Public Perspectives: Economic, Environmental and Social Concerns

Happiness lies not in the mere possession of money; it lies in the joy of achievement, in the thrill of creative effort. The joy and stimulation of work no longer must be forgotten in the mad chase of evanescent profits. These dark days will be worth all they cost us if they teach us that our true destiny is not to be ministered unto but to minister to ourselves and to our fellowmen. ... Our greatest primary task is to put people to work. This is no unsolvable problem if we face it wisely and courageously. It can be accomplished in part by direct recruiting by the government itself, treating the task as we would treat the emergence of a war, but, at the same time, through this employment, accomplishing greatly needed projects to stimulate and reorganize the use of our natural resources.

Franklin D. Roosevelt, president of the United States, First Inaugural Address, March 4, 1933
(*Record,* 73 Congress, Special Session of the Senate, pp. 5-6)

Overview

The public sector, which is responsible for many kinds of infrastructure systems, takes an entirely different perspective than the private sector when identifying needs and evaluating potential projects. The primary motivation for the private sector projects will be the financial returns to the owners, not the broader effects on the economy or society. For the public sector, the motivation is not to earn money, but to satisfy public needs or to promote growth in the economy. Financial issues are important, but not necessarily dominant, and every major project will have multiple purposes and multiple measures of effectiveness (Table 1). Social and environmental impacts are central to the public evaluation process, and equity in the distribution of costs and benefits will be critical. In dealing with non-monetary objectives, cost effectiveness will be a more relevant concept than return on investment: which of the proposed alternatives is the best way to achieve the desired objectives?

Table 1 Examples of Public Infrastructure: Multiple Purposes and Multiple Measures

Type of Infrastructure	Purpose	Measures
Transportation	Mobility Accessibility Regional competitiveness	Service levels (travel time, congestion) Cost of transportation Fuel consumption Safety Emissions
Dams	Flood control Irrigation Hydropower Recreation (boating, swimming, camping, picnic sites)	Risks associated with floods Volume of water available for irrigation Land area to be irrigated Electricity production (cost & revenue) Impact on wildlife
Water & sewage	Clean water for consumption Water for industry & irrigation	Volume of water available for each type of use Cleanliness (risk of disease) Cost per unit
Public Housing	Housing for elderly Housing for low income residents Housing for homeless	Number of units Size and quality of buildings Cost per unit (construction & operation) Safety & Security Aesthetics
Parks & recreation	Open space for residents Protect environment Aesthetics	Open space as % of total space Visitors per year Diversity of wildlife Safety

Another difference is that the time frame of the analysis will be much longer for the public than for the private sector, as the public entity is presumed to endure indefinitely. The long time frame requires the consideration of sustainability – will projects or programs be sustainable over long periods of time taking into account economic, financial, social, and environmental factors?

For many kinds of public infrastructure projects, the tolls, fees, and other direct revenues from the project will be insufficient to cover the costs of the investment. However, the non-monetary benefits could be considerable. A public transportation project may relieve congestion, improve air quality, and promote mobility for those without access to an automobile. While these benefits can at times be quantified by using concepts like consumer surplus or the multiplier effect of new investment, such benefits do not produce cash flows that cover the interest on bonds or the operating costs of the transit agency. If the benefits are clear, and if the public generally believes that these benefits are worthwhile, then public agencies may be able to use tax revenues to supplement the direct cash flows from the project. If taxes are used to finance a project, then that project will be competing not just against similar projects, but against all of the other projects that might be undertaken by that city, state or country. Transportation projects compete with housing for the elderly, and water projects compete with health care projects. Decisions for or against projects will be political decisions, and the relative importance of various kinds of costs and benefits will be subject to considerable debate.

To complicate the situation further, a project will also be evaluated in terms of its impact on the community:

- Economic impacts, including employment, regional economic growth, regional competitiveness
- Environmental impacts, including air quality, water quality, noise, loss of wetlands, and impact on ecosystems.
- Equity, including the distribution of costs and benefits across regions and groups of the population and the relative impact on current and future generations.
- Aesthetics, including the appearance of the new infrastructure, its effect on neighboring areas, and its effect on long-term changes in land use.
- Other social impacts, including such things as impacts on communities during construction, displacement of residents, and long-term changes in population distribution

Multiple objectives and multiple measures mean that these projects are inherently complex, with many conflicts possible among different objectives. The decision-makers ultimately will include the public, who may have a chance to vote for or against the funding sources proposed for a project, and the politicians or appointed officials who must justify their decisions to the public in order to be re-elected or to retain their jobs. Large projects will be politically sensitive, and it will be necessary to consider and to balance all of the conflicts. There will be real and apparent conflicts of interest among those who are supposed to be proposing, evaluating, and approving projects. It will not be possible to satisfy everybody, and there will likely be determined opposition to almost any major project. People commonly do not want anything built too close to them, even if they are going to be major beneficiaries of the project. This phenomenon, which can lead to intense community opposition, is known as the NIMBY response: "not in my backyard".

In summary, a major public project will be evaluated by many different groups of people, from many perspectives, with varying concerns for the relative importance of various features of the projects, and with potential disputes about how to measure or estimate costs and benefits.

