Can New Orleans Benefit from Market-based Approaches for Flood Protection? A Discussion of Options to Better Align Costs and Benefits[1]

Peter Gordon
University of Southern California

Richard G. Little
The Keston Institute for Public Finance and infrastructure Policy
University of Southern California

Introduction

The United States is a vast geo-political entity exposed to an abundance of natural hazards. Floods, earthquakes, hurricanes, tornadoes, wildfires, and ice storms affect different parts of the country with different intensities, return periods, and damage potential. There has been a major increase in the cost of natural disasters over the past 15 years and a comparison of the economic losses (corrected for inflation) due to natural disasters worldwide over each decade for the past 50 years reveals a huge increase: $53.6 billion (1950-59), $93.3 billion (1960-69); $161.7 billion (1970-79); $262.9 billion (1980-89); and $778.3 billion (1990-99). The current decade has already seen $420.6 billion in losses, principally due to the 2004 and 2005 hurricane seasons, which produced record losses.

The key socio-economic factor causing these increased losses is development in hazard-prone areas which puts increased value at risk. In the U.S., although much of the cost of natural hazard events is underwritten by private insurance,

[1] The authors want to thank, Prof. Ketra A. Schmitt, Faculty of Engineering and Computer Sciences, Concordia University, for helpful comments. She is not responsible for any errors or omissions.

when an event is escalated to the status of “disaster” the federal government has stepped in to provide disaster assistance of various kinds. This assistance amounts to *de facto* property and casualty insurance to which all U.S. taxpayers contribute.

However, it can be argued that unlike areas subject to earthquakes, extreme winds, or other hazards for which large-scale protective works are not feasible, much of the losses in areas “protected” by publicly-funded floodworks were, in fact, induced by the promise of total protection and the illusion that little or no personal risk was retained. Arguably, the federal flood protection program facilitates losses that would not otherwise occur. Using federal funds to then reimburse these losses is not sustainable policy. Beyond political expediency, it is difficult to fathom the thinking that supports such contradictory actions that not only waste enormous resources but contribute to untold human suffering and misery as well. It is, of course, likely that political expediency is the problem and moving beyond it the profound challenge.

New Orleans and the Mississippi River Valley have long been involved in the politics of flood protection and land reclamation. During the latter part of the 19th century, a program of levee construction along the length of the Mississippi River enabled the cultivation and habitation of tens of thousands of acres of land. When these levees failed along their length during the catastrophic flood of 1927, hundreds died and hundreds of thousands were made homeless. Property damage from the 1927 Mississippi River flood has been estimated at almost

$400 million (more than $4 billion in 2007 dollars)[2]. A recent study projects that the losses from the 1927 flood occurring today would approach $160 billion[3]. The cycle of federal funding of flood protection works and disaster assistance when the works prove inadequate continues to this day, despite Hurricane Katrina and the lessons that should have been drawn from the drowning of New Orleans.

This paper suggests some options that would provide decision-makers at each step in the process, from Congress to the individual homeowner, with incentives to base decisions on risk and not continue subsidizing behavior that ignores risk. However, prior to looking at possible options, it is useful to provide a context based on the failure potential of engineered systems and the assessment and management of that risk. To do this, we first review the role of technology and flood protection and the ways in which organizations learn from technological and institutional failures. This leads to a discussion of the concept of normal accidents and the mitigation of risk in high reliability organizations. These ideas are formalized through the treatment of risks and hazards. The risk-hazard framework provides a way to enumerate and discuss the institutional the options for risk management and mitigation. The paper concludes with the idea that institutional flexibility and open-endedness are required so that the most appropriate arrangements can emerge.

---

[2] Muir-Wood, R. 2004. "Mississippi river rages: the Flood Scenario: the Mississippi river system's flood protection plans and devices are overwhelmed. Thousands watch helplessly as their dreams drown in rising water levels," Risk & Insurance, April 15, 2004.
[3] Insurance Journal. 2007. "Study: 1927 Mississippi Flood Would Cost Up To $160 Billion," May 18, 2007. Available on-line: http://www.insurancejournal.com/news/national/2007/05/18/79826.htm [May 16, 2008]

Technology and Flood Protection

The classic approach to flood protection has been to provide structural controls through dams to hold back heavy rainfall or snowmelt, levees to keep swollen rivers within an artificial channel, and floodwalls and gates to protect isolated pockets of habitation or development. The reliability of the protection provided was largely based on the foresight of the designer to choose a design event of sufficient magnitude so that the likelihood of it being exceeded was acceptably low and the quality of construction of the physical infrastructure was sufficiently high that it would not fail in use. For the most part, when both of these conditions have been met, flood-prone communities in the United States have been taken from harms way. However, as the many post-Katrina reports have shown (see for example, ILIT 2006, IPET 2007), the levee system protecting New Orleans was not designed to withstand the effects of a highly likely event, was built to an insufficient height due to use of the wrong datum, and was poorly constructed and maintained. In the aftermath of Katrina, efforts have been underway by many agencies to rebuild and restore the levees to provide an increased level of protection. Although this is certainly understandable given the history of flooding and flood protection along the Mississippi River and in New Orleans, it should not preclude stepping back for a moment to consider alternative approaches.

