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Peace and Conflict: Engineering Responsibilities and Opportunities

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In many conflicts, the consequences of engineering projects are among the problems at issue, and engineers are unavoidably parties to the problems. Engineers need to raise their awareness of the potential effects of their projects, especially in situations of serious social and political contention, and to explore alternative designs or engineering solutions, and methods of implementation, that may ameliorate rather than exacerbate tensions. Engineers will also need to dialogue effectively with the many stakeholders affected if these projects are to be politically viable and achieve their technical purposes. The paper draws on several case studies of engineering projects in conflict situations, especially in developing countries. The article offers a check list of factors to take into account when designing and locating power, irrigation, mining, transport, and other types of engineering projects, in areas of conflict or potential conflict. The focus of the paper is primarily, but not entirely, on social conflict.

KEYWORDS: conflict prevention, engineering ethics, peacebuilding

INTRODUCTION

Conflicts among communities, peoples, and nations can arise from many causes, and often escalate to violence and warfare. In many cases, engineering programs and projects are among the problems at issue. Engineering professionals may unavoidably be parties to the problem. They may also be well placed to prevent or ameliorate the problem in the first place, or be in position to contribute to a peaceful resolution. The social responsibilities facing engineers has become a subject of its own, explored in books and engineering ethics journals. Apart from the role of engineers in the development and manufacture of armaments, the relationships between engineering and conflict, especially in developing countries, has been less well examined.

Engineering projects in the United States are frequently at the center of political conflict, e.g. disputes over the location of wind farms, the fracturing technology for extracting natural gas from shale formations, off-shore oil drilling, nuclear energy generation safety and spent fuel disposal, environmentally damaging open-pit mining, distribution of scarce water sources, and efficiency standards for vehicles.

Although disputes raised by these issues sometimes reach fever pitch in the United States, they seldom end in violent conflict. In developing countries, by contrast, contending groups that viewed their vital interests at stake in engineering decisions have sometimes resorted to violence over recent decades to resolve disputes not settled through negotiation or orderly political process. In some cases, engineering projects have deepened inter-group animosities that may have arisen initially for other reasons—religious, cultural, economic, etc.

There have also been numbers of positive-sum outcomes, where projects have been designed and decided through processes deliberately aimed at avoiding exacerbation of underlying animosities. Even more proactive are engineering investments designed to create common economic and/or communal interests among groups in societies marked by socio-economic fault lines.

THE ROLES OF ENGINEERS

Engineers are found at advisory, decision-making, or design levels in the processes leading up to the realization of programs and projects involved in conflict situations. Engineers play important roles in the management and operation of projects once they come on line. While senior engineers will bear greater responsibility for decisions and options chosen, engineers at all levels should consider the social and conflict consequences of projects they work on, and to put their views on the table. The feasibility of proposed projects, aside from technical and economic considerations, often depends on the social and political circumstances, particularly on how the stakeholders view the potential consequences. The individual engineer may be a political office-holder, a civil servant, an executive or employee in a private contracting organization, a private consultant, an academic in a university engineering faculty, or on the staff of an international development organization. In any capacity, engineers may find themselves involved in the deliberation and decision processes, at various levels of governance, that will determine a project's outcome.[1]

At whatever level, engineers need to take account of the fact that different engineering solutions—different locations, designs, technologies, scales, etc.—will have different consequences among potential beneficiaries and others affected. Technical choices have social, political, and distributional consequences. Some groups benefit more than others; some may be harmed.

Many engineering fields may perforce be involved in conflict-laden contexts—fields such as civil, hydraulic, electrical, transport, mining, petroleum, agricultural, etc. In recent years, both in the United States and other economically advanced countries and in developing countries, the engineering profession has been thrown into increasingly complex contexts. Designers need to think through unanticipated consequences. As a result, those responsible for the technical core of many projects need to develop skills of coordination, negotiation, and communication, and the ability to take account of environmental and other impact studies. In international work, engineers must be able to work alongside local engineers who will have a greater understanding of their own societies and who may have different perspectives and different levels of training and experience.