Benefit/Cost Analysis

Public projects require an evaluation process that includes, but is much broader than financial analysis. A simple dictum is mandated both by law and by common sense: for any public project, the total benefits should exceed the total costs. This does not mean that every project with more benefits than costs is a good project; it simply means that projects whose costs exceed their benefits are bad projects that should not be funded by the public. This may seem to

be a rather obvious principle, but it surely is necessary, as there are many instances of projects being built, at taxpayer expense, whose costs far exceeded their benefits. There are even names for such projects: "gold plated" projects that could have been constructed for far less money; "pork barrel" projects that were approved in order to get a crucial politician's support for some larger political scheme; and "white elephants" that are constructed at great expense, but that afford no greater benefits than ordinary elephants! The political process can provide a means to fund many different projects, and it is possible that many projects will be "earmarked" (i.e. specifically authorized in the legislation) rather than subjected to a rigorous examination of their costs and benefits. A requirement that the benefits of every project should exceed the costs is therefore a step toward a more rational allocation of public funds and a defense against mismanagement, stupidity, and corruption.

Measurement will be a major problem in determining whether or not costs exceed benefits: how can different types of non-cash costs and benefits be converted to monetary terms? How can important benefits such as savings in travel time or reductions in risk of accidents be converted into monetary terms? What about aesthetics? In some cases, the monetarization is straightforward; in other cases it is convoluted and controversial; and in still others it is essentially impossible.

For example, consider a proposal to construct a new highway that is intended to provide a safer, more attractive route around the congested core of a city. The basic question is whether the savings in travel time, the expected reduction in fatalities, and the prettier route justify the cost and the environmental impacts of constructing the highway through the surrounding region.

Travel time: Traffic engineers are able to model how commuters, truckers, and others will use the new facility, and they will be able to predict traffic flows on the new facility along with the changes in traffic flows on other facilities. Based upon the changes in traffic flows, they will be able to predict travel times on the new road and changes in average travel time on each segment of the existing network. The overall effect can be summarized as a reduction in travel time measured as vehicle-hours per day or per year, with details for commuters, local delivery trucks, long-distance trucks traveling through the region, and any other group of interest. The value of these time savings is commonly estimated by making a series of assumptions. For instance, the time saved by commuters could be valued by using the average hourly wage for workers in the region, and the value of time saved by truckers could be valued by using the average hourly wage for truck drivers, the hourly cost of truck ownership, and the hourly value of the contents of the truck. Some might argue that something less than the average hourly wage should be used, and others might challenge the methodology used to estimate the hourly cost of truck ownership, but these estimates of the value of time are commonly accepted, and the benefits are clear and verifiable.

Safety: estimating the value of the safety benefits will be trickier. Traffic engineers will be able to predict the number and severity of accidents based upon traffic flows and highway geometry, and safety analysts can use past history to quantify the expected damage to vehicles and the highway. However, no one can readily place an economic value on the most important safety benefits, namely a reduction in the expected number of injuries or fatalities. Instead, departments of transportation in some countries will consider the value to society of reducing fatalities and serious injuries resulting from automobile and other transportation accidents. In the United States, the U.S. Department of Transportation uses a value of approximately $2.5 million in its risk analysis. This amount represents the benefit to society of eliminating a single, future fatality. It does not represent the value of a human life, for it is impossible to say who would have been hurt or killed. In effect, the $2.5 million can be viewed as an aggregate benefit to all users of the system of a slight reduction in the probability of a fatal accident. Every user benefits because the probability of an accident is reduced.

Aesthetics: now we are close to the "impossible" in trying to quantify the benefits of the new highway. Whether or not aesthetics is viewed as an important component of the decision will depend upon the political situation in the region. It could be viewed as an afterthought, which might mean planting some flowers along the right-of-way, or it could be a major design consideration, as in the construction of roads in national parks or the construction of parkways into major cities. The argument may well boil down to someone showing artist's renditions of the options (or photos of similar projects elsewhere) and saying something like "isn't it worth spending an extra $5 million to get a nice

facility?" If people agree that "$5 million" is a small amount, then they will choose the more aesthetic option. If people note that $5 million" is equivalent to the park budget for 20 years, then they will probably be vocal in their opposition!

Economic Impacts: Measures Related to the Regional or National Economy

Governments and public agencies will be concerned with the effects of projects on the local, regional, or national economy. Primary measures will include gross regional or national product, jobs created or lost, average income, and personal and industrial productivity. These economic benefits could come from several types of benefits:

- Construction jobs and income
- The multiplier effect of construction
- Jobs and income related to the eventual operation of the new project
- The multiplier effect of operation of the new project
- Continuing productivity benefits resulting to citizens, users, industries or public agencies as a result of the project
- Growth in the economy related to the productivity benefits provided by the project

For example, consider the construction of a toll road. The initial construction may take two years, provide hundreds of jobs, and increase sales of construction materials within the region. The direct expenditure of several hundred million dollars would have a multiplier effect that would more than double the economic benefit to the region during the period of construction. Once the toll road is opened, there could be long-term jobs for toll-collectors (or for those who maintain any electronic toll collection devices) and for highway maintenance forces, providing both a direct and a multiplier effect to the regional economy. The toll road presumably offers benefits to the public in terms of higher capacity for rush hour traffic, reduced risks of accidents, and perhaps reduced travel time. With less congested highways, the region may be able to continue to attract new businesses and to absorb additional population growth. Land near interchanges is likely to increase in value and attract hotels, restaurants, trucking terminals, warehouses, and other businesses that depend on highway access or serve highway users.

These benefits could be offset by the impacts of both the construction and the continued operation of the highway. Disruption of normal activities can be a major economic cost of a highway project. Although construction of a new highway interchange will ultimately relieve congestion, it may cause increased delays for a year or two. Once the highway is built, it may act as a barrier that limits access between different parts of the region. Over time, land use will adjust to the existence of the highway, which could result in rapid growth in some areas and equally rapid declines in other areas.