History is littered with accounts of allegedly foolproof or failsafe technological systems designed to provide protection but that failed spectacularly when stressed. The ‘‘unsinkable’’ *Titanic* and the ‘‘impregnable’’ Maginot Line added

new terms to the lexicon of disaster (as have Chernobyl, Bhopal, and now New Orleans). Their designers assumed what was believed to be a rational hazard scenario, then planned and designed for it, yet both failed utterly in practice. The damage limits for the *Titanic* turned out to have no basis in reality—the iceberg that damaged the ship did not know that the design assumed that only a certain number of compartments could be compromised. In World War II, the Germans simply chose not to confront the extremely formidable defenses on the French border and attacked through lightly defended Belgium instead. Despite this, we continue to rely on protective technology where the potential for the loss of life and property is high and leave it at that. The Karpun tunnel fire in Austria that claimed 155 lives in 2000 started in a train believed to be fireproof. An assessment of the event noted:

> In November 2000, a supposedly ‘‘fireproof’’ train in a tunnel in the Austrian Alps caught fire and led to the deaths of 155 people. While many factors contributed to the disaster, one of them was thinking that a vehicle can be fireproof (Carvel 2002).

Not surprisingly perhaps, attitudes toward flood protection follow a similar trajectory. In the period following the Civil War, flood protection on the Mississippi River came under the control of the Mississippi River Commission. Of the Commission, John Barry noted in *Rising Tide* (1997)

> …the Mississippi River Commission never became a scientific enterprise. It was a bureaucracy. The natural process of a bureaucracy, by contrast, tends to compromise competing ideas. The bureaucracy then adopts the compromise as truth and incorporates it into being…The commission took positions and the positions became increasingly petrified and rigid. Unfortunately, these positions combined the worst, not the best of the ideas of Eads, Ellet, and Humphreys.

In a similar vein, the Standard Project Hurricane (SPH), the key parameter in the design of the New Orleans Flood Defense System (NOFDS) also "evolved" into something it was not.

- "The Standard Project Hurricane wind field and parameters represent a 'standard' against which the degree of protection finally selected for a hurricane protection project may be judged and compared with protection provided at projects in other localities." (Graham and Nunn 1959).

- "The project is designed to protect against the Standard Project Hurricane moving on the most critical track. Only a combination of hydrologic and meteorological circumstances anomalous to the region could produce higher stages. The probability of such a combination of occurring is, for all practical purposes, nil." (U.S. Army Corps of Engineers 1974).

- "The SPH is a steady state hurricane having a severe combination of values of meteorological parameters that will give high sustained wind speeds reasonably characteristic of a specified coastal location. By reasonably characteristic is meant that only a few hurricanes of record over a large region have had more extreme values of the meteorological parameters." (National Weather Service 1979).

- "The SPH was expected to have a frequency of occurrence of once in about 200 years, and represented the most severe combination of meteorological conditions considered reasonably characteristic for the region." (Government Accountability Office 2005).

As can be seen, over time the SPH went from being a general indicator of threat levels to a guarantee of safety. The methods used to define the SPH were buried, along with their potential flaws and questionable assumptions. Because it became the "gold standard" of flood system performance, the SPH served to prevent up-to-date reanalysis of the true risks of catastrophic flooding of the NOFDS.[4]

---

[4] ILIT (Independent Levee Investigation Team), 2006. *Investigation of the Performance of the New Orleans Flood Protection Systems in Hurricane Katrina on August 29, 2005.* Chapter Twelve: Organized for Failure. Available on-line: http://www.ce.berkeley.edu/~new_orleans/ [May 7, 2008]

Can we design a flood protection system that will not fail?

> Even if it were possible to reach perfection, it wouldn't matter for more than a short time, anyway. All complex systems mutate under pressure of technology and business, so what was good last week is different now. Every launch of the space shuttle is a little different from the last one because there are hundreds of suppliers in the chain, and they all have to change materials and techniques now and then. It's probably better not to believe in our own perfection, anyway, because it's such hubris that leads to the belief that failure is impossible.[5]

Perhaps not.

[5] James R. Chiles, *Inviting Disaster: Lessons From the Edge of Technology* (New York: Harper Business, 2001), 285.

Learning from Failure

Strategies for hazard mitigation, including hazard-resistant design for structures and other engineering works, have improved continuously from the observation of past failures, assessment of their causes, and improvements in techniques and materials (Petroski, 1992, 1994; NRC, 1994; Mileti, 1999). The numerous post-Katrina assessments are a case in point. However, the forensic approach suffers from its emphasis on identifying causes and determining who was at fault rather than preventing future failures. A case in point was the landmark Institute of Medicine (2000) study of errors in the health care industry that noted major conceptual concerns with commonly used forensic techniques in medicine:

> The complex coincidences that cause systems to fail could rarely have been foreseen by the people involved. As a result, they are reviewed only in hindsight; however, knowing the outcome of an event influences how we assess past events. *Hindsight bias* means that things that were not seen or understood at the time of the accident seem obvious in retrospect. Hindsight bias also misleads a reviewer into simplifying the causes of an accident, highlighting a single element as the cause and overlooking its multiple contributing factors. Given that the information about an accident is spread over many participants, none of whom may have complete information, hindsight bias makes it easy to arrive at a simple solution or to blame an individual, but difficult to determine what really went wrong.

Kletz, (2001) in a study of industrial accidents, also cautions about too much emphasis on causes:

> If we talk about causes, we may be tempted to list those we can do nothing about. For example, a source of ignition is often said to be the cause of a fire. But when flammable vapor and air are mixed in the flammable range, experience shows that a source of ignition is liable to turn up, even though we have done everything possible to remove known

> sources of ignition. The only really effective way of preventing an ignition is to prevent leaks of flammable vapor. Instead of asking, 'What is the cause of this fire?' we should ask 'What is the most effective way of preventing another similar fire?' We may then think of ways of preventing leaks.

