CHAPTER 3

Humanitarian Engineering

> Technology influences disaster aid in two ways: First, it enables agencies to devise quick, although not necessarily appropriate, solutions to needs. Second, it influences the way in which needs are perceived and thus indirectly shapes many approaches.
>
> — Cuny, F., 1983, *Disasters and Development*, pp. 138–139.

It is against the dual background of engineering as context dependent (Chapter 1) and the new context of humanitarianism (explored in Chapter 2) that what is called "humanitarian engineering" has emerged. In general terms, engineering is the *artful drawing on science to direct the resources of nature for the use and the convenience of humans*. Humanitarianism has been generalized as an *active compassion directed toward meeting the basic needs of all — especially the powerless, poor, or otherwise marginalized*. Humanitarian engineering may thus be described as the *artful drawing on science to direct the resources of nature with active compassion to meet the basic needs of all — especially the powerless, poor, or otherwise marginalized*

The concept of humanitarian engineering has been independently developed in other contexts as well. For instance, a graduate student in mechanical engineering at Queen's University, Canada, did an extended analysis of humanitarian engineering in the engineering curriculum using the definition of humanitarian engineering as "the application of engineering skills specifically for meeting the basic needs of all people, while at the same time promoting human (societal and cultural) development" (VanderSteen, J., 2008, p. 8). The close similarities to our proposed working definition should be obvious.

To some degree humanitarian engineering is related to what Mitcham, C. (2003) has termed "idealistic activism" among scientists and engineers, as exemplified by organizations such as International Pugwash (founded 1957) and the Union of Concerned Scientists (founded 1969). Among a diverse collection of related organizations seeking to build bridges between humanitarianism and scientific technology are the Responsible Care initiative of the American Chemistry Council and the International Network of Engineers and Scientists for Global Responsibility (INES). Responsible Care, founded in 1988, is a voluntary program to improve environmental health and safety in the chemical and related industries, especially in developing countries. INES, founded at a 1991 international congress in Berlin, is an association of more than 90 organizations in 50 countries promoting the involvement of technical professionals in humanitarian and peace development activities. But arguably the most significant and influential figure on the emergence of humanitarian engineering as such was the civil engineer Frederick (Fred) Cuny (1944-1995). It is thus appropriate to begin a discussion of humanitarian engineering with the Fred Cuny story.