Environmental impacts

Any project will alter the complex relationships between what might be thought of as the natural world and the manmade world. Construction activities convert more space from the natural to the manmade world. Projects require construction materials such as wood, steel, and concrete which ultimately depend upon activities such as forestry, mining, and manufacturing that certainly disrupt and may at times destroy the environment. Continued operation and maintenance of infrastructure require energy and other materials that ultimately come from the natural world. Normal operations, accidents and decay may release toxic substances that can affect air quality, water quality, soil composition and limit or destroy the ability of plants and animals to survive near project sites. Constructed facilities will cast shadows, they may be noisy, and they might just be ugly or interfere with people's day-to-day lives. Whether or not the benefits of the project are worth the environmental costs will always be a relevant question, especially when those receiving the benefits are not those who bear the costs. The extent to which this question is considered will depend upon the social, cultural and political institutions.

In many countries, developers must prepare an environmental impact statement (EIS) that at least states the goals of a project, presents major alternatives for achieving these goals, identifies the major environmental impacts, and

suggests ways to mitigate the most negative impacts. Preparing an EIS ensures that information is made available to the public and to public officials who must approve a project; the extent to which environmental considerations affect decisions about a project may well depend upon legal and political battles.

Courts and legislative bodies are well-structured for dealing with controversial trade-offs between environmental and economic issues and the extent to which developers must deal with environmental concerns. Legislation has limited the development of wetlands, promoted soil and water conservation, required more fuel-efficient automobiles, and limited land use via zoning and other restrictive matters. However, courts and legislative bodies are not well-structured for dealing with the underlying science, as evidenced by the controversies related to the extent of, the causes of, and the possibilities of responding to global warming and climate change.

Mankind has certainly transformed the world. Over a period of many thousands of years, humans have converted vast portions of the earth's land area to agriculture, drained innumerable wetlands, developed much of the land near the oceans, seas, and major rivers, and cut down vast areas of forest. These activities have changed the chemistry of the atmosphere, altered the natural flows of fresh water, and restricted the natural habitats crucial for many species of plants and animals. These activities have also allowed humans to prosper by helping to ensure adequate food supply, clean water, housing, abundant energy sources, and protection against floods and other natural disasters. In the future, we will still eat, drink, use energy and improve the way we live – but we will have to pay more attention to our impact on the environment.

There will be a whole of range of environmental issues that must be addressed in evaluating any major project, and there will be many major projects whose primary objective will be to improve the environment. Environmental issues will range from very local debates as to what gets built in whose backyard to regional and national questions related to the use of resources to international questions concerning the future of the planet. Since we can't expect to answer all of these questions every time we want to build a new hotel or new segment of a highway, we need to provide a reasonable structure for addressing these issues within the project evaluation process.

Environmental Concerns

Let's start by considering some basic environmental concerns. Soil, water, sunlight, and temperature are among the factors that determine what plants can grow in any location. Plants that are well-adapted to local conditions will prosper, those that are poorly adapted will struggle, and those that cannot survive the extremes of temperature or hydrological conditions will never gain more than a short-term foothold. Insects, birds and small mammals are necessary to the propagation of many plant species, and worms, amphibians, and insects make soil into a complex, living community. Animals may feed on plants or other animals, and they prosper in locations where there is an abundance of food along with sufficient cover for their own safety and appropriate places to raise a family, whether in trees, burrows, rotten logs, stream banks, or wetlands.

Left undisturbed, any location will eventually develop with a characteristic set of plants and animals that can survive or flourish within the constraints posed by soil conditions, sunlight, and climate. Biologists have identified distinct **ecosystems** that can be characterized by the kinds of plants and animals that will be found there. Within any healthy ecosystem, there will be a diversity of species, each of which is somehow related to the health of the overall system. Pileated woodpeckers make holes in dead trees as they look for insects, and these holes are later used as nesting sites for chickadees. When the dead tree finally collapses, it will provide cover for mice and other small rodents, as well as an ideal place for fungi to grow or for grouse and hares to hide.

In many cases, there are species that will only be found in certain ecosystems, so that they can be considered to be **indicator species** that are useful in documenting the existence of unusual ecosystems. For instance, wood frogs lay their eggs in vernal pools, which are small pools that are formed in rainy seasons or in spring as the snow melts. Vernal pools dry up for part of the year, so they cannot support fish, which means that eggs deposited in a vernal pool will be safe from predation from fish. Wood frogs are an indicator species for vernal pools. A single female wood frog lays hundreds of eggs in the early spring, so if the pool retains water long enough for the eggs to turn into tadpoles

and for tadpoles to grow into tiny frogs, then the wood frogs will prosper. If the vernal pools are filled as part of the process of building a parking lot or a suburban sub-division, then the wood frogs will die off.

In most regions, a few types of ecosystem will dominate the landscape, while a dozen or more other types will be commonly scattered throughout, and some will be found only in a few locations. Preserving the rare ecosystems may be essential for preserving bio-diversity, as there will be plants and animals that are only to be found in those locations. Preserving a good distribution of the more common ecosystems will prevent populations of plants and animals from becoming too isolated. Preserving large tracts of the dominant ecosystems will ensure healthy conditions for all of the region's most common species.

Ecosystems can be harmed in several ways. **Pollution** – the introduction of foreign elements into the air, the water, or the soil – may lead to the death of certain plants or insects and of the animals that depend upon eating them. Pollution could be in the form of toxic chemicals that are poisonous to certain species, but it could also just be the introduction of sediment into a pristine stream, thereby making the water quality unsuitable for certain types of fish. Pollution can also refer to the heated water that is discharged from a nuclear power plant, as the heated water will be lethal to the some species, while attracting others that may be alien to the previously existing ecosystem.

