. The growth of the Internet, electronic commerce and electronic government are critical areas where boundaries will be changed and new forms of collaboration developed. The greater variety and scope of relationships produces many challenges to clarify, redefine or defend the role of government and the ways it gets things done.

NOAA is moving activities to the private sector under A76 reviews. It undertakes major contracts in areas such as satellite development and supercomputing. Privatization, in the sense of transfer of whole organizations to the private sector, has been very limited in the U.S. and that is not likely to change.

NOAA and other agencies are emphasizing providing "products" as a way of defining and measuring what they to improve efficiency. The definition and in some cases standardization of products also can serve as a basis for comparison among ways of obtaining or delivering the service. As a result, over time the product approach can open the way for greater private sector competition.

The degree to which outsourcing is in fact facilitated will depend on how successfully the product emphasis is able to increase efficiency within government. The potential of private sector challenges could lead to increases in government efficiency and limit the actual extent of reallocation.

The U.S. is the leading proponent of free and open exchange of data. This reflects a more open philosophy generally than many other countries. The open approach has been critical to the development of the private weather services industry.

Government roles in research and information services have been based on a desire to achieve broad benefits to the public beyond those that would be expected from private activities that would be supported by charges.

The role of government is being challenged in the provision of weather services where there are areas of direct competition such as weather Web sites and models, and new services are vied for at the margin. The central policy of making data available strongly supports private sector growth for enhanced services and specialized distribution. However, *more could be done to coordinate with the private weather services industry to reduce conflict and facilitate cooperative expansion of services.*

Boundaries between the public and private sectors will be shifting as a result of the increasing capabilities of the private sector, its technological sophistication, access to risk capital, the growing scale of firms, and the ability of private organizations, whether they be companies, universities or research centers, to network with each other to extend their scope and reach. In the information age, those capabilities include widespread access to information and strong private incentives to develop it.

NOAA will be engaged in continual negotiation with the private sector over where boundaries should fall and how interactions should take place. W*eather services will continue to be a principal area of controversy regarding public/private roles. Other areas, particularly measurement of the local environment such as air quality, will become sources of tension as NOAA expands its activities and as the potential size of the private market becomes more interesting.*

The expansion of activities related to the environment and the stewardship of resources place NOAA in a position of being regulator as well as scientist. Regulatory responsibilities will expand in relation to oceans and arising from NOAA's lead role in the area of climate change. NOAA actively relies on outside research to support its mission and improve knowledge and education.

Many considerations can enter into decision about public/private sector roles for research, information and analysis. The need to balance these issues and the fact-specific nature of the decisions can elicit conflicting views that may require extensive discussion.

Among the considerations in determining roles are:

- How vital the information is for public purposes, notably health and safety and protection of property.

- How much incentive the private sector has to develop the service. If information is easily spread without the ability to charge, there is little incentive to invest in its development. Markets that do develop may be fragmented and inefficient.

- How rapidly the private sector is likely to develop extensive service coverage. For example the nation is not be willing accept great uncertainty and wait several decades while private firms try to develop critical mass in collecting the original data required to provide widespread local weather service.

- How complete coverage is likely to be once developed and whether there are alternatives for assuring complete coverage. Private weather warnings based on original private data may not cover sparsely populated areas in sufficient detail and may not provide adequate coverage to poorer populations if relying on revenue derived from advertiser support. Contracting for services may or may not permit fully filling in the gaps.

- Whether the private sector would experience major discontinuities in service, development and investment as a result of cutbacks, reorganizations, mergers, acquisitions, bankruptcies and changes in business direction. In recent briefing notes Maria Pirone of weather services company WSI states:

  > "As quickly as new weather players emerge, others are acquired or dismantled-leaving the weather services industry in a constant state of flux."

  Private sector discontinuities would have to be compared with the ability of government to average risks over many projects and continue the service, recognizing discontinuities in government as well.

- How easily private sector activities could be monopolized, leading to undesirable effects on price, availability and service.

- The degree to which the government is able to keep up with rapidly changing technologies, including its ability to make capital expenditures compared to the private sector, delays in decision-making and authorization, inefficiencies in contracting that may affect the vintage of technology that can be purchased and the ability to attract and retain technical staff.

- Whether the government has low incremental costs as a result of performing related or similar functions. For example, using similar resources to perform basic weather services may make it possible to provide some enhanced services at much lower costs than would be possible in the private sector. Some weather modeling is essential for issuing public warnings. Moreover, synergies between weather modeling and climate modeling, which combines basic research and

public responsibilities in the area of climate change, increase government capabilities for weather modeling.

Such calculations would have to take into account all of the true costs in government, including costs of oversight agencies and possibilities for private sector efforts that could reduce unit cost through innovation or sharing of costs with other users.

- The ease or difficulty of financing provision of services through private organizations, whether under grants or contracts, including the cost and effectiveness of monitoring and providing incentives to achieve desired goals.

One area in which issues of private sector roles arises for NOAA is high performance computing. This is discussed in an Appendix.

It is possible that federal government efficiency will improve after the 9-11-01 attacks provided a wake up call and exposed many deficiencies. Some of that improvement may reduce the need for shifting production to the private sector and security considerations could reduce cause some activities to be kept in house as well. But significant improvements also can come about through appropriate increases in contracting and partnering.

Networking and Partnering

Rapid technological change and the evolution of sophisticated organizations and networks are creating growing opportunities for NOAA and government generally to build on the capabilities of firms, research organizations, universities and/or other government agencies. Through the many possible forms of involvement government can facilitate efforts of private organizations to fulfill functions previously performed by government.

NOAA can work with other organizations in many ways. It can be a catalyst, organizer, partner, owner, member, customer or supplier. It can take active roles in encouraging and organizing efforts, especially where many organizations are involved. NOAA will want to explicitly determine appropriate roles in each circumstance and define ways of managing those roles.

Increasingly, the question is not what government should do, but what government should take responsibility for. There are many ways in which that responsibility can be provided for.

Some of the ways NOAA can partner and/or participate in networks of organizations are indicated in the chart below. It shows what the NOAA role might be if NOAA had a particular function and the potential partner another function. That is, the chart is read from left to right. Fore example, if NOAA acts as an organizer it can be a catalyst to external funding organizations or promote the effort among potential customers or clients of the service.

Some Possible NOAA Roles in a Network or Partnership (read from left to right)						
		Partner Function				
		organizer	**funder**	**owner**	**operator**	**customer**
NOAA Function	**organizer**	co-initiator	catalyst	catalyst and shaper	catalyst and shaper	promoter
	funder	supporter	co-supporter	shaper and supporter	shaper and supporter	catalyst
	owner	shaper	manager or conduit	co-owner	strategic outsourcer	promoter
	operator	developer, supplier	developer, supplier	developer, supplier	co-operator, shaper joint purchaser	supplier, integrator or distributor
	customer	buyer providing critical mass, shaper	buyer providing critical mass, shaper	buyer providing critical mass, shaper	buyer providing critical mass, shaper	catalyst, group buyer

Privatization

The process of privatizing state-owned firms has been strong across the globe for more than two decades. Fiscal considerations of governments often have been even more important than recognition of advantages of private production for efficiency and innovation.