In the case of New Orleans, Figure 1 indicates how hindsight bias could direct the focus on the levee breach or the hurricane which were just precipitating events leading up to the flooding. The root cause, however, was much deeper, embedded in the technical *and institutional* arrangements that contributed directly to the failure, i.e., incorrect design basis, lack of funding, and poor maintenance. This suggests that care needs to be taken in considering the

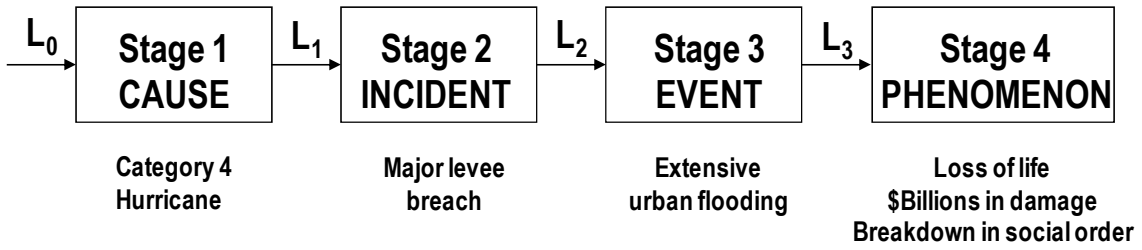

Figure 1. The event chain leading up to the flooding of New Orleans during Hurricane Katrina

recommendations of the post-Katrina assessment teams so that proposed solutions and future approaches address all of the aspects, not merely the obvious technical ones. For example, in the aftermath of Katrina, there has been much public demand to "get the engineering right" as though that was the only problem. Although the connection between poor design, construction, and maintenance and the breach and collapse of the levees is valid, it gets caught in Kletz's ''obvious cause'' trap and thereby misses the point. Instead of asking

‘‘How can we design levees so that they will not collapse or breach if subjected to a storm of Katrina’s intensity?’’ perhaps the more appropriate question is ‘‘How can we protect the people of New Orleans from floods in the future at reasonable cost?’’

The answer to the second question lies at least as much with institutions, governance and finance as with structural design and levee maintenance. Following Kletz’s admonition, perhaps the real question is not ‘‘What are the best technologies to hold back floodwaters?’’ but rather, ‘‘How can we reduce exposure, damage, and casualties in the event of future hurricanes?’’— a fundamentally different question.

Normal Accidents and High Reliability Organizations

Charles Perrow (1999a) was among the first researchers to discard the traditional approach to failure analysis that focused on the technical cause of an accident or event and the underlying human error that gave it life. In his classic work, *Normal Accidents*, he describes complex, socio-technological systems where the technical, institutional, and human elements are inseparable.

These systems, which are sufficiently complex to allow unexpected interactions of failures to occur and so tightly coupled to result in a cascade of increasing magnitude, give rise to what he has termed “normal accidents”. A particularly troubling characteristic of these systems is that while they predictably fail, they do so in unpredictable ways. Similar chains of events do not always produce the same phenomena, but system level or “normal” accidents of major consequence can be expected to recur on a continuous basis. In the search for increased speed, volume, and efficiency, he maintains that we have neglected the kind of system designs that are inherently more reliable and secure (Perrow, 1999b).

Perrow ascribes many of the causes of normal accidents to organizational issues such as the nature of the power hierarchy and organizational culture. These causes were abundantly apparent in the forty years leading up to the flooding of New Orleans during Hurricane Katrina. (Actually, the roots of this disaster are much older, predating the Civil War.) Beginning with the Congressional

authorization of the Lake Pontchartrain and Vicinity Hurricane Protection Plan (LPVHPP) in 1965, even a cursory analysis shows a project destined to fail at some point. Federal appropriations were never sufficient to complete the project in a timely manner. As a result, construction lagged behind schedule causing further cost escalation and funding shortfalls. Local cost-sharing was slow to materialize and even in-kind contributions for maintenance were not made. In addition, encroachment by local property owners made remedial work identified by the U.S. Army Corps of Engineers (USACE) difficult or impossible to impossible to undertake. Despite these obvious omissions and shortfalls, everyone involved, from the U.S. Congress to the individual homeowner, pretended that that a fail-safe flood protection system was in place. Although certainly not unique, reliance on such “fantasy plans” (Clarke, 1999) had particularly devastating consequences in New Orleans.

Risk and Hazards

Risk is a useful analytical concept that gives meaning to those uncertainties of life that pose a danger to people or what we value (NRC, 1996). Risk is often expressed as a combination of the likelihood of an adverse event, the vulnerability of people, places, and things to that event, and the consequences should that event occur, i.e., the probability of an adverse event (threat and vulnerability) multiplied by the consequences of that event, or $R = P \times C$. For example, if we consider the case of rising sea level, the risk is greater to people living in coastal areas than to those at higher elevations because of their increased vulnerability to lowland flooding and the greater consequences (to them) if flooding occurs.

One of the inherent shortcomings of this simplified, expected value-type approach to risk is that the structure of the model can produce apparently similar risk levels for vastly different classes of events. For example, from an arithmetic standpoint, a catastrophic event with extremely low probability can be interpreted to have a similar level of "risk" as a relatively frequent event with far lower consequences. Although it is compelling to believe that designing for some "maximum probable event" (or Standard Project Hurricane) fully addresses the risk issue, the experience with Katrina demonstrated that this may not be the case. In addition, relying on the presumption that protection from a "maximum probable event" has been provided when this is not actually the case will increase the vulnerability (and hence the risk) if more people locate in a formerly hazardous area now believed to be safe.