ENGINEERING, CONFLICT, AND SOCIAL RESPONSIBILITY:

ENGINEERING PROJECTS ARE EMBEDDED IN WIDER CONTEXTS

The World Bank's experience with financing large hydroelectric and irrigation projects in developing countries shows how projects in a specific field of engineering have had to develop beyond their technically-defined boundaries in order to take account of complex networks of connections with other (engineering and non-engineering) disciplines. The projects also faced the need to interface and negotiate with stakeholder groups that, in earlier decades, were ignored as outside the boundaries of individual projects. As a general rule, experience shows that the larger the project, the wider the scope of interactions with activities and interests outside the project's

[1] The problems of dealing with officials demanding corrupt payments that distort these processes raise important questions of engineering ethics, and of law, that are outside the scope of this discussion.

technical boundaries, and the more important it is to take a "holistic" approach. In the case of large hydraulic projects, that means taking a river basin-wide approach.

For many years the Bank avoided financing hydro projects after encountering opposition by NGOs and criticisms for ignoring bad outcomes for displaced and indigenous people who had been forced to relocate to make way for the engineering structures. The Bank resumed hydro project financing in the 1990s after meeting these objections by developing extensive guidelines and safeguard requirements, including adequate offsets to compensate losers, and design standards to take account of a range of human and environmental impacts. These requirements are formalized in the Bank's Operational Manual (2012) as "Environment and Social Safeguard Policies." Policies that bear directly on project conflict potentialities include: "Indigenous Peoples" (OP/BP 4.10); "Involuntary Resettlement" (4.12); "International Waterways" (7.50); and "Projects in Disputed Areas" (7.60).

The policies cover both project substance and how the Bank must process the designing and approval stages. For example, for "Projects in Disputed Areas," which "may raise delicate problems . . . between the country in which the project is carried out and one or more neighboring countries," the project appraisal documentation must demonstrate that Bank staff have considered the nature of the dispute, that the other countries involved in the dispute have no objection to the project, that the project is not harmful to the other countries' interests, and that a conflicting claim has not won international recognition or is being actively pursued (OP 7.60, p. 1).

The policy paper on projects involving involuntary resettlement states that "resettlement of indigenous peoples with traditional land-based modes of production is particularly complex and may have significant adverse impacts on their identity and cultural survival." To avoid these impacts if possible, the Bank must be satisfied that "all viable alternative project designs" have been considered. If displacement is unavoidable, the policy requires that project authorities conduct consultations, monitoring, grievance procedures, and planning and implementation processes that include the displaced persons and their communities. Resettlement sub-projects and their costs are to be included as integral parts of the overall project (OP 4.12, p. 5).

The complexities that extensive networking imposes on project designers and authorities is illustrated by an example from Tanzania, in this case involving not social conflict but the environmental problem of impact on endangered species. Projects must deal with an increasing prevalence and influence of a multiplicity of government agencies in developing countries as well as local NGOs. As evaluator J. Fox (2011) found,

> In one case, a snail in Tanzania was deemed by MCC (the U.S. Millennium Challenge Corporation) to be endangered by a dam slated for construction under an MCC Compact. Senior Tanzanian officials considered the snail's possible demise negligible collateral damage for an activity that would provide large numbers of Tanzanians with electric power. However, the Tanzanian National Environmental Council would also have rejected the project. The snail prevailed, as the MCC and the country's environmental council, rather than the senior leadership of the government of Tanzania, held control of the implementation process. Nevertheless, the Tanzanian government and MCC were able to agree on an alternate set of investments to address the country's energy problem. (p. 12)

Extending an engineering project's boundaries to cover all direct and indirect linkages imposes additional costs: research studies, time-consuming decision and negotiation processes, extra financial costs, borrowing country irritation, and wide-ranging policies required of the borrowing government, etc. The studies and policies often feed back into the engineering "core" of the projects, requiring some redesign and reengineering. For examples, see the Liebenthal's (1996) *World Bank's experience with large dams: A preliminary review of impacts*, and Haney and Plummer's (2008) *Taking a holistic approach to planning and developing hydropower: Lessons from two river basin case studies in India*. The need for extensive networking is especially acute where engineering projects are to be located in areas of actual or potential socioeconomic conflict.