Privatization has been driven by a need for revenue from the sale of businesses and a desire to stop paying heavy subsidies to cover losses. Also, heavily indebted governments have sought the access to capital that private firms could provide. Even where the private sector was not far ahead of the government operation, it sometimes was believed that private firms would be better able to make large workforce reductions and in some cases that more efficient foreign firms would come in.

Privatization has been limited in the U.S. because of the much smaller role of government enterprises and greater reliance on the private sector generally.

In some cases, resistance to privatization has developed because of opposition to paying twice for capital expenditures. That occurs when a firm buys assets such as a pipeline that has been paid for with taxpayer revenue, the firm pays a price for the assets that reflects their market value and it then raises prices to the consumer to cover the cost of debt that was used to buy the assets.

The U.S. more often is privatizing "from the bottom up" through detailed reviews of activities, rather than "from the top down" by disengaging from entire industries. Where the activity is contracted out, public responsibility is maintained directly while private production is funded by the public sector. Budget pressures can cause privatization and contracting to go further.

It is not clear how much recent accounting and business ethics scandals will affect contracting and privatization in the U.S. over the long term. Actions of companies and regulation are causing adjustments that can allow a return to healthier business practices fairly rapidly. However, residual public attitudes may cause resistance. One impact could be turnover of elected officials that leads to changes in policies that may persist.

Open Access to Data

Where government provides information services it has to take into account the impact on the development of services in the private sector. Many information services are highly price sensitive, so keeping the cost to the consumer low can lead to great expansion in markets. The U.S. has had a policy of ready access to public weather and environmental information and both the public and private sectors have benefited.

> "In the US, open and unrestricted access to public sector information has resulted in the rapid growth of information intensive industries particularly in the geographic information and environmental services sectors"
>
> Peter Weiss, "*Borders in Cyberspace,"* p.2.

In contrast to the U.S. policy of charging private users only the cost of dissemination, European nations generally charge full costs. The result is that private weather services have fared poorly in Europe, weather service firms that have been successful in the U.S. have had great difficulty in Europe and "…efforts to build transnational data sets, be they meteorological or environmental…, statistical or cartographic, are hampered by national policies bent on preserving intellectual property to pursue local cost recovery policies." (Weiss, p.3)

In addition to failing to stimulate private development, biases against the private sector can arise when the government uses a cost model Government may raise charges above costs for sale of data to private vendors to obtain revenue. The power to stop a competitor may be increased when government is also a regulator. Spin-offs from government operations may come with advantages unavailable to private competitors, such as prepaid technology and product development costs, pensions, low interest rates, and commercial and political relationships.

Because it only charges for costs of dissemination and not data collection and monitoring, NOAA sales of information are tiny. NESDIS receives $2.7 million per year from three data centers. Most of the data are ordered online and delivered online by FTP. There is some fax for weather data and a small number who receive data by CD-ROM. Bandwidth is limited to 50MB but that will change soon ad allow more growth. Nevertheless, *revenue from data sales will remain small compared to overall costs.*

Private commercial firms that wish to process and redistribute information will increase pressure on NOAA to provide data in basic forms through automated processes in real time.

There also will be increased pressures to release data, research and models from pubic policy interests, including other government agencies and research organizations. The experiences of the Freedom of Information Act and the Data Quality Act illustrate the growing demands for availability of policy information and the creation of frameworks for meeting those demands.

Interest in open access will extend from weather to a broader range of climate and environment data as NOAA increases its offering, as technology for electronic media and private services develop and as public policy debates grow,. NOAA will have to deal with those demands in its positions on roles of government vs. other entities, in its technology planning and development and in assuring the integrity of its operations.

E-Government

U.S. and International Developments

Electronic government encompasses systems for public and employee information, purchasing, payment and other transaction services, contract management, regulatory communication and more. The focus here is on Web-based services.

More than 68 million Americans have visited government sites, according to the Pew Internet & American Life project. The most frequent uses cited and their use rates were:

Getting tourism and recreation information	77%
Doing research for work or school	70%
Downloading government forms	63%
Finding out what services a government agency provides	63%
Seeking information about a public policy or issue of interest	62%
Getting advice or information about a health or safety issue	49%

After that use falls to 34% and below for other objectives.

In a broader survey of efficiency of government agencies in 2001 by Government Executive magazine and George Washington University, the National Weather Service received straight "A"s in its overall grade and in each of the components — managing for results, financial management, human resources management, information management and physical assets management. It was commended for its emphasis on keeping weather information up-to-date and accurate and its systems up and running, for above average communication and use of information technology to strategically restructure. (Dean)

E-government has made a lot of progress. In a detailed analysis of 2,288 government Web sites in 196 nations during the Summer of 1991, The World Markets Research Centre and Brown University found that:

72% of national government Web sites have an English version.
45% of sites offer two or more languages.
71% provide access to publications and 41% have links to databases.

However, only 2%-8% feature a one-stop services portal or have links to a government portal, offer services that are fully executable, accommodate the disabled, show privacy policies or have security policies.

Of course, sites in the more developed countries typically were better.

Accenture evaluated more than 160 national government services during 2001. The study noted:

> "Governments have had a number of harsh realities to deal with—everything from the pressures of increasing service demands to more closely managed government spending to human capital shortages. All of these drivers are forcing governments to look at new models of service delivery that were more reliant on electronic channels."

The study found that much more needed to be done to enable people to complete transactions online rather than just access information.

Countries with an overall approach and leadership behind it did better.

Canada was particularly successful with cross-agency implementation, a major hurdle in most countries.

The Federal government has made significant advances in electronic government and NOAA is at the forefront of those efforts. NOAA's Web sites receive about 300 million visitors per month, about 200 million of which are in the National Weather Service. The National Weather Service site is by far the stickiest in government — people stay longer. NWS's research shows high satisfaction with the navigability of its Web site. Offering both functional and organizational paths facilitates finding information on the NOAA Web site. The site once again demonstrated its value to employees and stakeholders with the rapid posting of the full report on its Program Review and its guidelines for under the Data Quality Act.

E-Government in NOAA and the Federal Government

NOAA participates in at least eight of the 24 OMB e-government initiatives. The Department of Commerce has identified 130 e-government applications that are most amenable to being set up as transaction-based. The agency is focusing on 30, about half of which are in NOAA. Web sites are at the heart of many efforts.