A more formalized process of risk assessment and risk management can help to illuminate and deal with these uncertainties. *Risk assessment* has classically been defined by three questions (Kaplan and Garrick, 1981):

1. What can go wrong?
2. What is the likelihood that it could go wrong?
3. What are the consequences of failure?

Based on the findings of the post-Katrina assessments, it is clear that the answers to these questions could have been summarized as follows:
"In the event of a not uncommon intensity hurricane, it is highly likely that the levees will be breached or otherwise fail in a number of locations with the result that hundreds to thousands of mostly poor people will perish and damage in the billions of dollars will accrue."

Had this perfunctory statement of risk been broadly disseminated, it is interesting to speculate on whether it would have affected development patterns in the city, especially in particularly vulnerable areas such as the Ninth Ward. However, not even this pessimistic forecast needed to preclude all activity in vulnerable areas. Risk can be managed, and, under the appropriate conditions, managed quite effectively. *Risk management* is the process by which the results of risk assessment are integrated with other information—such as political, social, economic, and engineering considerations—to arrive at decisions about the need and methods for risk reduction. Risk management seeks answers to a second set of questions (Haimes, 1991):

4. What can be done and what options are available?
5. What are the associated trade-offs in terms of all costs, benefits, and risks?
6. What are the impacts of current management decisions on future options?

It is the answers to these three questions and how they can influence governance and decision-making in and about New Orleans that will occupy the remainder of this paper.

What can be done and what options are available?

Options for managing flood risk can be grouped into five general categories. We can

1. Avoid the risk by locating somewhere else. In the case of flood protection, not locating in the flood prone area is perhaps the wisest choice. However, for many communities this is no longer an option.
2. Reduce the risk by taking countermeasures. These might include a combination of advance warning and evacuation, flood protection works, such as levees, hazard-resistant structures that are designed with sufficient robustness or sited above likely flood levels, and rapid response and recovery mechanisms so that the city has sufficient resilience to recover quickly.
3. Spread the risk by choosing multiple redundant locations for certain activities. (It would have been wise to locate at least some of the special generating capacity for New Orlean's dewatering pumps outside of the flood zone.)
4. Transfer the risk by buying insurance. The relevance of this option will depend on the continued viability of the Federal Flood Insurance Program and the willingness and ability of the commercial insurance industry to underwrite flood hazard risk at rates that homeowners are able and willing to pay.
5. Retain the risk. In light of the preceding points, property owners, neighborhoods, the City of New Orleans, or the entire state of

Louisiana may have no choice but to accept a portion of the consequences of the multiple hazards they face. Catastrophe bonds[6], either private (insurance industry) or sovereign (local, state, federal) may be an option to supplement traditional insurance. Mexico has recently issued a $160 million catastrophe bond to cover losses in the event of an earthquake greater than a pre-specified magnitude and the declaration of a national emergency[7].

As will be shown in the subsequent discussions, options 1, 4, and 5 offer New Orleans the most opportunity to explore alternative approaches for delivering effective and equitable flood protection as the city rebuilds.

What are the associated trade-offs in terms of all costs, benefits, and risks?

Benefit/cost (B/C) analysis was practically invented to do the type of trade-off analysis inherent in large flood control projects. A very simplified B/C analysis would determine that in exchange for $X in capital outlays and $Y for annual operating and maintenance expenses, benefits totaling $Z would be estimated to accrue. If the net present value of the annualized equivalent of Z > X + Y, the project has a favorable cost-benefit structure and is justified. However, this analytical procedure makes no effort to distinguish between

[6] Anderson, M. and O. Suess. 2006. "The allure of catastrophe bonds." *International Herald Tribune*. July 13, 2006.
[7] *Insurance Journal*. "S&P Rates Mexican Quake Cat Bond Managed by Swiss Re 'BB+'." May 22, 2006.

who bears the costs and who reaps the benefits. For example, although all U.S. taxpayers underwrite a portion of the federal share of the costs of flood control, the benefits accrue locally. Although often labeled “National Economic Development” benefits, these are usually targeted to reach a far narrower audience. The equity of federal water development has been debated for years and will not be resolved here. However, it will suffice to say that from the standpoint of managing risk equitably, much better alignment of who benefits and who pays is certainly possible.

What are the impacts of current flood management practices on future development options?

The Mississippi River valley historically has been a focal point of man’s efforts to “harness” nature to his purpose. The U.S. Army Corps of Engineers and its predecessors were charged with controlling the periodic and damaging floods that occurred on the Mississippi River and its tributaries. New Orleans, subject to both river flooding and tidal storm surge, has also seen the almost continuous installation of floodworks. The decision to encourage the growth of a major city and build flood works to enable that growth precluded other approaches. Once the size of the population and the value of the constructed environment achieved certain thresholds, there was little to do but to keep investing in large protective flood control structures. However, as demonstrated by Hurricane Katrina, these large investments were not sufficient to avoid disaster.

At this point, New Orleans and the nation are faced with another set of decisions that will affect the city and its residents far into the future—to continue with the failed policies of the past or to seek a more harmonious and equitable balance with the forces of nature, the desires of man, and basic economics. Hurricane Katrina has shown us what can happen when the only option is structures to provide flood control. It is time to consider other approaches that could be less costly and place fewer people and their livelihoods and possessions at risk.