ENGINEERING AND CONFLICT PREVENTION

International frictions over exclusive claims to resources or to ownership of disputed areas with natural resources development potential have often threatened to grow into outright conflict and warfare. Recent examples of areas with past or ongoing such tensions include islands in the South China Sea, in an area that may hold oil fields, claimed by Vietnam, Taiwan, and China; the Senkaku Islands in the East China Sea, also with oil potential, claimed by Japan and China; oil produced in southern Sudan that flows through pipelines in northern Sudan; division of scarce water resources among Lebanon, Israel, and the Palestinian West Bank; hydro and irrigation schemes along the Mekong River affecting the downstream riparian countries; and irrigation and hydro development in Turkey on the Tigris and Euphrates rivers, diminishing the flow down river in Syria and Iraq.

Recent or ongoing internal conflicts in developing countries—centered on mineral, land, water and other development projects, some involving violence—have been located in (among others) Peru (with demonstrations and casualties); Colombia (gold mining); India (tribal land rights); Papua New Guinea; Mexico; Ecuador; Ghana; and Bangladesh. An international conference held in London in 1996—the Mining and Indigenous Peoples Conference—issued a declaration on conflicts between corporations and indigenous peoples (América Latina en Movimiento, 2009, para. 4). This led in 2007 to the United Nations General Assembly issuing the Declaration on the Rights of Indigenous Peoples, aimed at strengthening the claims of indigenous people whose traditional lands were in danger from modern "development" project inroads.

Two examples illustrate how engineering solutions to resource conflicts can prevent violent outcomes. Soon after the partition that separated the Indian sub-continent into Pakistan and India, it became clear that failure to design (and finance) a system for the control and distribution of the waters of the Indus River basin that was acceptable to both India and Pakistan, was likely to result in warfare between the two countries. The World Bank took the lead in designing, negotiating, and financing a large-scale, multi-dam irrigation solution acceptable to both sides. After nine years of negotiation spearheaded by World Bank president Eugene Black, the two countries signed a treaty in 1960 on development of the Indus waters. Unfortunately, although this massive scheme took the Indus Basin dispute off the table, India and Pakistan had other disputes that did lead to recurrent armed conflict and that remain unresolved.

The second, and unequivocally successful, example is the Gal Oya irrigation project within Sri Lanka, built in 1948–1952. The upper arms of the irrigation canal system went through areas occupied by ethnic Sinhalese, the country's dominant ethnicity; the lower arms of these channels went through minority Tamil areas. Farmer user groups were set up for overseeing the cooperative (and more efficient) distribution of the water, ensuring that the downstream Tamils received the flow they needed for proper cultivation. Despite efforts of the Tamil Tigers, the insurgent side in the long Sri Lankan civil war (1983–2009), to persuade the Tamil farmers to cease cooperating with their Sinhalese neighbors, the user groups held fast and relations between the Gal Oya ethic communities remain peaceful. Details on this experience can be found in Norman Uphoff (1992).

By contrast, another Sri Lankan irrigation scheme became a major missed opportunity. The massive Mahaweli project, begun in 1970, the biggest engineering works in the island's history, was originally designed with a major channel stretching into the largely Tamil region of northern Sri Lanka. In 1977 the Sri Lankan authorities redesigned the project to exclude the northern channel. The decision was defended on technical grounds, but was seen by the Tamils as demonstrating Sinhalese discrimination and exclusive hegemony. The government also discriminated against Tamils in the redesign of the settlement plan for agricultural land that would be newly opened by the project. Retaining the original designs could have helped avert the subsequent political deterioration that spiraled into warfare. For a full account see World Bank Operations Evaluation Department (1998), and Muscat (2002, pp. 66–70).