NOAA has demonstrated excellence and continued progress in electronic government. Additional possibilities include:

- *Moving beyond early stages in developing transaction capabilities.*
- *Evolving more extensive interagency capabilities for Web and other applications.*
- *Developing cooperative arrangements with universities, research institutions and private firms to offer the user seamless navigation on the Web.*
- *Finding additional ways to communicate with international constituencies.*

A number of additional issues arise for the future. Some individuals may wish the capability to tailor home pages with NOAA links and streaming information. Over time there may be interest in mobile access to government functions and information. Public/private roles in mobile weather information will require early resolution to allow services to move ahead. Eventually there may be advantages to some automated voice systems or even interactively typed human responses or ability to switch to a live person for some purposes. Improved Web site access for the blind would require the ability to go to text-based pages to avoid the problem of automated readers having to read extensive heading information. Much ore will have to be done to take advantage of extensible markup language and other Web services capabilities.

Private business-to-business portals and exchanges have not been of great interest to federal agencies for purchasing and are not likely to be. The government is so large that suppliers do not have any trouble finding it. Large numbers of items and large orders do not readily lend themselves to exchanges reliance on competition among a large number of suppliers. The government has more security when unrelated transactions and users are not present. When the government operates its own portals it can integrate its contracting processes more fully. As a result, independent B2B operations will remain largely unattractive to the federal government.

Changes in on-line information with public and national security concerns after September 11, 2002 and potential effects of the Data Quality Act on withdrawal of information have raised concerns that a backlash against providing too much information may be brewing. Computer security breaches also raise concerns about what limitations should be in place. One example of reaction to the new environment is withdrawal of location information from NOAA's People Locator.

The result is likely to be temporary and selective slowing of the ongoing trend to providing more information rather than long term reversal of direction. Changes may result in more appropriate and better information and security. There already has been a restoration of a significant amount of information that was pulled from the EPA Web site after September 11, although in some cases with restrictions placed on who can access it.

The federal Infrastructure Protection Board is seeking to build a secure GovNet for government use only. However, a draft of the report of the administation's cybersecurity advisor Richard Clark in September 2002 states that the federal government should not install wireless networks until security features are improved. If GovNet is built as a separate system at all, it is not likely to accommodate wireless access anytime soon.

Over the next decade we can expect that the U.S. federal government will make substantial gains in electronic government through its systematic efforts and coordination as well as through advances by individual agencies. State and local government systems also have made progress and will continue to add services as well as information. For some functions, considerations of privacy and security, whether real or unfounded, will prevent developments from proceeding as rapidly as would otherwise be possible.

Keeping Up with Web Services and XML

The development of extensible markup language (XML) creates a challenge because participation in setting standards and structures must be done well in advance of use. The federal government has tended to lag and risks losing the ability to easily build on systems in their early years. As the General Accounting Office noted:

> "The federal government faces many challenges as it attempts to gain the most from XML's potential. First, no explicit government-wide strategy for XML adoption has been defined to guide agency implementation efforts and ensure that agency enterprise architectures address XML incorporation. Second, federal agencies have not yet identified and consolidated their needs for effective representation before key standards setting bodies. Third, the government has yet to establish a registry of government-unique XML data structures for systems developers to consult when building or modifying XML-based systems."
>
> General; Accounting Office, *Electronic Government: Challenges to Effective Adoption of the Extensible Markup Language*, April 5, 2002, abstract.

Appendix A: Implications of Trends for NOAA by Function

Implications of Trends for NOAA by Function - Overview

(relative importance indicated by presence and size of x)

Trend	Mission and Vision	Observing Systems	Research and Prediction	Resource Management	Management and Human Capital	Infrastructure	Relationships with Other Organizations and the Public
Observing technologies and their platforms – sensors, satellites, unmanned ocean vehicles, etc.	X	X	x	x	X	X	
Communication technologies – broadband, wireless, Internet, etc.	X	X	X	x	X	X	X
Globalization	X	X	X	X	X	X	X
Climate change and climate change initiative	X	X	X	x	X	X	X
Government demands for services	X	X	X	X	X	X	X

Business and consumer demands for services	X	X	X	X	x	X	X
Business structure trends	X				x	X	X
Economic trends	X			X			
Budget climate	x	x	x	x		X	
"Smart regulation"	X	x	x	X	X	X	X
Ecosystem management	X	x	x	X	X	x	X
Increased regulatory responsibilities.	X	x	x	X	X	x	X
The President's Management Agenda	X				X	x	X
National and domestic security	X	X	x		X	X	X

Implications of Trends for NOAA by Function - Detailed

	Implications by Area						
Trend	**Mission and Vision**	**Observing Systems**	**Research and Prediction**	**Resource Management**	**Management and Human Capital**	**Infrastructure**	**Relationships with Other Organizations and the Public**
Rapid rate of technological change and innovation, including convergence of technologies and applications Key technologies include broadband, satellites, supercomputing, sensors, Web services, wireless communication and unmanned ocean and air vehicles.	Creates opportunities for increased role of science in decision-making Increases need for government to become more business-like. Rapid obsolescence creates a need for more rapid replacement and greater coordination of acquisitions and uses among NOAA units — including rethinking how things will get done when new	Combinations of technologies such as satellites and sensors with unmanned ocean and air vehicles create capabilities for global and integrated observing. Makes it possible to handle the massive increases in data that will be generated.	Revolutionary effects can be expected to come through cumulative impacts of evolutionary changes in and interactions of technologies. Advances in mathematics and supercomput-ing enable provision of climate and weather forecasts for detailed geographic areas. Revolutionary	Creates a climate that benefits from greater reliance on markets and more flexible regulation. Creates specific solutions such as nets that reduce bycatch, trawling methods for shrimp that reduce destruction of habitats and mapping technologies that identify habitats requiring protection. Assuring use of some of these technologies may require	Requires strong management at a level that facilitates cross-fertilization and integration of activities. Creates benefits from arrangements to move more rapidly from research findings to operations. Demands a greater range of disciplines and people with knowledge of the latest technologies. Creates greater	Increases the importance of responsive systems and policies for making technology decisions and keeping up with rapid change when obsolescence is high. Areas where keeping up with technology is an issue include: The explosive growth in satellite data. Opportunities to use Web	Creates a need to rely more on the private sector to provide some of the increased technological capabilities NOAA requires and to meet some of the financing and capital investment requirements. Requires capabilities to make information and services available in ways that meet the demands of a technologically sophisticated private sector that increasingly is a

	technologies are available and how the technologies complement, change or replace preexisting systems. Convergence of technologies also increases the need for coordination of acquisitions and uses among NOAA units.		changes also can be expected from evolutionary changes in technology that permit breakthrough discoveries. Discovery of El Niño and the Southern Oscillation. Discovery of the hole in the ozone layer.	regulation or funding demonstrations. However, also creates capabilities for greater destruction of habitats, such as through tools for finding and dredging, requiring further intervention. Opportunities for electronic consultation and rulemaking.	need for people capable of managing technology. Creates a need to deal with information overload on top managers. This typically involves delegation of responsibilities and decisions to decentralized units, which in turn requires attracting and developing personnel capable of management roles. Facilitates more flexible work arrangements.	services technologies in government. Requires development of new infrastructure for unmanned ocean vehicles and other new systems, along with adapting the role of the NOAA fleet. More competition among technology standards lengthens time to agreement but potentially allows better choice of standards. Need for active and early participation in standard-setting processes to fully benefit from outcomes.	direct or indirect partner in serving end users. Creates opportunities for more extensive use of the Internet and other forms of electronic communication and commerce. Growth of broadband enables sharing of large data sets among organizations and researchers and providing streaming multimedia. Increased importance of science education.