Post-Katrina New Orleans

We suggest that the way to proceed in light of this general discussion is to step back and consider the nature of alternative institutional arrangements and their prospects. Post-Katrina, many have come forward with various "visions" for the new New Orleans. But this has been accompanied by a mostly unimaginative set of institutional discussions. In contrast, we suggest that the scale of reforms necessary for change in New Orleans will require a rethinking of institutional relationships, and that an utter failure in existing institutions is precisely the time for real reforms. This type of institutional change is already taking place in New Orleans. Allowing many more charter schools in New Orleans in 2005 was not a decision made on the basis of a policy evaluation; rather, it was forced by necessity because the established and troubled school district received a knockout blow from the storm.[8] Interestingly, in 1982, economist Mancur Olson noted that many social and economic problems develop with the passage of time via the ossification of institutional arrangements; the selection of improved spontaneous orders is stymied. And it then takes natural or man-made calamities to shake up these arrangements and allow real reform.

[8] There is already test score evidence of success from this reform (*New York Times*, May 7, 2008)

Olson's analysis describes the New Orleans school reforms. But these involved a local institution, particularly vulnerable to a localized disaster. Levees and ports, on the other hand, also provide regional and national services and involve state and national policy.

Most discussions of how New Orleans could be restored have done so by considering *how pre-Katrina institutions would do it*. This is not surprising. Conventional public discourse instinctively looks to known leaders to "do something." And these decision makers operate through well developed networks and channels. When Congress allocated $200 billion of relief funds, it was presumed that this would be administered via the same agencies that had been in place all along, the Army Corps of Engineers, the U.S. Department of Housing and Urban Development, etc., and their counterpart state and local agencies. These are the standard responses, but not adequate in a case as extreme as post-Katrina New Orleans.

The institutional status quo involves many well known problems. To take the example of housing markets, it is increasingly recognized that subdivision requirements in the U.S. are excessive. The U.S. Department of Housing and Urban Development recently reported that "The estimated average cost of excessive regulation for one dwelling unit was $11,910, or 4.8 percent of the average cost of a new home in

2004."[9] Many now call this the "housing affordability crisis" and look for new sets of policies, in this case requirements that new developments include "affordable" units, to alleviate the problems caused by previous policies. But the dysfunctional policies survive. In fact they are practically enshrined by the nature of the proposed remedies, most of which involve requirements that new residential developments include a specified amount of affordable units. But these policies exacerbate the problem because they are a tax on the new units that are eventually built. This example highlights the idea that where policy flexibility is missing, things get worse.

It is occasionally rationalized that the U.S. is wealthy enough to tolerate the costliness of these sorts of approaches. Unfortunately, it may take disruptions as extreme as Katrina to prompt a reassessment. New York City received a shock on 9/11 but the area was a comparative economic powerhouse that could handle the blow – even in spite of policy mis-steps. This is not the case for New Orleans.

To be sure, there is some evidence that some small reforms have performed as hoped. Some de-regulation of occupational licensing was

[9] www.huduser.org/publications/coodev/subdiv_report.html

implemented in Florida and New Orleans immediately after Katrina. In light of the standard fears that consumers would be left exposed and vulnerable when regulations and restrictions are relaxed, recent research for the Florida case corroborates the idea that they did fend for themselves and were not adversely affected (Skarbeck, 2008).

The case before us

Much of New Orleans is below sea level and some of it has been sinking for years. The category 4 storm that hit the area on August 29, 2005, overtopped and breached the area's levee system which had been designed to withstand a category-3 storm. As many as 1,500 people lost their lives and area damage levels were approximately $150 billion.[10] Surprisingly, there was comparatively little damage from the high winds of the hurricane; most of the losses and damage were in the area's low-lying districts as a result of the levee breaches. Hurricane Katrina and its aftermath continue to highlight a variety of problems involving the delivery of most of the local services that city dwellers normally expect and receive. In the case of New Orleans, these local service demands are overlaid on a port complex that legitimately qualifies as national critical infrastructure. The local and national-serving infrastructures both depend on almost 300-miles of levees, pumping stations, and associated flood control works that are required to protect a uniquely vulnerable area.

[10] Lee and Willardson (forthcoming) report that three major factors accounted for the levee system failures, (i) levee overtopping from the storm surge, (ii) floodwall failures traced to weak levee soil conditions, and (iii) poor levee system maintenance. The latter included pump stations that underperformed and that even caused reverse flows of water.

Levees, because of their broad flood protection mission, are often thought to be a classic public good and therefore the responsibility of the public sector to construct and maintain. But the discussion of public goods has recently become more complex (and more interesting) for two reasons. First, it is recognized that many *local* public goods have a spatial ambit: excludability ceases to be an overwhelming problem and benefits are capitalized (priced) in land markets. As such, there are market signals that private developers can (and often do) respond to when providing local public goods and facilities (Foldvary, 1994). Second, public authorities have started looking to private capital markets to facilitate funding for projects that had, in most of the 20th century, been mostly funded by taxpayers. Rights to own and operate proposed projects as well as existing ones are made available.

The New Orleans school reforms cited earlier were mostly a local matter. But the complex relationship between the levees and ports suggests that they require local, state, and federal participation. We have already discussed how participation of overlaying levels of bureaucracy causes the true social costs to be hidden from local officials, investors, and residents, causing them to overinvest in and

overpopulate vulnerable areas. In the same vein, this prompts underinvestment in local mitigation measures and private insurance.