Disruptions to the flow and retention of water can have devastating effects on ecosystems. Draining wetlands to increase the land available for highways, housing or agriculture will lower the water table and make the remaining wetlands more susceptible to drought and fire. Extensive development in Florida, for example, has changed the flow of water through the Everglades, threatening the future of what was once the seemingly endless wetlands of southern Florida. More rapid runoff of water means that both floods and droughts are more likely, which means that certain species of plants and animals will have greater difficulty surviving.

Fragmentation of an ecosystem will eventually create areas that are too small to support the wildlife that formerly flourished there. A black bear requires a range of 10 to 100 square miles; if a region that formerly supported large populations of black bears is crisscrossed by roads and disrupted by housing developments and malls, then the habitat will no longer be large enough for the bears to survive.

For species requiring less extensive ranges, it is not so much the fragmentation of the habitat as the total **loss of habitat** that will be decisive. As agricultural land is turned into housing developments or malls, the birds that used to feed on the insects and seeds will have to go somewhere else, and the deer that used to feed on the leftover corn cobs will be hit by cars as they try to feed on the shrubs and gardens of the new developments. Colonies of butterflies and dragonflies will be lost, along with vast numbers of mice, voles, and moles and the hawks, owls, and weasels that feed on them. For migratory birds, the loss of habitat is especially problematical, as they need places to feed and to breed, perhaps on two continents, and they need extensive areas for resting and feeding along their migration routes.

A final threat to ecosystems comes from the introduction of **alien species**. In a well-functioning ecosystem, everything is in balance. Insects or other animals eat some but not all of the seeds, none of the animals eat all of any of the species of plants, and none of the plants grows so rapidly that it crowds out all of the other plants: it is a complex system of natural checks and balances. An alien species is one that originated in a distant ecosystem where it had adapted to competition with the other plants and animals that comprised that ecosystem. It undoubtedly served to control some of the other species, and other species controlled it. However, when introduced as an alien into a new ecosystem, there may be no controls and balances, and an alien species may prosper to the extent that it out-competes and eventually crowds out the native species. Purple loosestrife is a tall, tough wildflower that has a large woody ball of roots; it has numerous flowers on a spike, and it grows profusely in wetlands. When introduced to wetlands in the United States, it faces only modest competition from less aggressive plants, and it has no natural insect competitors. As a result, it can, within a few years, fill the wetlands, creating what is a beautiful purple covering but what is also a barren wetland. As there are no native insects that eat the stalks or the flowers, there are no native birds that are attracted to the plant, and there are no hawks circling to catch any of those birds off-guard. The weeds grow so close together that it is difficult or impossible for muskrats or beavers to keep their channels open, and there is too little space between plants to support families of ducks.

Alien species often get their start when ground is disturbed for some sort of construction project. If these species are not dealt with – which often requires people who search for the first aliens and then pull them out by hand – then they can rapidly spread and destroy many acres of land. The key point to remember is these alien species overflow their niche, eliminating the chance for native species to prosper, and also eliminating the niche that was occupied by insects and animals that depended upon the native plants and animals. Alien species may be beautiful, but they tend to limit biodiversity.

Maintaining the health of ecosystems requires local, regional, and national strategies. One useful concept is **Green Infrastructure**, which refers to the network of natural areas that is necessary to support the diverse populations of native plants and animals that live within a region. This term does not refer to man-made infrastructure that is constructed in an environmentally friendly manner. Rather, it refers to the connected natural system of open spaces, forests, waterways, and wetlands that allows plant and animal species to prosper. Green infrastructure includes the following kinds of components:

- Very large areas of undeveloped land that are able to support and protect habitat for the widest-ranging animals and ensure the continued existence of diverse ecosystems
- Small areas of undeveloped land that protect uncommon or rare ecosystems
- Numerous small or medium-sized natural areas that are large enough and close enough together to avoid isolation of plant and animal species
- Connecting corridors of open spaces that can be used by animals to move between the larger open areas

By acknowledging the existence of and the need for green infrastructure, it is possible for government agencies and conservation groups to develop plans that preserve and protect suitable green infrastructure. National parks, state parks, public conservation lands (e.g. national forests or wildlife management areas) can provide the critical large areas. Smaller parks, wetlands, and private land-holdings can protect enough smaller areas to ensure diversity and density of ecosystems. The hardest part is ensuring that wide enough corridors are maintained between and among all of the open spaces so that wildlife can in fact move throughout the region. The corridors need to be wide enough to be perceived as safe routes for animals to travel. For the largest mammals, 100 to 200 foot-side corridors will be needed. For smaller mammals and amphibians, narrower corridors will suffice. Land adjacent to waterways and wetlands is ideal for use as connecting corridors, as is land next to railroads, power lines, or other infrastructure networks.

Pollution can be controlled by limiting emissions, by confining emissions, or by cleaning up emissions. The cheapest control strategy is to prevent emissions, but that may or may not be feasible depending upon the nature of the process that causes the pollution. Some pollutants are extremely toxic, and even a small release can be hazardous to anyone living close to where the release occurs. Hence, special consideration is necessary in dealing with the most toxic chemicals and spent nuclear fuels or other radioactive substances. Finding a safe means of sequestering nuclear waste is one of the main challenges facing the nuclear power industry.