	Mission and Vision	Observing Systems	Research and Prediction	Resource Management	Management and Human Capital	Infrastructure	Relationships with Other Organizations and the Public
Globalization	Requires expanded and more systematic international efforts, including scientific and measurement support for international monitoring, research, negotiations and dispute resolution. Terrorism and war add new dimensions to international responsibilities. Global commitments require leadership and assuring that managers give serious attention to international responsibilities.	Increased attention will be required to: Global ecosystems. International cooperation. Demands related to international negotiations, boundary determina-tion and dispute resolution. Private and government information for navigation.	Demand for more global analyses, with geographic detail for more areas. Increased international demands for services relating to climate change, fish migration, military and relief efforts and international negotiations. Increased importance of international cooperation in research.	Increased acceptance of complementarity between the environment and economic development involves NOAA in development issues. Conflict with other nations over the degree of government intervention on climate change and other environmental issues.	Potential benefits for recruiting more people with language skills, people who have lived or worked in other countries and people who have dealt with international organizations. Possible benefits of rotational assignments with other countries and international organizations.	Need for resources for infrastructure development and maintenance to support global systems. Need to determine when new observing technologies can be cost-reducing. Locations of some activities may be far flung. Issues of how to manage the transition from current systems. Possibilities of international collaboration on satellites, ocean monitoring or other systems and sharing of data, e.g. from Chinese environmental satellites.	Globalization creates demand for services from government and private organizations with international involvements. Renewed U.S. reliance on multinational institutions and networks increases demands for NOAA participation and support. Potential to use the Internet for communication tailored to international scientific and policy audiences and publics.

	Mission and Vision	Observing Systems	Research and Prediction	Resource Management	Management and Human Capital	Infrastructure	Relationships with Other Organizations and the Public
Climate change	Provides an opportunity to enhance NOAA's leadership in science and measurement 1) by its work, 2) by leading other agencies and organizations, and 3) by defining what information and research government as a whole should develop or cause to be developed. Requires support for large-scale scientific approaches and investments. Requires integration of efforts of many disciplines.	Makes global and integrated observing systems essential. Requires an ability to handle several orders of magnitude increases in the volumes of observational data from satellites and other systems which involve new generations of supercomputing and advances in mathematics.	Public concern, together with unwillingness to make great sacrifices, places a premium on: More complete and detailed explanation and prediction of climate change Assessment of economic, demographic and social consequences of climate change. Research support for developing policies, especially those that are less costly and restrictive.	Opportunity to foster a strong scientific basis for policy throughout government. Increased demands for information to support regulation. Continuing tension between approaches that emphasize science and those that emphasize precautionary policies before scientific answers are available will put on pressure to provide results and scientific assessments at early stages of research.	Requires management and arrangements that cut across many areas of activity. Creates demand for more people capable of developing climate models—with a possible role for NOAA in creating or supporting arrangements for developing the skills.	Demands new generations of supercomputing and advances in mathematics. Potential role for NOAA in working with other agencies to encourage the development of later generations of high performance computing and encourage development of competing sources to prevent monopolization of high performance computing.	Requires extensive interagency and international cooperation. Requires coordinating capabilities of universities, research organizations and private companies with government efforts. Importance of the problem, the range or uncertainty and the potentially far-reaching responses creates a heightened need for public education.

			Will result in demands for NOAA to assess impacts of efforts to address global warming. Requires integration of efforts of many disciplines.				

	Mission and Vision	Observing Systems	Research and Prediction	Resource Management	Management and Human Capital	Infrastructure	Relationships with Other Organizations and the Public
Government, business and consumer demands for services	Demands for more global and more local information. Increased demands from other government agencies. Increased international demands, including: Military, including information support for changes in military structure and force posture, domestic security, origin and spread of contamina-tion, missile	Increased public and business demands for weather and climate information and information on pollution and marine developments. International demands for information. Increased government demands related to security, economic development and relief, global developments in marine life.	Demands for more accurate prediction of weather and climate change. Demands for more local weather and climate data. Interest in air quality measures and warnings.	Demands for more science addressing the merits of regulations, including demands for more social science capabilities.	Requires internal organization and increased skills to manage expanded and more complex relationships with external organizations.	Need to maintain modern interfaces to accommodate users of information. Potential for public and private inter-organizational development of Web and other electronic services.	Demands for greater and earlier coordination with commercial firms when new services are introduced. Demands for greater international cooperation in data and research. Increased demands for information from the public and increased need for public education, satisfied through a wider array of distribution means.

	defense. Economic development and relief efforts. Disputes over use of the oceans, delineating boundaries of the outer continental shelf, charting passageways for navigation, global develop-ments in fish stocks and other marine life.						

	Mission and Vision	Observing Systems	Research and Prediction	Resource Management	Management and Human Capital	Infrastructure	Relationships with Other Organizations and the Public
Business, economic and budget climate	Growth of capabilities of the private sector to provide services that have been provided by government means that increasingly the question is not what government should do but what government should take responsibility for. Opportunities for NOAA to develop new types of relationships and act as a catalyst for initiatives to be fulfilled in the private sector.	Opportunities for new arrangements with the private sector as a result of changing organizational structures and capabilities. These may involve multi-firm organizations and a variety of possible roles. Greater competition for budgets with worsened budget balance. Increased demands for weather and climate information if higher energy prices.	Need for greater collaboration with universities and research centers to reach critical mass in numbers and range of skills and for and equipment for climate change science.	Economic development will put more pressure on coastal resources, domestically and internationally. Competition for water among communities and among uses will become more contentious.	Long-term shortages of technical skills and difficulty of government competing with the private sector for technical personnel require creating a desirable climate in NOAA.	Increased bandwidth and private sector capabilities facilitate off site location and contracting out of supercomputing. Competition reduces opportunities for sustained technological monopolies. However, shakeouts from competition, combined with restrictions on procurement, can create new monopolies (e.g. in supercomputing).	Opportunities to take advantage of innovation and resources of the private sector to respond rapidly to change, keep up with technology and utilize private capital.