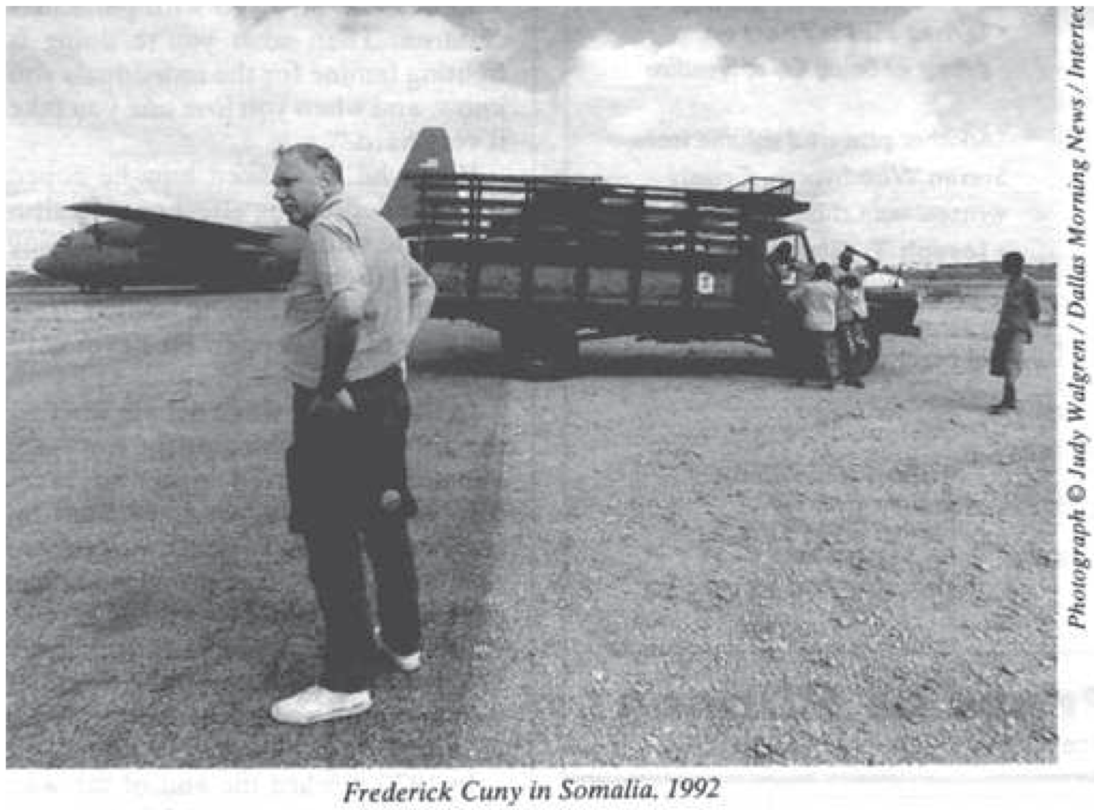

Figure 3.1: Fred Cuny (1944-1995), whose humanitarian engineering work has become an inspiration to many aspiring humanitarian engineers.
(Source: `www.world.std.com/~jlr/doom/cuny.htm` Credit: Judy DeHass).

3.1 THE FRED CUNY STORY

Versions of the Cuny story are available in at least three formats. A Public Broadcasting System *Frontline* program, *The Lost American* (1997), told his story in an investigative television report. Michael Pritchard's "Professional Responsibility: Focusing on the Exemplary" (1998) is an academic argument inspired in part by Cuny. Scott Anderson's *The Man Who Tried to Save the World* (Anderson, S., 1999) is a book-length biography. What follows draws on these and other sources, but simplifies.

Fred Cuny was born in New Haven, Connecticut, but in 1952 his family moved to Texas where, after graduating from high school, he studied civil engineering at Texas A&M University. As a student, he was fascinated with flying airplanes and wanted for a time to become a pilot in the U.S. Marines. He also took some courses dealing with urban planning and development and became increasingly involved with the problems of Mexican migrant workers in south Texas. After doing a small amount of engineering for the new Dallas-Ft. Worth international airport (begun in

1966), Cuny went in search of a more fulfilling form of engineering work. He wound up flying relief supplies for CARE into the civil war between Nigeria and the break away region of Biafra (1967-1970). Afterward he returned to Dallas to found the Intertect Relief and Reconstruction Corporation and became involved in a series of disaster relief operations.

Two early involvements were with the natural disasters caused by earthquakes in Nicaragua in 1971 and in Guatemala in 1976. His experience there led to formulation of what became known as the "Cuny approach" to disasters, using them as catalysts to improve people's lives instead of simply working to return to the status quo. As Cuny observed in *Disasters and Development* (Cuny, F., 1983), an influential analysis sponsored by Oxfam America and summarizing some of the lessons learned from these experiences, in the past there had been a tendency for disaster relief and development workers to go their separate ways. Disasters were seen as one thing, development another. But because developing countries were more likely to experience disasters, and the experience could undermine momentum toward development, Cuny argued for new forms of collaboration. Disasters, Cuny thought, should be seen as opportunities to promote development.

> Generally, speaking, simply helping victims until they can get going [that is, disaster relief work] has little overall impact on reducing recovery time and, depending on how the aid is provided, may even prolong it. … Helping people *to* recover [a form of development work], … can demonstrably reduce recovery time (Cuny, F., 1983, p. 202).

As he summarized this insight, "disasters can be a primary cause of underdevelopment, as well as intertwined with a country's progress toward development" (Cuny, F., 1983, p. 206).

Another of Cuny's key beliefs was that there was a distinct place for engineering in humanitarian disaster relief work. As he pointed out in his analysis of the Guatemalan case,

> none of the [disaster relief] agencies had contact with any of the major earthquake engineering institutions, nor (with only one or two exceptions) were the institutions consulted during the course of the reconstruction efforts. The earthquake engineering institutions, for their part, completely ignored the program implementors. Several international earthquake engineering organizations sent survey teams to Guatemala to study the collapse of buildings, bridges, and other structures, but made virtually no contact with those organizations involved in reconstruction programs (Cuny, F., 1983, pp. 134–135).

