because an element of its social infrastructure, the insurance of airplanes, stopped functioning. The material infrastructure of this socio-technical system remained in place but this was not sufficient to let it work successfully.

These developments in engineering can be characterized as ones in which the boundaries of the systems designed are no longer drawn solely around individual material products. Engineers must now enlarge their scope by recognizing wider boundaries, including human agents, their behavior, and ultimately their social institutions. As a result, engineers, like architects, are beginning to recognize their responsibility for the design of both material artifacts and the behavior of the agents interacting with those artifacts.

The notion of systems boundaries can also be used to capture an inverse development within architecture. What architects refer to as "building science" has transformed architectural practice in dramatic ways. New digital production techniques and new materials make possible architectural designs that could only be dreamt of a few years ago. In a way, architecture has narrowed its systems boundaries through a new emphasis upon building performance and the physical sciences. This is a development that brings parts of the architectural world much closer to engineering design. Here, as in traditional engineering design, design problems are approached primarily in a reductive, and not in an expansive way.

The turn by engineers from reductive to expansive design considerations produces a design practice which is more likely to resemble the moral and social consequences of architectural practices. Engineers working on socio-technical systems, like the architects of the working class' houses with their small kitchens, are in the business of consciously shaping the way people behave. This shaping of human behavior not only takes place with regard to man-machine interaction but, as argued above, social infrastructure. As molders of human behavior and interaction, engineers will have to think about the normative aspects of their choices on such structures. There they will encounter ethical and political dilemmas that are inherent in any consideration of human behavior. Moreover, the design of the material hardware and social infrastructure of a socio-technical system cannot be easily disentangled. The way in which the material products are technically designed produces constraints on the behavior of individual users and also requires the enactment of social institutions, such as building codes, regulations, and laws, to ensure that the system will function properly.[12] Engineering then becomes a deeply ethical and political practice.

Many design disciplines, other than systems engineering, must now recognize that design always has such social consequences, whether we choose to acknowledge them or not, and that these social consequences affect the success or failure of projects. The call to achieve environmental sustainability provides an illustrative example. Environmental degradation, most analysts now recognize, is as much a social problem as it is a technological one. The heating and cooling of urban buildings, which is linked to the "urban heat island effect," and rates of fossil fuel consumption,

[12] For a specific discussion on the historical development of building codes and their place within socio-technical systems, see Moore (2005).

are just two considerations. In the United States almost every building has its own heating and air-conditioning system. In contrast, many European cities have municipally owned "district" heating and cooling systems that significantly reduce emissions and improve fuel efficiency. The reasoning that lead to the production of such different systems are based, not upon engineering criteria as such, but on different traditions in different countries regarding property rights and the appropriate domain of public services. If the objective of technological development in this example is to successfully solve environmental problems, then designers must learn to think in new ways. In the design of socio-technical systems for environmental sustainability engineers must move, as in architectural practice, toward an expansive understanding of design problems. However, because of that move, engineers will have to confront the larger climate of social responsibility in which their design solutions will be developed and implemented. Some design solutions will be at odds with the broader social climate, and engineers like many architects today, become *de facto* social critics representing a substantial expansion of their professional responsibilities.

So as not to overstate our case, we must acknowledge that part of the expansion of responsibility will be a matter of choice. Many engineers will either ignore such considerations entirely and follow older expectations of the limits of design protocols and practices, or intentionally choose to do "business as usual" and refuse to push the boundaries of the social climate in which they have traditionally worked. Our point is that part of this expansion of responsibility will be imposed from outside by the sheer scale and complexity of the design problem at hand. To take a dramatic example, in the wake of the destruction of the city of New Orleans in 2005 after hurricane Katrina, how could it be possible to redesign the socio-technical system (which, in this case, was a city) without confronting the larger social and political climate that allowed for the growth and development of the city in the first place? One could, we imagine, simply rebuild the system of levies and canals to exactly their pre-Katrina state. But to do so would obviously be irresponsible, and given the likelihood of a similar climactic event in the future, a waste of public money. The engineering community could simply cede the decision on how and what to rebuild to politicians, differing responsibility for the success or failure of the effort to them. Clearly such a solution would also be irresponsible and irrational simply because politicians are not sufficiently trained in the relevant sciences. At some point engineers will either be called upon by politicians and city planners to describe what is possible in a rebuilding effort or else they will advocate certain solutions themselves. In that moment they can either choose to offer a design solution that accepts the goal of sustaining a city of a certain size on the New Orleans site or else reject it as imprudent or irresponsible. In either case, engineers will be implicated in a framework of responsibility for the future citizens of New Orleans whether they like it or not.

The emerging resemblance between the domains of design in engineering and architecture may be developed to a point where both may take advantage of the experiences and methods followed by the other discipline. We have three observations here.