Some of this oversight complexity is recognized in a recent report prepared by the National Research Council on various post-Katrina levee restoration challenges. This NRC report states

> "Conflicting stakeholder interests represent one of the greatest barriers to robust coastal restoration efforts in Louisiana." (p. 5, 2006).

Such "stakeholder" discussions elaborate the political context. Yet, the economic context cannot be ignored and economic oversight must be provided concurrently with political oversight. The next part of our discussion explores some options for substituting economic decisions and economic oversight for political oversight.

The options for New Orleans

Levee investment choices typically involve comparisons and tradeoffs of the costs and benefits of building various levels of protection, typically specified as protection against an x-year vs. a y-year event.[11] But this choice has an implicit spatial dimension: Are protected lands made suitable for agricultural or residential (or other) uses? These options belong in the cost-benefit analyses. Such studies would, then, consider what benefits (revenues) residential development would contribute. Knowledge of the amount of water stored as a function of levee height; the area of possible flooding could be estimated based on local hydrographical data. Waterfront and/or low-lying property can be secured for community development, but at an incremental cost. If so, then transactions between levee and floodwall providers and interested consumers (developers) are plausible. Efficiency as well as equity considerations dictate that the incremental costs be charged to those who stand to gain.

To date, we have seen few serious discussions of this aspect of post-Katrina redevelopment. Very few of them address the question of the

[11] Specified along with associated levels of risk in risk-based analysis. See, for example, Johnson (200x).

extent and the means by which market discipline can be brought to bear. We now consider levee ownership and maintenance along with the governance of the abutting land. Four hypothetical combinations are possible, as shown in the following diagram. We will explore the nature of all four cases.

		LEVEES	
		Publicly Owned And Operated	Privately Owned And Operated
LOCAL COMMUNITIES	Conventional Governance And Planning	I	III
	Private Governance And Planning	II	IV

Quadrant I depicts the status quo, but it merits further discussion. Without major changes in property ownership, new finance options can and should be considered. One of these involves catastrophe bonds issued by the levee authorities or other joint powers umbrella organizations to offset the risk of levee failure.

Catastrophe bonds are risk-linked securities that transfer a specified set of risks (in this case levee failure) from a sponsor to investors. They are often structured as floating rate corporate bonds whose principal is forgiven if specified trigger conditions are met. Catastrophe bonds are typically used by insurers as an alternative to traditional catastrophe reinsurance. However, sovereign catastrophe bonds (those issued by a public or quasi-public agency) could also be an option for the New Orleans levees. For example, Mexico has issued earthquake catastrophe bonds to provide reconstruction funds which are triggered by an earthquake greater than a certain magnitude and a declaration of a national emergency. In the case of New Orleans, the trigger could be the breach of a levee(s) followed by a Presidential disaster declaration.

To the extent that market participants have faith in the performance of the levees and their administration, they would demand a lower risk

premium and bonds would command higher prices. Catastrophe bonds would act in essence as self-insurance and bring some market discipline to levee reconstruction and maintenance. For example, the willingness of market participants to purchase levee catastrophe bonds would serve as an excellent indication of the degree to which people believed that the land "protected" by the levees was viable for private development. Absent such participation, the cost of public subsidy to support such development would be transparent and the policy implications at least open to debate.

Quadrant II retains the suggested modifications to public levee ownership in the Quadrant I discussion, but also alludes to the rise of private communities in the U.S. The Community Associations Institute reports that there were 295,700 private association-governed communities in the U.S. in 2007. These included 23.8 million housing units and were home to 58.8 million people. Over half of the associations involved planned communities. The phenomenon is thought to involve approximately 20 percent of the value of all U.S. residential real estate.[12] These associations are essentially private local governments. They deliver a variety of common services and provide common facilities and common areas that are managed by essentially private governments with the contractual power to assess fees that amount to private taxation. The associations are governed by "constitutions" usually called CC&Rs (Covenants, Conditions and Restrictions), that are designed by the developer. Competing developers offer trade-offs of rights surrendered for protections gained in light of market demand. Homeowners are usually keen to protect what for most is the major asset in their portfolio. Neighborhood quality and neighborhood transition are thought to be collective goods.

---

[12] (http://www.caionline.org/about/facts.cfm)

The popularity of this approach is easy to understand. It suggests more flexibility and responsiveness than conventional municipal government.[13] Robert Nelson (2005) has suggested that established neighborhoods be given the option of privatizing. He calls it "privatizing the inner city." A recent report that involved one of the authors suggested that this approach may be appropriate for post-Katrina New Orleans (Ikeda and Gordon, 2007). For the purposes of this discussion, we look at private governance for any community that might be sited in low-lying areas that would be habitable only if protected by levees. To the extent that all of the various low-lying lands are represented by one community or one authority representing all of the communities involved, there would be no free riding.

Developers of planned communities fund local infrastructure construction mostly within these communities and, in return, have achieved land design flexibilities and savings. Local governments, in return, benefit from cost savings whenever infrastructure is privatized (Ben-Joseph, 2004). But these developers are also subject to

[13] William Fischel (2001) has argued that "homevoter" cities, typically small suburban cities, are unique in that their raison d'etre is also the protection of home values. Fischel (2004) also claims that most homeowners want the protections offered by the homevoter city as well as the homeowners' association; they are complements. Nelson replied that private governments are less constrained; they do not, for example, have to abide by one-man-one-vote. All systems of governance involve politics and the problems of politics. The move to small cities and private communities suggests that politics at the more local level is more widely accepted.

exactions and impact fees to the extent that local governments also provide new infrastructure services (Althsuler and Gomez-Ibanez, 1993). The involved governments can be the local city or county or special district or state. Nelson sees these arrangements as thinly veiled transactions, sanctioned via odd legalese like "a nexus of development." Transacting for augmented levee services would be no different and arguably, with closer linkages between services, costs and benefits, there would be greater interest and involvement with the performance of the infrastructure and the institutional entity charged with its maintenance.