From Cuny's perspective, even in disaster relief more than physicians and nurses were needed. Likewise in the work of development, there exists a need for more than agricultural specialists and agronomists. In both disaster and development work, engineering knowledge and skills have been under-utilized. Indeed, it was precisely through the use of his own skills in engineering analysis and design that Cuny came to think about disaster and development in new ways and to reach conclusions somewhat at odds with existing assumptions.

One of these conclusions concerned the importance of not waiting for disasters to happen, but in planning for them. Planning and the development of strategies to deal with possible disasters such as earthquakes and hurricanes is not as glamorous or adrenalin producing as jumping into a disaster. In Cuny's words, "Typical preparedness activities include predetermination of effective strategies and appropriate modes of involvement, development of tools needed by the emergency staff, development of plans for the actual response, and training for crisis operations." This kind of work is "normally seen as an activity of the planning and engineering disciplines," not just of medical or military personnel (Cuny, F., 1983, p. 220). Planning requires analysis and office work, if you will. It can also save lives more effectively than simply waiting for disaster to strike. Earthquake or other natural disaster preparedness means that when such events occur there will be less disruption in peoples' lives and recovery will be much quicker. In a subsequent analysis of famines, Cuny and Hill (1999) likewise argued for the priority of counter-famine planning and preemptive strategies over conventional famine relief.

In some ways Cuny picked up and extended aspects of the alternative technology movement from the 1960s and ideas such as those associated with E.F. Schumacher's *Small Is Beautiful* (Schumacher, E., 1973). Although Cuny promoted the importance of engineering and technology, for instance, he also recognized their limits.

> In the future, not only will the scope of the disaster problem increase, but so will the diversity of the challenges. As both our technological capabilities and our understanding of the social and economic aspects expand, we will be called upon to participate in a wider range of activities than ever before. The technological aspects will bring, perhaps, the most visible changes. … [But as] disaster technologies and capabilities are improved, [volunteer organizations] will be faced with a parallel challenge — how to keep technology at an appropriate level (Cuny, F., 1983, pp. 258–259).

Following his work in Central America, Cuny became involved in disaster and development work during the Sudan-Ethiopia famine (1985) and with the Kurds in Iraq (1991); during the Somalia relief operation (1992); and to repair the water system during the siege of Sarajevo (1993-1994). His Sarejevo work lead to a "Talk of the Town" report and interview in *The New Yorker* (November 22, 1993). As an anonymous author wrote, "Over the years, Cuny and his associates have honed an approach that honors solid technical competence over vaporous good intentions." But why should "doctors and medicines routinely get flown in [to disaster areas], rather than engineers and piping"? The biggest problems in Sarejevo, according to Cuny's engineering analysis,

> were water and heat and, to a lesser degree, food, and, specifically, the way people were having to leave the relative security of their homes to forage and line up for such necessities for hours at a time, thereby subjecting themselves to the relentless bombardments and sniper fire. The key, therefore, lay in finding, as quickly and efficiently as possible, some way of getting such things to people in their homes, so that they wouldn't have to always be going out for them.

This Cuny did by engineering a new water system and providing the tools and instructions so that people could safely tap into a gas pipeline that was available. Then to help out with the monotony of United Nations food supplies, he distributed seeds for potted gardens on apartment balconies.

In 1995 Cuny was awarded a MacArthur Foundation Fellowship in a program designed to recognize "hard-working experts who often push the boundaries of their fields in ways that others will follow." But at the time of the award Cuny was on a mission to broker a peace agreement in Chechnya. He was assassinated there before the award notification was able to reach him.

3.2 OTHER PRECURSORS AND INFLUENCES

Cuny's life and work may have exercised a particularly strong influence on the humanitarian engineering ideal — his story is especially useful in helping students imagine new possibilities for engineering careers — but there were other precursors and influences as well. Two engineers who became U.S. Presidents, the engineer co-founder of the United States Peace Corps, and the NGO Doctors without Borders are all cases in point.