A rural development project in Rwanda that started in 1974 is another example of a missed opportunity that turned out to exacerbate underlying tensions. Financed in part by the World Bank's "soft window," the International Development Association, the Mutara project was designed to provide several thousand households with land for agriculture and ranching. The project was built around an infrastructure core comprising 750 kilometers of road along with houses, warehouses, offices, and other structures for the use of project staff. The World Bank's own evaluation of the project's results reported that the physical targets had been met but that the project had failed because there had been no provision for complementary social infrastructure. In addition, the benefits of the project—the buildings, vehicles, access to land, etc.—were captured by local Hutu elites, to the disadvantage of Tutsis. Even when schools and other social infrastructure were added in a second, corrective, phase, the project still failed due to mismanagement and the unequal access to the benefits. The final result was judged by one Africa scholar to be "a great increase in inequality between regions, social classes, groups and individuals." For details, see Peter Uvin (1998, p. 121).

Projects to improve transportation can make major contributions to the economic development of poor regions and to the scope for reducing poverty. New or improved roads can lower the costs of getting agricultural produce to markets. New highways and feeder roads have often opened new areas previously shut out from market access. These projects can also have downsides, especially where they open up areas already inhabited by people previously marginal in terms of economic or political power. New low-cost access can create incentives for developers of large-scale agriculture, cattle-ranching, or resource extraction, who may expropriate the land or otherwise sweep aside the claims, and livelihoods, of the previously isolated inhabitants. One of the most widely publicized cases (in which, in one episode, Brazilian courts convicted some intruding gold miners of genocide of native inhabitants), new road access starting in the early 1970s opened remote Amazon areas to miners and cattle-ranchers whose intrusions have threatened the health and livelihood of the indigenous Yanomami (Survivial for Tribal Peoples, n.d.; Wallace, 2012).

Taking Conflict Into Account

To be alert to the relevance of engineering projects to potential conflict, engineers (and others involved in planning and implementation) should take account of the following factors:

1) Is the project located near geographic fault lines between rival groups?
2) Will the location and design of irrigation channels impinge on divisions between different ethnic (or religious, etc) groups?
3) In the case of international waterways, the World Bank's cautions should be taken into account.

4) The World Bank cautions should similarly be applied to projects in internationally contested areas, and in border-spanning resource development (e.g. natural gas, petroleum, water).
5) Dealing with external “diseconomies” (e.g. effluent pollution causing health or economic damage to communities receiving no employment or income benefits from factories outside the affected areas) should be integral to project design and negotiation.
6) Is a project opening up, or otherwise affecting, areas inhabited by indigenous people? How will this effect project design, cost, negotiation, and implementation?
7) Will mining degradation of local environments be justifiable, minimized, etc.?
8) Will there be adequate and fair compensation payments/projects for people negatively affected?
9) Will new road location raise issues of equity and benefits between favored and omitted communities?

In general, engineers should seek opportunities for mutually satisfactory, inclusive project designs that create strong motivation for peaceful coexistence or cooperation. Some engineering firms have developed in-house capacity for exploring the social context surrounding a project’s engineering core. Others could ensure that such capacity is brought to bear through suitable cooperating organizations.

Conflict-Avoiding Implementation

Even if good practices have been followed throughout the design phases of a project, and the kinds of conflict potential discussed above have been avoided, care needs to be taken during project construction and implementation where underlying conflict-potential remains. Transparency and public information can prevent misunderstandings between groups. Calls for bids should be published in local languages. Bidding processes should be explained and transparent. Equal-opportunity hiring and subcontracting practices can sustain the appearance of fairness established during the pre-implementation phases. Banfied and Tripathi (2006) discuss “good practices” in conflict situations, and provide guidelines for selecting engineering organizations with “conflict-sensitive” capabilities and experience. Regular dialogue with affected communities can uncover potential disaffection at an early stage. The normal practice of post-project evaluation should include examination, through beneficiary assessment and other means, of any social tensions that may have been created or heightened by the project.

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