	Mission and Vision	Observing Systems	Research and Prediction	Resource Management	Management and Human Capital	Infrastructure	Relationships with Other Organizations and the Public
Environmental and resource management policies **Trends include:** Global change initiative "Smart regulation" Ecosystem management Local approaches Technological solutions Data Quality Act Economic development as complementary to the environment Rejection of the "precautionary principle"	Potential for the combination of upcoming legislative reauthorizations, activities of the two ocean commissions and changes in Congress and/or the White House to produce much more fundamental legislative and policy change than is widely expected. Change also can come from leadership by NOAA. NOAA will be asked to provide more information and analysis to support regulation and could see expanded	Increased demand for ecosystem information. Demand for more global and more local information. Increased collection of air quality information.	Opportunities to foster the role of science in regulation. Opportunities to advance knowledge, utilizing data from global and integrated observing systems. Need for research to understand ecosystem interrelationships and responses to changes Increased analysis of air quality information and development of products.	Ecosystem approach Makes strong demands on internal and inter-organizational coordination. Requires extensive international involvement and cooperation. Requires integration of efforts of many disciplines. "Smart regulation" will require efforts to apply tools such as cost-benefit analysis,	Requires integration of efforts of many disciplines. Requires more management personnel with skills in both management and science. Requires greater capacity and coordination at the regional and local level. Requires structures to manage regulatory initiatives and rules and procedures.	Requires local operations offices with science capabilities.	Requires efforts to organize and support new governance structures (e.g. for fisheries management councils and ocean stewardship) and incentive systems.

	regulatory roles in fisheries, oceans and the beginnings of regulatory roles relating to climate change. Growth of regulatory responsibilities requires greater efforts at managing relationships between science and regulation. Growth of regulatory responsibilities requires integration of efforts of many disciplines.			incentive systems such as tradable permits, contracting, determining geographic scope, and developing governance and participation arrangements for self-regulation, more systematically. Need to evolve "smart regulation" approaches on an ecosystem scale. Need to resolve environmental issues relating to military facilities and activities, including training, encroachment of the surrounding environment and the military request for exemption to the Endangered Species Act.			

	Mission and Vision	**Observing Systems**	**Research and Prediction**	**Resource Management**	**Management and Human Capital**	**Infrastructure**	**Relationships with Other Organizations and the Public**
Government initiatives Initiatives include: The President's Management Agenda Environmental and resource management policies Ocean policy review War on terrorism, homeland security and disaster preparedness and response Changes in military structure and force posture	Need for a more systematic effort to interface with universities, research organizations and private firms. Opportunities for greater contracting with private organizations. Opportunities for public and private interagency cooperation in Web and other electronic services.	Anti-terrorism and military efforts create: Increased demands for international information. Demands for ability to determine sources and paths of chemical, biological and nuclear releases. Demands for internal protections and responses. Demands resulting from changing military structure and	The Data Quality Act can delay and/or complicate release of findings.	Growing regulatory responsibilities Require greater efforts at managing relation-ships between science and regulation. Require greater coordina-tion of NMFS and NOS activities. Will require both more interna-tional *and* more local efforts. Will involve	Requires greater coordination of ocean policy, legislation, regulation and operations. Requires greater interagency coordination. Increased capabilities required for management of outsourcing.	Need for coordination and reevaluation of uses of NOAA vs. other agencies' facilities, including substitution and cooperative arrangements.	Increased interagency responsibilities.

		structure and force posture to support rapid response. Demands for outsourcing to improve government efficiency. Increased scrutiny of release of information for security implications.		increased reliance on new approaches such as "smart regulation" and efforts to apply and adapt those approaches systematica lly Will require more personnel that have both science and manage-ment skills.			

Appendix B: Evolution of Multinational Corporations

The Evolution of the American Multinational

Kenneth Chilton presents an interesting perspective on the evolution of the American multinational company. The chart is developed for manufacturing but much of it applies more generally. His formulation was published in 1994, adapting and updating a 1989 chart by Christopher Bartlett and Sumantra Ghoshal. The analysis of the 1990s continues to apply to the new decade. The analysis of the 1990s continues to apply to the new decade.

Dashed lines indicate conditions continued into the next period.

Evolution of U.S. Multinational Corporations			
Year	**Competitive/Policy Environment**	**Firm Strategy**	**Firm Structure/Organization**
1950	U.S. dominant economic power	Domestic orientation	H-form (organized around functions)
1960		International/multi-national U.S. responsible for 59% of foreign investment held abroad	M-form (functions within product divisions) Large corporate headquarters Hierarchical — 10 to 15 layers
1970	Growing strength of Japanese and Western Europe Declining trade barriers	Increased exports *and* imports Global economies of scale for homogenous products	International divisions popular with U.S. and Western European firms Japanese firms typify global organizational form
Early 1980s	U.S. merchandise trade deficit becoming a political issue Recession highlights U.S. firm weaknesses. U.S. becoming "one among equals" LBOs force a focus on financials	Greater emphasis on world-wide sourcing "Searching for Excellence" Greater use of debt instead of equity	Quality circles copied from Japanese
Mid-1980s	Strong dollar increases trade deficits, creating pressure for local production EC trade barriers rising	Write-offs for restructuring become acceptable in financial markets, causing firms to review business portfolios and staffing Product innovations become a key weapon in the global competitiveness battle	"Early-out" programs and flattening of hierarchies Global matrix panacea
Late 1980s		Articulating a corporate "vision" Beginnings of a regional focus. Efficiency still vital but national responsiveness and worldwide innovation also important	Total Quality Management and self-directed work teams
1990s ↓	EC '92 further unites Europe Potential trading blocs emerge — EC, NAFTA, Asian rim	"Getting close to the customer" calls for local presence and regional international outlook EC customers consolidate and focus businesses, requiring a single purchase source	Firms become *trans*national. Need to be efficient, responsive *and* apt at diffusing knowledge/competencies. Separate business headquarters for major products according to customer base Increased focus on human resources. Rewards to match performance for appropriate geographic responsibility. Group and individual rewards.
Kenneth Chilton, *The Global Challenge for American Manufacturers*, Table 1.			

How Japanese Management Lost Its Appeal

A View of Japanese Management from 1992

"Close links in many Japanese and European firms between investors, lenders, and management make for a community of interest and a longer-term outlook that is difficult to achieve in the United States."

James B. Burnham, *Business Responsibility in a World o Global Competition*, p.10.

What happened to the fascination with Japanese management? Japanese conditions influencing the change in thinking include:

- Bursting of the stock market bubble and a decade without recovery.
- Lack of transparency and insulation from market forces, permitting improprieties and imbalances to grow.
- Rigidity of the system becoming a disadvantage in adapting to rapid change.
- A sluggish political consensus process producing gridlock in developing solutions adequate to the magnitude of the problems, in spite of one party rule.

The Japanese kieretsu, with close relationships among member companies and between companies and their banks, and the sluggish consensus management style, are vastly different from the network organization that draws strength and flexibility from many firms and adapts the system to changing needs. The structure and processes proved to be insufficiently open and flexible for an environment requiring fundamental restructuring.