Herbert Hoover (1874-1964), who earned a degree in mining engineering from the first class of Stanford University, became the 31st U.S. President (1929-1933) primarily on the basis of his success as the organizer of European relief work during and immediately after World War I (1914-1918) and then again as the first Secretary of Commerce (under Presidents Warren Harding and Calvin Coolidge) especially during the Great Mississippi Flood of 1927. Although disaster relief was not part of the remit of the Secretary of Commerce, the governors of affected states requested that Hoover lead an effort that became a model for mobilizing and coordinating volunteers, local authorities, and national agencies. With a special grant from the Rockefeller Foundation, Hoover also set up health units that helped address problems of malaria, pellagra, and typhoid fever throughout the region. From Hoover's own perspective his success was grounded in his training as an engineer and his commitment to the promotion of efficiency through the use of analytic experts to identify problems and then propose solutions.

Jimmy Carter (born 1924), the 39th President (1977-1981), graduated from the United States Naval Academy at Annapolis with a BS in engineering. After his term as president he became a well known humanitarian working, for instance, with Habit for Humanity and home construction that could be presumed to draw on his engineering skills. Carter was awarded the Nobel Peace Prize (2002) "for his decades of untiring effort to find peaceful solutions to international conflicts, to advance democracy and human rights, and to promote economic and social development."

3.3 MAURICE ALBERTSON AND THE U.S. PEACE CORPS

More directly relevant than Hoover or Carter, however, was the life and work of civil engineer Maurice (Maury) Albertson (1918-2009). Growing up during the Great Depression in Iowa, Albertson was strongly influence by a family commitment to try to live out the Christian message of the Sermon on the Mount and by witnessing the impact of an extended drought on farmers and their communities. This led him to study water resource engineering and earn a doctorate from the University of Iowa.

After graduation, in 1947 he joined the faculty at Colorado State University, where he helped found the department of civil engineering and develop its focus on hydrology.

Figure 3.2: Maury Albertson (1918–2009), an engineer contributor to the founding the U.S. Peace Corps and a model humanitarian engineer.

Having been impressed with the way the Marshall Plan helped Europe recover after World War II, Albertson wondered, as he said in a 2008 interview, "Why not [something similar] with the rest of the world?" (Albritton, J., 2008). As a result, in the late 1950s he became a consultant to new U.S. Government efforts to promote development in Asia and was seconded to Bangkok, Thailand, where he helped establish a hydrological engineering program at what became the Asian Institute of Technology. Then in 1960 he was awarded a contract by the U.S. State Department to examine the feasibility of creating what was called a "point-four youth corps." The "point-four" referenced President Truman's fourth point in his 1949 inaugural address, which called for the United States to "embark on a bold new program" to "make available to peace-loving peoples the benefits of our store of technical knowledge in order to help them realize their aspirations for a better life" (as discussed in

Chapter 1) — a commitment that Democratic Senator Hubert Humphrey had promoted with the vision of a volunteer youth corp to provide technical assistance in developing countries. Albertson's co-authored report, expanded into book form, became *New Frontiers for American Youth: Perspective on the Peace Corps* (Albertson et al., 1961). The book explicitly describes the Peace Corps as extending the reach of volunteer Christian international service organizations into the promotion of American political ideals and lists among its Principal Project Needs, "engineering (irrigation, community water supply, flood control, roads, surveying, bridges)"(Albertson et al., 1961, p. 39).

As an upshot of his report, Albertson was asked by R. Sargent Shriver, the first director of the Peace Corps, to head a panel that would lay out many of the operational structures which, in short order, had over 10,000 volunteers serving in some 50 countries. Albertson subsequently became a consultant to such agencies as the World Bank, the United Nations Development Program (UNDP), and the United Nations Educational, Scientific and Cultural Organization (UNESCO) with a persistent focus on water and sanitation, farm water management and village development, and appropriate technology. In all cases, Albertson emphasized, as he said when awarded an honorary degree in 2006,

> We need to be motivated by service as well as by profit. We serve best by finding out what people want and helping them work to realize their dreams, not by going into a country and telling villagers what they need (Press Release, 2006).

In the words of Sandra Woods, Dean of Engineering at Colorado State, Albertson "was a world leader in water research [who continued] to work for what he [believed was] right and for the benefit of humankind" (Press Release, 2006).