Quadrant III introduces private levee ownership and management. There is increasing interest in the private finance of highways because modern tolling technology makes it simple to sell highway access. There is never the presumption that private groups would want to manage all of any single highway or any highway system. Rather, they may find that owning and managing potentially profitable links is appealing.

Similarly, levee services could be transacted if private investors became involved. Unlike the situation discussed for Quadrant I, the levees could be operated and maintained by a proprietary organization if there were a contracted flow of rent payments.

Competitive bidding whereby private contractors are awarded exclusive franchises is actually an old idea. Catherine Wolfram (2004) traced the history of this approach for the case of the early U.S. airmail routes. She describes competitive bidding as an alternative to regulation of a private (natural) monopolist. Auctions force firms to reveal information about their costs that often eludes regulators. Such arrangements are increasingly being discussed in various states seeking to exchange lease deals for highways and turnpikes.

This option could also involve insurers directly; they or their surrogates could own and manage the levees and they would offer to insure protected properties on terms that they have some control over. For insurers to be innovative, however, they would have to be freed of the regulations and requirements that states like to impose. They would also have to operate without competition from state insurers.

For the case of levees, bids would be submitted to a local government agency. This has been accomplished to some degree in Great Britain. In these cases, a private consortia was granted a long-term concession to build, operate, and maintain a series of coastal flood defense works in exchange for annual availability fee payments. Ownership of the facilities and liability for their failure rests with the government.

The case depicted in Quadrant IV combines two of the innovations already introduced. Private levee providers would negotiate with private governments (homeowners associations), or developers or consortia thereof. The latter owe their existence and their prospects to reliable levees and, therefore, the management entity tasked with ensuring levee performance. The value of their properties would be linked to the reliability of the levees and give them a real stake in the performance of levees that abut their communities.

What makes this case different is that negotiation is between private entities on both sides of the table; property owners on one side and contractors on the other. The analyses of Tiebout, Nelson, and Fischel all suggest that efficient levels of public services would result. Foldvary has pointed out that voluntary contracts are more likely to be positive-sum, as opposed to zero-sum or even negative-sum. These sorts of negotiations would occur unless they were pre-empted by law or unless positive-sum gains were absent. But the answer to the latter question can not be known until political pre-emption is withdrawn.

Conclusions

Public provision of "public goods" does not necessarily crowd out private provision. Public provision can fail and voluntary private provision can fill the gap. Wal-Mart's actions in light of FEMA's post-Katrina failure are now well known (Boaz, 2005). Indeed, Chamlee-Wright (in Boettke, et al. 2007) documents a variety of similar activities that can be characterized as bottom-up successes in light of top-down failures. Leaving more room for the former is the strong policy implication.

This brings us to the question of which of our four quadrants is "best". No one knows and one size never fits all. Trial and error learning must occur – and it must be tolerated. This means that the important details will not be known until pre-emption is identified and scaled back. Appropriate contractual norms and arrangements are likely to emerge only in this sort of setting. But can the political will be mustered to allow some open-endedness and tolerance for trial and error? Generally speaking, and in the absence of a serious commitment to reform, the answer is "no". Lease deals for turnpikes and highways have been discussed in various states, but they have been stymied by the challenge of finding arrangements that are attractive to investors, but that are also politically acceptable.

A private-private option for flood protection would also have an uphill battle – just as there is continuing controversy with respect to this option in the discussion of highways[14]. At a minimum, there are the usual caveats concerning information asymmetry and transaction costs. As Katrina so aptly demonstrated, flood control is not child's play. But plausibly capable institutions with decades of experience make mistakes and, we have seen, maintaining the status quo involves serious problems.

Negotiating appropriate levels of protection tied to engineering and management solutions will require skills on the part of the private association that will not, in all likelihood, be readily available. These skills are available but contracting for such technical expertise can raise the transaction costs to such a level that the arrangement is no longer financially attractive. From the perspective of a private services provider, dealing with an uninformed customer is not desirable. Questions of whether the public interest is adequately protected by such an arrangement, which party is liable for what, and the reasonableness of the fee structure are all issues that have arisen in recent discussions of the private provision of transportation

[14] See http://www.innobriefs.com/abstracts/2007/nov07.html#1

infrastructure[15]. Attitudes in United States in 2008 exhibit deeply conflicted behavior in this regard. Although many brand the public sector as inefficient at best, and lazy, corrupt, and stupid at worst, when it comes to issues of safety and security, there is an identifiable bias toward public provision of vital services. The creation of the Transportation Security Administration in the aftermath of the 9/11 attacks is a case in point.

The challenge for people in New Orleans, and the United States as well, is whether there is adequate will to explore options that extend beyond the national socialization of local risk to better align the benefits received from flood protection and who bears its costs.

[15] Ortiz, I.N., J.N. Buxbaum, and R. Little. 2008. "Protecting the Public Interest: The Role of Long-Term Concession Agreements for Providing Transportation Infrastructure." Proceedings of the 84th Annual Meeting of the Transportation Research Board. Washington, DC. National Academies Press.