Climate change caused by excessive emissions of carbon dioxide, methane, and other so-called greenhouse gases is a major challenge for the world in the 21st century. Scientists believe that increasing concentrations of these gases in the atmosphere will trap heat, thereby leading to warmer temperatures. With warmer temperatures, there will be more energy available to power hurricanes, tornadoes, tsunamis and other extreme weather conditions. Warmer temperatures will also accelerate the melting of glaciers and the ice caps, which will raise the level of the oceans and threaten flooding of the many cities and developed regions along the coasts. Changes in climate could also include regional changes in precipitation, which could have major implications for agriculture and for the natural environment.

Environmental Impacts of Projects

Proposals for major infrastructure projects can raise many different kinds of environmental issues. Abutters, politicians, environmental organizations and others are likely to express concerns about some or all of the following:

a. Use of materials in construction and operation
b. Pollution: impacts on air quality, water quality, and soil toxicity
c. Loss of habitat and disruption of ecosystems: Impacts on plants and wildlife
d. Impacts on the local environment (noise, shade, aesthetics)
e. Sustainability or the lack thereof

It will not be possible or necessary to consider all possible levels of impacts for every project that is considered. Regulations can be developed that govern the use of materials and that establish acceptable limits for pollution. Regional plans can help identify the necessary green infrastructure, and zoning can be used to direct development away from the most critical natural areas. Local impacts on noise, aesthetics, and land use will of course be a concern for nearly any project, and some sort of community involvement can be helpful in anticipating and responding to potential problems.

In the United States, a process has been created to ensure that environmental impacts are considered along with the economic and social impacts of any major project or program involving federal funding or approvals. This process emphasizes the need for determining and disclosing environmental impacts in what is called an **environmental impact statement (EIS)**, and it requires developers to consider how to mitigate negative impacts, but it does not indicate what can or cannot be done. That determination is left to the legislatures and the courts. An EIS is required for any major federal legislation or action "significantly affecting the quality of the human environment."[1] The federal agency proposing the changes must prepare the EIS, which must include "a detailed statement of these environmental effects."

> *"The National Environmental Policy Act of 1969 (NEPA), as amended, (42 U.S.C. 4321 et seq., Public Law 91-190, 83 Stat. 852), requires that all Federal agencies proposing legislation and other major actions significantly affecting the quality of the human environment consult with other agencies having jurisdiction by law or special expertise over such environmental considerations, and thereafter prepare a detailed statement of these environmental effects. The Council on Environmental Quality (CEQ) has published regulations and associated guidance to implement NEPA (40 CFR Parts 1500-1508)."*[2]

The Environmental Protection Agency (EPA) is responsible for reviewing the draft EIS and rating it according to two criteria. First, the EPA must decide whether or not the EIS is acceptable in terms of the depth of its analysis and the completeness of its findings. Second, EPA rates the environmental impact according to one of four categories:

- Lack of objections (LO): "The review has not identified any potential environmental impacts requiring substantive changes to the preferred alternative. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposed action."
- Environmental Concerns (EC): "The review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact."
- Environmental Objections (EO): "The review has identified significant environmental impacts that should be avoided in order to adequately protect the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative)."
- Environmentally Unsatisfactory (EU). "The review has identified adverse environmental impacts that are of sufficient magnitude that EPA believes the proposed action must not proceed as proposed."

[1] The material in this sub-section is based upon EPA's "Policy and Procedures for the Review of Federal Actions Impacting the Environment" October 3, 1984, pp. 4, 19-20. The document is available from EPA's web site (www.epa.gov)
[2] Ibid. p. 4

The EPA review is a major hurdle for any project involving the federal government or requiring federal approval. After a draft EIS is published, time is allowed for public comments concerning what the draft includes or fails to include. The draft EIS and all of the comments and procedural rulings are available to the public on-line. If the EPA finds environmental concerns, it may require substantial changes in the proposed actions or prevent the project from proceeding as proposed. Moreover, if EPA finds the EIS to be inadequate, EPA may require it to be revised or redone, an action that could delay a project for a year or more.

The conditions that would allow the EPA to raise environmental objections are specified by government regulations. Objections can be raised in five situations:

1. *"Where an action might violate or be inconsistent with achievement or maintenance of a national environmental standard;*
2. *"Where the Federal agency violates its own substantive environmental requirements that relate to EPA's areas of jurisdiction or expertise;*
3. *"Where there is a violation of an EPA policy declaration;*
4. *"Where there are no applicable standards or where applicable standards will not be violated but there is potential for significant environmental degradation that could be corrected by project modification or other feasible alternatives; or*
5. *"Where proceeding with the proposed action would set a precedent for future actions that collectively could result in significant environmental impacts."*

In other words, EPA must have a clear reason for raising objections, and other guidelines and policies will be used to determine whether proposed actions are acceptable or not. More stringent guidelines are in place for finding a proposal with environmental objections to be environmentally unsatisfactory:

1. "*The potential violation of or inconsistency with a national environmental standard is substantive and/or will occur on a long-term basis;*
2. *"There are no applicable standards but the severity, duration, or geographical scope of the impacts associated with the proposed action warrant special attention; or*
3. *"The potential environmental impacts resulting from the proposed action are of national importance because of the threat to national environmental resources or to environmental policies."*

Thus, the environmental review process places the onus on the proposing agency to identify the potential impacts, while establishing an agency with the necessary skills and responsibility to review and interpret the EIS. The criteria cited above could be quite qualitative, leaving approval up to the judgment of the EPA. Since the whole process is open to the public, it is possible for groups opposed to any action to make their objections to EPA.