3.4 *MÉDECINS SANS FRONTIERS* AND ENGINEERS WITHOUT BORDERS

Perhaps even more influential than individuals, however, has been the model of the NGO known as of *Médecins sans Frontiers* (MSF or Doctors without Borders). Hoover, Carter, and Albertson all fundamentally accepted, even when they were frustrated by, the notion of national sovereignty. The U.S. Peace Corps, with which Albertson was so much involved, is actually an agency of a sovereign country and thus tends to reinforce the whole concept of sovereignty or the idea that national governments have the final say over what goes on within their state boundaries. At the same time, from its beginnings, humanitarianism involved a questioning of the idea of sovereignty and associated ideas such as national patriotism and sacrifice. One of the fundamental tenants of MSF, which was founded in 1971, was to criticize and reject the primacy of national sovereignty as a final arbiter of boundaries for humanitarian action. MSF activists are committed to going where the problems are, even without the permissions of national governments, and to exposing the misbehaviors of governments toward their own peoples, insofar as these involve mistreating their citizens or depriving them of protection and care.

Stimulated by the ideals of MSF, the late 20th century also witnessed emergence of a host of other MSF-like NGOs: *Aviation san Frontiers* (1980), providing air deployment for humanitarian projects, Pharmacists without Borders (1985), Reporters without Borders (1985), Education without Borders (1988), Translators without Borders (1993), Lawyers without Borders (2000), Sociologists without Borders (2001), Chemists without Borders (2004), MBAs without Borders (2004), Librarians without Borders (2005), Farmers without Borders (2007), Scientists without Borders (2008), and Astronomers without Borders (2009). Yet one of the strongest parallel without-borders organizational developments has been associated with some form of the name "Engineers without Borders," in which engineering students and their professors began independently to explore possibilities of humanitarian engineering in diverse localities: *Ingénieurs sans Frontiers* (France, 1982), *Ingénieurs Assistance Internationale* (Belgium, c.1987), *Ingeniería sin Fronteras* (Spain, 1990), *Ingenierer unden Graenser* (Denmark, c.1992), *Ingenjörer och Naturvetare utan Gräser-Sverige* (Sweden, c.1995), Engineers without Borders (UK, 2001), Engineers without Borders (Australia, 2003), *Ingenieure ohne Grenzen* (Germany, 2003), *Ingegnería senza Frontiere* (Italy, c.2005), and others. In 2003 a number of these groups organized "Engineers without Borders — International" as a network to promote "humanitarian engineering … for a better world," now constituted by more than 41 national member organizations.

Complementing such interests among engineers, humanitarians have increasingly come to see engineering and technology as having increasingly crucial roles to play in the world of humanitarian action. As one of three authors in a collection of studies reflecting on *Technology for Humanitarian Action* have put it, technologies that have been used for war must be developed for peace.

> For the future, there is a lot of potential for adapting and creating technologies for humanitarian ends, but new technologies will not automatically be put to humane uses without the political will and the economic means to do so. This necessitates building upon and furthering the … trend of enlargement of humanitarian concern and expanded organizational effort [since the middle of the 20th century]. It means mobilization of the new culture to encourage the wealthy part of the globe … to make the economic sacrifices necessary to create and apply technology in effective ways (Cahill, K., 2005, p. 19).

3.5 HUMANITARIAN ENGINEERING: CORE FEATURES

As Chapter 2 argued, humanitarianism has gone through a number of developmental phases. It is the more recent phases, from the latter decades of the 20th century, that have constituted a new context for the practice of engineering. From the Cuny, Albertson, and MSF stories of this period, one can abstract some key attributes of the humanitarian engineering ideal that pick up and emphasize especially the notions not just of crisis intervention humanitarianism but also vulnerability reduction leading to more rapid crisis recovery and even crisis prevention.

The central feature of the humanitarian movement as a whole has been the exercise of active compassion for those on the margins of social wealth and power. This marginality can be temporary or more long-term, but in either case humanitarian action aims to serve the well-being of otherwise under-served populations.

Engineering itself has been described as design within a context or under constraints — constraints largely imposed by physical, political, cultural, ethical, legal, environmental, and economic phenomena. Insofar as this is the case, humanitarian engineering may conveniently be described as working to escape what has been called the "social captivity of engineering" by capitalism or nationalism or some other form of wealth and power (Goldman , 1991; see also Johnston et al., 1996). In doing so, however, humanitarian engineering seeks to work within a new self-imposed constraint of seeking to help meet the basic needs of under-served populations. In brief, humanitarian engineering in the most general terms is the artful drawing on science to direct the resources of nature with active compassion to meet the basic needs of all — especially the powerless, poor, or otherwise marginalized.