REFERENCES

Agthe, Donald E, R. Bruce Billings and Simon Ince (2000) "Integrating Market Solutions into Government Flood Control Policies" *Water Resources Management* 14:247-256.

Altshuler, Alan A. and Jose A. Gomez-Ibanez (1993) *Regulation for Revenue: The Political Economy of Land Use Exactions*. Washington, DC: The Brookings Institution, Cambridge: The Lincoln Institute of Land Policy.

Barry, J. M. 1997. *Rising Tide: The Great Mississippi Flood of 1927 and How It Changed America*. Touchstone. New York.

Ben-Joseph, Eran (2004) "Land Use and Design Innovations in Private Communities" *Land Lines*, 16:4.

Boaz, David (2005) "Catastrophe in Big-Easy Demonstrates Big Government's Failure" cato.org

Boettke, Pete, et al (2007) "The political, economic and social aspects of Katrina" *Southern Economic Journal*.74:2.

Bostic, Raphael and Danielle Molaison (forthcoming) "Hurricane Katrina and Housing: Devastation, Possibilities and Prospects" in Harry W. Richardson, Peter Gordon and James E. Moore, II (eds.) *Post-Katrina: Economics, Social Assessment and Risk Analysis*. Cheltenham, U.K: Edward Elgar.

Carvel, R. (2002). ''The history and future of fire tests.'' *Tunnels Tunnel. Int.*, 11, 34–35.

Clarke, L. (1999) *Mission Improbable: Using Fantasy Documents to Tame Disaster*. Chicago, Il., University of Chicago Press.

Fischel, William A. (2001) *The Homevoter Hypothesis: How Home Values Influence Local Government Taxation, School Finance and Land Use Policies*. Cambridge: Harvard University Press.

Fischel, William A. (2004) "Revolution or Evolution?" *Regulation*.27:2, 48-

Foldvary, Fred E. (1994) *Private Goods and Public Communities*. Aldershot, UK: Edward Elgar Publishing Limited.

Foldvary, Fred E. (2005) "Infrastructure: Optimal Private and Governmental Funding Provision" *Economic Affairs*. 25:1, 25-30.

Haimes, Y. Y., (1991) "Total Risk Management," *Risk Analysis*, Vol. 11, No. 2, pp. 169–171.

Ikeda, Sanford and Peter Gordon (2007) *Power to the Neighborhoods* George Mason University: Mercatus Center

ILIT (Independent Levee Investigation Team) (2006). Investigation of the Performance of the New Orleans Flood Protection Systems in Hurricane Katrina on August 29, 2005. Available on-line: http://www.ce.berkeley.edu/~new_orleans/ [May 7, 2008]

Institute of Medicine (IOM) (2000). *To err is human: Building a safer health system*, National Academy Press, Washington, D.C.

IPET (Interagency Performance Evaluation Task Force) (2007). Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System. March 26, 2007. Available on-line: https://ipet.wes.army.mil/ [May 2, 2008].

Kaplan, S., and Garrick, B. J., (1981) "On the Quantitative Assessment of Risk," Risk Analysis, Vol. 1, No. 1, pp. 11–27.

Kletz, T. (2001). *Learning from accidents*, Gulf Professional, Oxford, U.K.

Lee, J.J. and Bennington Willardson (forthcoming) "Hurricane Katrina: Engineering Lessons Learned" in Harry W. Richardson, Peter Gordon and James E. Moore, II (eds.) *Post-Katrina: Economics, Social Assessment and Risk Analysis*. Cheltenham, U.K: Edward Elgar.

Mileti, D. S. (1999). *Disaster by design: A reassessment of natural hazards in the United States*, Joseph Henry, Washington, D.C.

Nelson, Robert H. (2004) "The Private Neighborhood" *Regulation*.27:2, 40-47.

Nelson, Robert H. (2005) *Private Neighborhoods and the Transformation of Local Government*.

NRC (National Research Council) (1996) *Understanding Risk: Informing Decisions in a Democratic Society*, National Research Council, National Academy Press, Washington, D.C.

NRC. (1994). *Practical lessons from the Loma Prieta earthquake*, National Academy Press, Washington, D.C.

Nossiter, Adam (2008) "Changes at New Orleans Schools Bring Gains in Test Scores" *New York Times*, May 7.

Olson, Mancur (1982) *The Rise and Decline of Nations*. New Haven: Yale University Press.

Pennington, Mark (2002) *Liberating the Land: The Case Private Land-use Planning*. London: Institute of Economic Affairs.

Perrow, C., (1999a) *Normal Accidents: Living with High-Risk Technologies*. Princeton University Press, Princeton, N.J.,

Perrow C. (1999b) "The Vulnerability of Complexity", Paper presented at the Planning Meeting on the Role of the National Academies in Reducing the Vulnerabilities of Critical Infrastructures, April 28-29, 1999, National Academy of Sciences, Washington, D.C.

Petroski, H. (1992). *To engineer is human: The role of failure in successful design*, Vintage, New York.

Petroski, H. (1994). *Design paradigms: Case histories of error and judgment in engineering*, Cambridge University, Cambridge, U.K.

Skarbeck, David (2008) "Occupational Licensing and Asymmetric Information: Post-Hurricane Evidence from Florida" *Cato Journal*, 28:1, 73-82.

Wolfram, Catherine (2004) "Competitive Bidding for the Early U.S. Airmail Routes" UC Berkeley and NBER Working Paper.