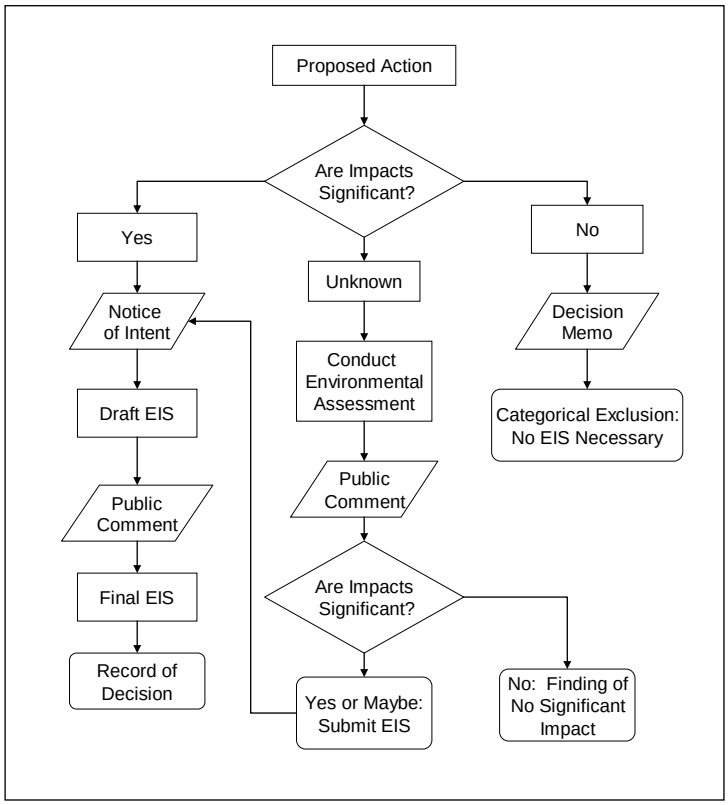
Figure 1 summarizes the review process used by EPA. If a major project or action is proposed, the first step is to determine whether or not there will be significant impact on the environment. If EPA believes that there will be no such impact, then it can allow the project to proceed without an EIS. If EPA finds that there will be significant impact on the environment, then the proponents of the project must prepare a draft EIS, which will be available for public comment and review by EPA prior to submission of the final EIS. EPA will then make its decision, as described above. If EPA finds that the environmental impact is unknown, then an initial environmental assessment can be required, which could lead to a finding of no significant impact or to the preparation, review, and revision of an EIS.

A great deal of judgment is involved in preparing and reviewing environmental impact statements. EPA has developed two sets of checklists of questions that might be asked in order to guide reviewers as they evaluate an EIS.[3] The first set of checklists address general areas of environmental concern that might apply to any proposed project: energy management, habitat preservation, landscaping, water use, and pest management. In each area, EPA has summarized

[3] Science Applications International Corporation, "Pollution Prevention – Environmental Impact Reduction Checklists for NEPA/309 Reviewers", Final Report, EPA Contract No. 68-W2-0026, January 1995

the relevant scientific factors and posed a series of questions that could and probably should be asked when reviewing any project. The second checklist provides questions that address the problems likely to be encountered in different types of projects. In each special area, such as a transportation or waterway project, the guidebook includes a brief summary of the likely problems and then provides several dozen questions that could be asked to determine how well an EIS has addressed issues that might be anticipated.

Figure 1 Summary of NEPA Decision Process



Social Impacts

Almost any project will have social impacts that may be related to the users of the project, people who live near the project, people who are displaced or competitively disadvantaged because of the project, or people who are hurt or whose lives are hindered as a result of the construction or operation of the project. Social impacts could be positive as well as negative, but it is the negative impacts that must be considered most carefully. Positive social impacts will help make a project more attractive, whereas negative impacts may be sufficient to arouse intense public opposition that prevents or markedly restricts a project. Anticipating negative impacts is therefore something that should be done early in the evaluation process, so that there will be an opportunity to adjust plans so as to reduce the negative impacts or to provide means for mitigating them.

Major projects may have far-reaching consequences that are difficult or impossible to quantify or comprehend. In some cases, projects that appear at first to be wholly desirable turn out to have unexpected consequences that are viewed very unfavorably by some people. In their famous study of Middletown, Robert and Helen Lynd reported that some residents recognized the social benefits of having automobiles for commuting, but were outrage by the dreadful social impacts of auto ownership:

"No one questions the use of the auto for transporting groceries, getting to one's place of work or to the golf course, or in place of the porch for "cooling off after supper" on a hot summer evening; however much the activities concerned with getting a living may be altered by the fact that a factory can draw from workmen within a radius of forty-five miles, or however much old labor union men resent the intrusion of this new alternate way of spending an evening, these things are hardly major issues. But when auto riding tends to replace the traditional call in the family parlor as a way of approach between the unmarried, "the home is endangered", and all-day Sunday motor trips are a "threat against the church;" it is in the activities concerned with the home and religion that the automobile occasions the greatest emotional conflicts."[4]

In the United States, social impacts must be considered as part of the process required for environmental impact assessment. A set of principles and guidelines for social impact assessment was developed by the Interorganizational Committee on Principles and Guidelines for Social Impact Assessment (ICPGSIA), a group of social scientists who sought to help public agencies and private organizations in carrying out responsible social impact assessment (SIA). Their motivation was that "SIAs help the affected community or communities and the agencies plan for social change resulting from a proposed action or bring forward information leading to the reasons not to carry out the proposal."[5] Like the environmental impact assessment, a major purpose for the SIA is to provide a mechanism for understanding and responding to the potential negative impacts of proposed policies, programs or projects.