The reputation of Japanese firms of getting into markets early, tolerating mistakes, but making changes and adapting quickly gave way to inertia as companies became larger and more far-flung. Maximizing sales instead of profits and burying finances within the kieretsu left little cushion when financial prospects of firms and their bankers deteriorated. The so-called" lifetime employment system" warehoused surplus employees in affiliated companies while financial pressures built to require even more retching change.

International Convergence of Corporate Structures and Practices

More generally, there has been a movement away from authoritarian styles of business and government in some Asian nations and from the more insular structures of large European companies. Changes have occurred with market pressures on companies and with financial pressures on governments. Privatization often has proceeded as a way to raise revenue and rid treasuries of the drain of growing subsidies for units that are losing large and increasing amounts of money from inefficiencies and competitive challenges.

Convergence in business organization has been developing as Japanese firms reduce cross-ownership of shares, German banks sell industrial holdings, foreign companies disclose more information to the public, cross-border mergers proliferate and more companies gain ownership or control where it has not been possible before.

In spite of these changes, convergence between corporate structures in the U.S. and other nations has been more gradual that is sometimes believed (Doremus, *et. al.*) However, it has been accelerating as reliance on markets has increased with influences of the information revolution, trade opening, European integration, and the impact of U.S. policies and multinationals.

Convergence has been occurring in governance, finance, and legal and regulatory systems that set preconditions and provide oversight. Convergence of forms of business organization and practices has been rapid for some companies and has accelerated with increased economic pressures. However, for most

countries as a whole it remains gradual and incomplete as historical and cultural factors to continue to exert powerful influences.

Moreover, convergence occurs in both directions. U.S. companies take actions that are viewed favorably in foreign markets, chose executives with experience abroad, and respond to the influence of growing foreign units, customers and suppliers. Foreign companies have increasing ownership of U.S. businesses. And compromises are made among nations in international law and treaties. However, the U.S. influence has been greatest, and, in spite of some resentment, can be expected to produce more convergence in the future because the underlying market pressures which the philosophy and management reflect are so great.

The influence of U.S. companies is evident in patterns of trade and investment. In an analysis of international trade, finance and production, Joseph Quinlan and Rebecca McCaughrin of Morgan Stanley note that contrary to popular myths:

- There was little change in the proportion of people employed by U.S. multinationals that worked outside the United States between 1990 and 1999. A "hollowing" of U.S. corporations out of the manufacturing base was not taking place.

- Capital outlays of parents of U.S. multinationals grew rapidly in the United States. More foreign investment by U.S. firms was not associated with less investment in the U.S.

- Access to markets, not low wages, has been the primary driver of U.S. firms going abroad. Most sales by foreign affiliates of U.S. companies are for the home market rather than returning to the United States. U.S. parents sell more to their majority-owned foreign affiliates than the affiliates sell to them.

Competition for Standards

Technological change that is rapid and widespread results in the development of many competing technologies and applications. Competition is most intense in new markets but also is strong in more dominated markets, making it more difficult for companies with proprietary systems to maintain or extend their franchise. The open source software movement has spawned the Linux operating system that challenges both Unix and Windows. Microsoft faces competition from Java, Apple, and operating systems from handheld devices manufacturers and cellular phone companies.

Competition among standards is much greater in the U.S. than in Europe. Europe tends to move more quickly in deciding which standards to use, relying on negotiation and government action, while the U.S. more often lets competing standards fight it out in the marketplace. The market-based process can greatly delay agreement on a standard but it can result in the choice of a better standard. And it can make it very difficult for a proprietary technology to dominate, as occurred when VHS won out over Beta.

The different approach to standard setting in the U.S. and Europe can result in different standards being chosen, as happened with the use of currently incompatible cell phone technology. Eventually, new technology may come along that lets the incompatible systems work well together or is superior enough for the U.S. and Europe to agree on standards and technology for the next generation of services. (For example, the BlackBerry 5810 combination wireless email system and mobile phone operates on GSM/GPRS networks to allow users to receive signals in Asia, Europe and North America.)

Of course, difference in who owns the new technology and where production is based can complicate international agreement on standards and technology even where there are clear advantages to all. However, competition among nations may create opportunities for alternative technologies or standards that might otherwise be bypassed to be accepted by one body when another is not receptive.

The proliferation of technologies, the growing importance of other nations as sources of technology, the integration of policy in Europe and the difference in approaches make it likely that important incompatibilities will arise in the future. Technological incompatibilities can take decades to overcome.

Appendix C: High Performance Computing

High performance computing for weather applications offers an interesting case study of some of the issues involved in NOAA's decisions about public/private roles. NOAA just announced that purchase of a new supercomputer from IBM. The computer will be leased for three years with two 3-year options for renewal. The contract calls for a technology refresh every 2-1/2 years. It will be installed in 2003 with a speed of 7.3 trillion calculations a second (teraflops), five times the speed of the current NCEP system, and is expected to reach 100 trillion calculations a second by 2009. The machine will be housed at an IBM computer center in Gaithersburg, MD.

NOAA must take into account several factors in making such a decision:

- Since NOAA uses the full capacity of available generations of operational weather supercomputer, it cannot share one with another organization.

- Choice of technology and issues of competition are intertwined. The massively parallel computer design of the IBM computer links numerous conventional microprocessors while the vector supercomputer design of NEC uses custom hardware designed for long strings of calculations. While massively parallel computers are not as fast, they can be adapted more readily.

  A source of contention has been whether the U.S. is willing to rely on a foreign supplier and how failure to do so affects forecasting performance. The Japanese Earth Simulator on which NEC's commercial models are based is the fastest computer in the world, and weather models can produce greater accuracy if more speed is available. Speed is even more essential in climate modeling where vast increases are required to produce desired resolutions for local prediction.

  An NEC supercomputer is being tested for possible use in climate research at the Arctic Region Supercomputing Center on the campus of the University of Alaska but whether it will be purchased is uncertain.

  The market for technical high performance computing is small and IBM increasingly is dominating. That raises issues of how much competition will persist and whether reduced competition will raise costs in the future if alternative sources are not supported.

  DARPA has funded initial research to develop the subsequent generation of high performance computers for technical uses. All three of the contending manufacturers — IBM, Sun Microsystems and Cray, Inc., representing NEC in the U.S., are included. It is believed these will be followed by another approach — quantum computing — in perhaps 20 years.

  Other technological approaches may emerge and win government and private backing for development, but it is by no means certain that strong competition among companies or alternatives will develop for the most demanding uses. Even if choices were to evolve, such options would not be identifiable until they made additional progress.

  Peer-to-peer computing that relies on networking to tap unused capacity of many computers is not effective for weather and climate forecasting because atmospheric models need data from nearby cells to capture atmospheric spillover effects between cells.