> *By social impacts, we mean the consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society. The term also includes cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society.*
>
> The Interorganizational Committee on Principles
> and Guidelines for Social Impact Assessment

This group defined social impacts and identified six principles for social impact assessment. The first principle calls for identifying the people who will be affected by the proposed action and collecting information about their social conditions so as to establish a base line for evaluating changes to those conditions. The second principle is that the analysis should be focused on the most important social and cultural issues that are likely to be affected. The SIA need not address every possible social or cultural impact that might be imagined. The third principle emphasizes the need for using proper methods and input from the public in identifying and quantifying problems that might be encountered. In other words, social scientists know how to do this kind of analysis, and they should be involved early in the design and evaluation process for major projects. The fourth principle establishes the role of the SIA as providing information to be used by decision makers and the public; the SIA and the people conducting the SIA are not the ones who ultimately make decisions about whether or not to go ahead with the project.

The fifth principle deals with environmental justice, which refers to the sometimes commonly used approach to locating or structuring projects: "locate them in the poorest neighborhoods and don't worry about how the disadvantaged will be hurt by the project." Who benefits and who pays are important considerations in SIA and in project evaluation in general. The final principal indicates that SIA doesn't end when the project or program or policy is implemented. It is necessary to monitor what happens to ensure that mitigation measures are actually implemented and to ensure that unforeseen social impacts will be recognized.

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[4] Robert S. and Helen Merrell Lynd, *Middletown: A study in Contemporary American Culture*, New York, 1929 [the authors spent more than a year in Muncie, Indiana, interviewing residents about all facets of life in that small city].

[5] The Interorganizational Committee on Principles and Guidelines for Social Impact Assessment, "Principles and guidelines for social impact assessment in the USA", **Impact Assessment and Project Appraisal,** Vol. 21 No. 3, Beech Tree Publishing, Guilford, Surrey, UK, September 2003

Predicted social impacts may be temporary or long-lived, and there may be minor impacts that affect a lot of people or intense impacts for a few people. To understand the importance of social impacts, it will help to consider the kinds of social impacts that might be encountered in typical infrastructure projects. Table 2 lists some of the notable types of impacts.

Table 2 Examples of Negative Social Impacts of Projects

Type of Impact	Examples
Relocation of people	• Entire villages displaced for the construction of a dam. • Hundreds of people and small businesses relocated to allow the construction of a highway through a city.
Deaths and injury during construction	• Deaths of more than 20,000 from tropical disease in the various efforts that eventually led to the Panama Canal. • Deaths resulting from workers falling off bridges or buildings in situations where safety nets were not installed.
Deaths, injury or illnesses resulting during normal operation of infrastructure	• Millions of people severely injured or killed in highway accidents • Bridges and tall buildings serving as jump-off points for suicides • Asthma and other illnesses resulting from air pollution caused by emissions from power plants, automobiles, or home heating • Tens of thousands of people injured or killed annually worldwide in grade crossing accidents between highway vehicles and trains
Deaths and injuries resulting from infrastructure failure	• Thousands of deaths and destruction of cities resulting from dam failures. • Loss of life from buildings and structures that collapse in earthquakes
Disruption of neighborhoods	• Limited access highways serving as barriers when they are constructed so as to divide urban neighborhoods. • Loss of property values following construction of large, noisy, or ugly buildings or infrastructure. • Creation of suburbs and decline of central cities following construction of better highways and policies that encouraged home ownership.
Loss of livelihood caused by negative environmental aspects of a project	• Destruction of fishing and shell-fishing areas following construction of bridges, port facilities, or oil spills • Decline in use of informal taxis and buses following opening of new subway lines in large cities in Latin America and Asia.
Loss of livelihood related to projects that help competitors	• Bankruptcy of canal companies following construction of railroads. • Bankruptcy of railroads following construction of highways and invention of cars, trucks and airplanes. • Decline in newspapers following widespread use of the internet.
Loss of privacy	• Disruption of the life of native peoples following construction of roads or railroads through their previously remote homelands.
Reduced quality of life	• Noise and dust resulting from construction of a highway • Shade resulting from construction of tall buildings

It might be even more helpful to consider some projects where the social impacts, whether foreseen or unforeseen, turned out to be devastating or reprehensible. If the leaders of the French company that set out to build the Panama Canal knew that tens of thousands would die in their failed attempt, would they have ever begun the project? If city officials in New Orleans had long ago understood the risks posed by hurricanes, would they have allowed housing to be built in the lowest-lying areas of the city? If automobile manufacturers, highway engineers, and government officials truly understood the dangers of automobiles (hundreds of thousands killed worldwide each year), would we have the system that we have today? These questions are worth some discussion. Hindsight may suggest that we

would have done things differently if we had only known – but maybe the drive for a route to the Pacific, the need for more housing, and our great love affair with the automobile would have led us exactly to where we ended up.

Various researchers and agencies have used different categories of social impacts, and it is possible to construct quite elaborate topologies of social impacts. Whatever the categories, the main concern for the SIA will be to determine who is going to be hurt by the project or program, when will problems arise, and what can be done about them. As with environmental impact assessment, it is believed that there is much to be gained simply requiring these questions to be asked, with the answers and supporting information made public. If the problem is understood, then it may be possible to take action.

There broad categories of actions can be identified

- Adjust the design so as to avoid or reduce the social impacts
- Require mitigation as a condition for approval of the project
- Compensate those who are hurt by the project.

Whether or not any or all of these are necessary is something that will ultimately be decided by those who are threatened, local governments, developers, other stakeholders, and the courts.

Safety and Security

Safety and security are particularly important and emotional social concerns. Public reactions to projects seldom derive from a calm, rational assessment of the costs and benefits. Sometimes the public response is driven by fears and emotions, whether the fears relate to the potential for disaster or for national security. Proponents are likely to downplay the potential problems, while opponents are likely to stir up people's emotions. The classic case is nuclear power. While there have been only a very few serious accidents involving nuclear power plants in the U.S., the public has been very fearful of such accidents and very leery of proposals for sequestering nuclear waste. If nuclear power plants are built to modern safety standards, and if radioactive waste is properly sequestered, then they would seem to provide an efficient, clean alternative to the use of fossil fuels for generating electricity. However, public fears have forced extraordinary measures to be taken to limit the risks of such plants, and some countries have banned such plants altogether.

In the United States, a rather inconsequential incident at the Three-Mile Island Power Plant in 1979 was "the most serious in U.S. commercial nuclear power plant operating history, even though it led to no deaths or injuries to plant workers or members of the nearby community."[6] The accident led to very little off-site release of radiation. The average dose (1 millirem) of radiation to the population of 2 million closest to the site was only one-sixth of the dose received during a full set of chest x-rays. In addition, the NRC reports that studies have determined that there were no more than negligible effects on the environment. However, the accident at Three Mile Island led to sweeping changes in the regulation of the nuclear industry, including the addition of many costly safety procedures. The negative media attention that it received also created a terrible public image for the nuclear power industry as a whole, and no new plants were built in the US for 30 years. Acceptance of nuclear power varied widely in other countries. In Germany, public opposition led to a political decision in 2003 to phase-out of nuclear power plants, but in France, nuclear power had by then become the dominant source of electrical power.[7]

[6] Fact Sheet on the Accident at Three Mile Island. 1 Mar. 2004. United States Nuclear Regulatory Commission. 10 Nov. 2004. < http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html>

[7] Stephen Graham, "Germany begins nuclear phaseout," The Boston Globe, November 15, 2003

Summary and Discussion

The public sector's perspective regarding projects differs in several important ways from that of the private sector. Entrepreneurs view projects as a means of making their fortune; investors view projects as a way to earn a return on their investment; public officials and charitable organizations view projects as a way to achieve goals related to society's needs or desires. Many of the differences can be captured by the distinctions between financial analysis and economic analysis. Financial analysis addresses cash flows, whereas economic analysis also considers safety and security, growth in the economy, and provision of education, infrastructure, and other public services.

Another difference between the public and private perspective is that environmental and social concerns are more likely to motivate public projects, whereas such concerns are apt to be constraints on private projects. This is not an absolute difference. In particular, many infrastructure projects may have very negative consequences on the environment or upon people who live near project or who must move to accommodate the projects. Construction of roads through cities, creation of dams that displace thousands of people, irrigation projects that require flooding of fertile valleys, and use of public land for forestry and mining are examples of public efforts that can lead to serious controversy among agencies and among those who favor or oppose the projects. When controversies arise about public projects, a change in government, legal battles, or the passage of new legislation may be needed to resolve the issues. When controversies arise with respect to the social or environmental impacts of private projects, there could be legal and legislative battles to determine what kinds of activities are allowed and what kinds are prohibited.

A principle underlying public projects is that the benefits should exceed the costs. The project itself does not have to produce the cash necessary to cover the investment or even the operating costs, as the government has the power to raise taxes to pay for projects. However, the project should provide measurable economic benefits that are at least as great as all of the economic costs of the project. Just as the benefits can be more than the cash flow directly related to the projects, the costs can include social, economic and environmental impacts that are directly or indirectly related to the project. The logic underlying benefit/cost analysis can easily be misinterpreted. The proper interpretation of this kind of analysis is that the government should not pursue projects if the expected benefits are less than the expected costs. This does not mean that projects where benefits exceed costs should be approved, it only means that they deserve further consideration. Many controversies about the need for projects boil down to controversies as to what counts as a benefit, what counts as a cost, and how values should be put on factors such as safety, air quality, or job creation.

The extent to which concerns about environmental impacts, social impacts, or safety should affect the design or implementation of a project is something that will ultimately be decided by governments, developers, other stakeholders, and the courts. Over time, as the validity and magnitude of such concerns become clearer, it may be desirable or necessary to require improvements to existing infrastructure and develop more stringent regulations for locating, designing, and constructing new projects.

This essay has addressed the key factors that must be considered in enhancing the sustainability of infrastructure systems: financial feasibility, economic impact, environmental impact, and social impacts including safety and security. Finances are important, because cash will be needed to construct, maintain and operate infrastructure. Economic impacts are important, because they include many types of short- and long-term impacts that can help to justify a good project or to prevent a bad project. Environmental impacts are important, because an infrastructure-system that is too destructive to the environment or that requires excessive use of limited natural resources will not long endure. Social impacts are important, because it is ultimately society that decides whether or not to proceed with infrastructure projects and that bears the brunt of failures to consider hidden costs of projects.

It is clear that there are many diverse factors that will influence what needs are addressed, what projects are considered, and how projects will be evaluated. There will be no easy methods for determining the best projects, and no simple ways to gain public support for a particular project, although various methods and concepts can be used in reaching a consensus about what is needed and what should be done.

Resource: Project Evaluation: Essays and Case Studies

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