- While communication costs are a consideration, it is no longer necessary for the computer to be on the same site as the scientists or the specialized programmers that work with them. NWS currently has a supercomputer in a dark building in Bowie with no people in it.

Physical separation increases the advantages of contracting out operation of the computer since the computer can be in an environment structured to focus on its operation and attract the skilled personnel required for the process.

The periodic of refreshing the technology also favors contracting out since it is done with testing over a period of time.

These factors enter into comparisons of both relative cost and system performance.

A recent GAO study of private sector outsourcing of services finds three factors as critical to the success of outsourcing:

- Executive leadership.
- Partner alignment.
- Relationship management.

These have all been prominent in the management of NOAA's high performance computing effort.

Planning will take place in an environment of changing technical possibilities and computing requirements and differences in needs of weather and climate and research and operational computing. Interrelated high performance computing developments in the Department of Commerce, other government agencies and outside organizations will create opportunities but also require coordination. There will be ongoing questions about the locus and continuity of decision-making, contracting and management that will require periodic, forward-looking and thorough review.

Appendix D: Telecommuting, Teleconferencing and Flextime

Telecommuting and Teleconferencing

Temporary Offices

Some companies have eschewed traditional workspaces for some employees by providing temporary desk space. While the result is cost savings, benefits of personal interaction are lost. Consequently, temporary desk arrangements are not likely to involve a large of the workforce. However, they could be significant for individual occupations or companies.

Telecommuting

Many companies encourage or allow telecommuting. These arrangements are likely to grow because they are suited to a service economy and some lifestyle choices.

Growth of fast connections from homes and availability of alternatives like wireless for the "last mile" will enable companies to rely more on telecommuters without having to pay for special bandwidth arrangements or deal with issues raised by sparse geographic coverage of high speed connections.

Heightened concerns about cyber-terrorism and hacking could make companies reluctant to allow employees to access their systems from home and slow the growth and scope of telecommuting.

Most telecommuting will be in addition to time in a regular office rather than in place of it. For the modest percentage that telecommute for all of their hours or do so in combination with temporary offices there will be some cost savings. However, for most situations the importance of maintaining motivation, ability to monitor performance, and social and cultural interactions will overshadow direct cost savings and temper the extent of telecommuting's use.

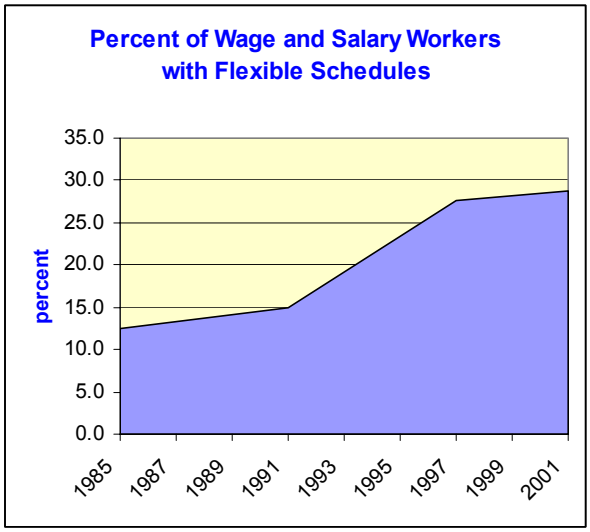
Teleconferencing

Teleconferencing has been held back by high costs but has become increasingly affordable. Capabilities are being added and increasingly low cost and personalizable systems are becoming available. Growth of bandwidth will radically drive down the cost and will eventually make teleconferencing for business use as commonplace as the conference call. Technologies such as Internet telephony and instant messaging may become the basis of additional teleconferencing and videophone services or substitutes for them.

Teleconferencing received an impetus from the September 11, 2001 attack that led to cutbacks in air travel. It will continue to benefit from greater travel costs and difficulties.

While growing, in the long run, teleconferencing in its many forms is likely to be more of a supplement to travel than a substitute for it. Face-to-face and informal contact will continue to have advantages. Face-to-face contact will lead to more reasons to have contact of all kinds, including through travel.

Extensive Use of Flextime by Managers and Professionals



The use of flexible work schedules has been growing rapidly among full-time wage and salary workers. In 1995, 12.4% worked flexible schedules. By 2001 the number had more than doubled to 28.8%.

The Bureau of Labor Statistics defines flexible schedules as those that allow people to vary the time they begin or end work. Most arrangements are informal. About one in ten are enrolled in a formal employer-sponsored flextime program.

Flextime is especially prevalent among managerial and professional occupations. In May 2001, 45.5% of those in executive, administrative, and managerial positions had flexible hours. The overall percent for professional specialty occupations is high but somewhat lower at 35.5%. However, for mathematical and computer sciences, 58.7% had flexible hours and for natural sciences 52.4%. For technicians and related support occupations as a whole, flextime was used by 31.4%. (U.S. Bureau of Labor Statistics)

Growth in flextime is leveling off, but its high levels and the potential for new variations will be a fact of life for NOAA and for business management.

Appendix E: Analyzing Trends

Trend Analysis

It is difficult to predict changes over long periods of time with any accuracy or detail. Yet we make important decisions whose outcomes depend on conditions that will exist years from now. Our assumptions in these decisions may be implicit, but in making the assumptions we are also predicting. It is better to make assumptions explicitly so their reasonableness can be examined and alternatives can be considered.

Advance consideration of prospects helps to recognize changes early, giving decision-makers the opportunity to modify their course rather than merely react.

Moreover, some of the biggest decisions are profoundly influenced by our overall view of the future. By understanding how they depend on that view we can be better prepared to adjust if another conception become more appropriate.

Understanding trends requires a blending of many kinds of thinking, a willingness to take a step back from what we thought we knew and exploring a wider range of possibilities and evidence. It necessitates consideration of alternative forces, outcomes and paths, and involves thinking about what a host of changes may add up to.

Hudson Institute's trend analysis involves:

- Examination of many potential trends.
- More detailed assessment of the most critical trends.
- Exploration of implications of critical trends for NOAA.
- Examination of potential NOAA responses.

In this effort a 5-10 year period of interest was indicated. For some NOAA issues it will be important to consider longer time frames as well.

A large number of trends are considered and some are chosen for more intense examination.

Special attention is given to understanding the mechanisms behind the trends as a way of recognizing their strength and impacts.

A broad list of trends can be assessed according to a combination of:

- Likelihood
- Consequences
- Opportunities to respond

Hudson Trend Analysis

- Examining many types of changes- economic, demographic, social/political, technological.
- Utilizing many methods and sources of information.
- Giving special attention to the big changes that affect many things.
- Exploring the mechanisms behind the changes to understand their nature, likelihood and persistence.
- Effectively characterizing what diverse and often interacting trends add up to.
- Developing both broad and detailed implications.

Identifying and assessing a wide range of trends and mechanisms producing change involves relying on many methods of sources of information. Sources include historical data and analyses of past changes,

scientific literature, products of forecasting organizations, expert opinion, predictions made in connection with the millennium, popular literature, existing polls, and views and knowledge gained in interviews and discussions with NOAA customers, stakeholders, employees and others.

In thinking about which trends to focus on and the consequences trends would have, we can ask:

What would be the impacts of key trends on:

- Existing or new policies or programs.
- Demands for existing services.
- Demands for new or enhanced services.
- Current or new ways of providing and/or distributing services.
- Competition, cooperation or interface between public and private sector services.

What are the potential responses? When do they include:

- Policy revisions.
- Data collection and dissemination.
- Analysis, modeling and prediction
- Services - research, training, policy support, etc.
- Operations - processes, technologies, etc.
- Collaboration with other entities.

Hudson Institute uses many methods to examine the information that is developed in order to understand the importance of likelihood of each trend.

Technology assessment can identify technologies that are already developed and could become important during the next decade, and the capabilities that they will bring. It can consider areas where the winners among competing technologies cannot be known but there can be some assurance that, by one method or another, certain *capabilities* will become available. It also can consider longer-range possibilities for which advance planning could be important.

Historical analogies and relationships provide an important foundation for understanding current and prospective developments. In the case of technology impacts, such topics may be included as the processes of diffusion of technological change, the rate of market penetration for new technologies or services, consequences of a high rate of interconnections among technologies, changes in the economy in periods of rapid technological change and shifts among industries, products and competitors that result.

We make a clear distinction between continuation of previous trends and structural changes that involve shifts in level or altered rates of change or direction. At a time of great change in science, technology, economy and society and new international challenges the identification of structural changes becomes especially important.

- In some cases quantitative changes that continue for a long time can produce qualitative changes. A prominent example is the decline in the price and size of computers that lead to a shift from mainframes to distributed computing.

- Often, it is useful to recognize that some trends cannot continue indefinitely. Counterforces may be set in motion by the trends themselves, as with the overbuilding of telecommunications facilities.

- It is important to examine where past predictions have gone wrong. Errors may be based on too easy assumptions of business as usual when great changes are taking place or imminent or on misreading new patterns of behavior. Errors can take place in informal analysis or be formalized in

deceptively appealing sophisticated models and quantitative analysis.

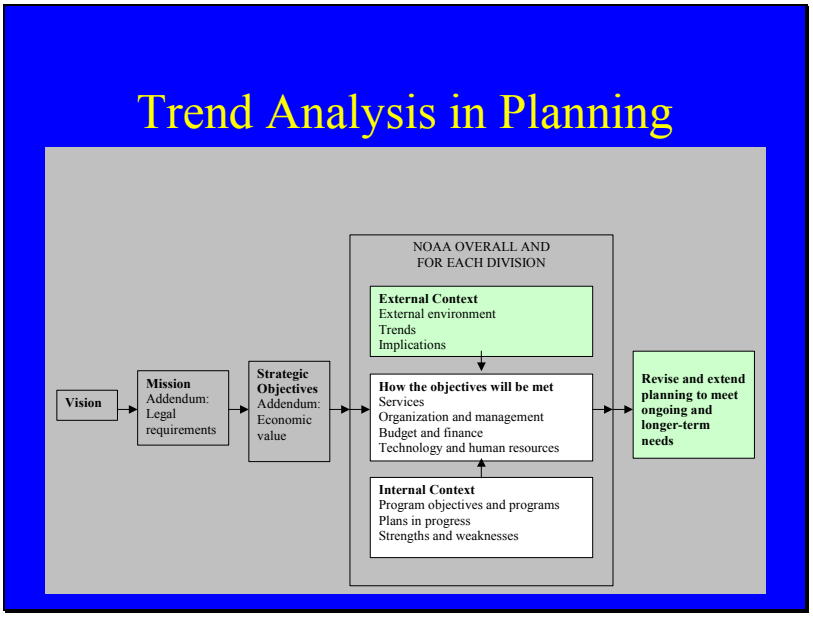
Scenarios provide a way of organizing thinking about interrelated developments and their evolution over time. While forecasts may inform scenarios and may be useful in the own terms, scenarios are distinguished by an emphasis on central themes. They can reflect complex combinations of many elements even when stated as simple expectations or alternatives such as the pace of change of technology, prospects for "new economy" or directions in regulation.

NOAA is particularly interested in recognizing and understanding trends that can have "disruptive influences." We look for big and far-reaching changes but shy away from using the term because it implies that such influences are negative. Major change can be positive or may be made positive by actions that take advantage of and even create opportunities.

Uses of Trend Analysis in Developing a Plan

In developing a plan, trends analysis can:

- Set the stage for discussion of issues, plans and programs.
- Identify subjects that merit attention in the plan.
- Indicate why certain issues have been given attention in the plan.
- Provide reasons for directions or actions chosen in the plan.
- Contribute supporting data.
- Help to define needs of ongoing planning.



Appendix F: Persons Interviewed

ORGANIZATION	NAME/POSITION
NOAA	
National Weather Service	Jack Hayes, Dir., Office of Science and Technology
	Ed Johnson, Dir. of Strategic Planning
	Peter Weiss, Strategic Planning
	Jim Laver, head of Climate Prediction Center and John Janowiak
	Ants Leetmaa, Director, GFDL
	Bruce Ross, Deputy Director, GFDL
National Environmental Satellite, Data and Information Service	Warren Hall and a dozen others
Office of Oceanic and Atmospheric Research	Dave Evans, Ass't Admin. for Ocean and Atmospheric Research
National Ocean Service	Bud Ehler, Office of Coastal and Resource Mgmt
	Gary Matlock, Director, Nat'l Centers for Coastal Ocean Science
	John Ramsdell, Nat'l Centers for Coastal Ocean Science
National Marine Fisheries Service	Rebecca Lent, Depty Ass't Admin. For Regulatory Programs
	Mark C. Holiday, Chief, Fisheries Statistics and Economics Div.
	Bonnie Ponwith, Office of Science and Technology Policy
Other U.S. Gov't	
Commerce Department	Thomas N. Pyke, Jr., CIO
White House Office of Science and Technology Policy	Paul Onastas & Rebecca Lankey
State Department	Mary Beth West, Deputy Ass't Sec'y for Oceans and Fisheries, Bill Gibbons Fly, Maggie Hayes
Non-Gov't	
National Center for Atmospheric Research (NCAR)	Warren Washington
The Weather Channel	Raymond J. Ban, EVP, Meteorology Science and Strategy Lawrence M. Denton, Consultant
Accuweather	Barry Lee Myers, EVP
American Fisheries Society	Gussan (Gus) Rassam, Executive Director
National Ocean Industries Ass'n	Tom Fry, President
IBM	Stephan Haeckel, Director of Strategic Studies, IBM Advanced Business Institute

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