Making the human dimensions of sustainable community development visible to engineers

Juan Lucena MS, PhD
Associate Professor, Colorado School of Mines, Colorado, USA

Jen Schneider MA, PhD
Assistant Professor, Colorado School of Mines, Colorado, USA

Jon A. Leydens MA, PhD
Associate Professor, Colorado School of Mines, Colorado, USA

Recently, engineers – particularly those working on sustainability-related initiatives – have increasingly turned their efforts towards under-served communities. This paper summarises the findings in *Engineering and Sustainable Community Development* (Juan Lucena et al., 2010) aimed at a diversity of these efforts which are grouped here under the term ‘engineering to help’. These initiatives often exist under names such as community service, humanitarian engineering, and engineers without borders or activities such as the Institution of Civil Engineers’ co-sponsored workshop ‘Helping local communities to help themselves’. Although there has been a blossoming of engineering-to-help-related programmes around the world, there is a lack of critical reflections of engineers’ involvement. The book summarised in this paper attempts to fill that void. The paper concludes with an invitation to engineers to become critically involved in the complex world of sustainable community development.

1. Historical overview of engineers and development

To understand the present and future possibilities and constraints for engineers involved in sustainable community development (SCD), episodes of the history of engineers’ involvement in development were traced, from 18th century colonial development to 21st century SCD, and an attempt was made to try to answer the following questions: How did engineers first become involved in development? How have engineers been engaged in imperial, national, international, sustainable and community development? What kind of socio-political, economic, ideological and institutional factors might have contributed to engineers’ complex engagement with the groups of peoples (tribes, national societies, communities etc.) that they are supposed to serve? To what extent might this history constrain engineers’ ability effectively to define problems and implement SCD solutions? Because of the limitations of time and space in this paper, historical findings are outlined in Table 1. These are broad historical generalisations that perhaps apply more to engineers from certain countries than from others. For example, beginning in the 1980s concerns about economic competitiveness with Japan were more prevalent among US engineers than among engineers from other countries. (Lucena, 2005). For a comprehensive list of supporting references for these historical periods, see Chapter 2 in Lucena et al. (2010).

Clearly, the history of development has shaped institutions, practices, ideas and assumptions about how engineers view and work with community. Every epoch of development has positioned engineers differently with respect to community, often in problematic ways. The present is no different. Current engineering practices in SCD continue to be shaped by this history and, in most cases, communities continue to be marginalised or simply treated in market terms as ‘customers’ or ‘clients’ whose problems need to be solved or as ‘charity cases’ whose basic requirements need to be satisfied. Why might communities be important for those engineers working in global settings?

Engineers depend on the transfers of knowledge, capital, materials and technologies that take place through financial networks, supply and demand chains, and multinational
<table>
<thead>
<tr>
<th>Historical period and main socio-economic and political drivers</th>
<th>Engineers’ primary emphasis</th>
<th>Engineers’ main view of communities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineers and the development of empires (18th and 19th centuries)</td>
<td>To transform nature into a predictable and lasting machine that could be controlled to ensure their imperial patrons a return on investment and display superiority over indigenous people (Adas 1989; Headrick, 1981).</td>
<td>Communities as sources of potential imperial subjects to be taxed, converted to the religion of the empire and often forced into labour for the construction of imperial projects.</td>
</tr>
<tr>
<td>Imperialism, colonialism and mercantilism shaped political, cultural and economic relations among countries</td>
<td>To map territory and natural resources of new countries; to build national infrastructures that connect dispersed populations into a national whole and integrate their productive capacity for national and international markets (Diacon, 2004; Lucena, 2009).</td>
<td>Communities as part of a larger national whole (national subjects) brought into a functional order with other parts of the nation to ensure its progress.</td>
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<td>Communities as sources of potential imperial subjects to be taxed, converted to the religion of the empire and often forced into labour for the construction of imperial projects.</td>
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<tr>
<td>Engineers and national development (19th to 20th centuries)</td>
<td>To develop and modernise the ‘Third World’ through science and technology; to move ‘traditional’ societies from their current stage of backwardness and launch them through a stage of ‘take-off’ by implementing large development projects (hydroelectric dams, steel mills, urbanisation) (Adas, 2006).</td>
<td>Communities as obstacles to ‘efficient’ economic production and mass consumption. Communities to be convinced, transformed or coerced to join the modernisation path by abandoning their subsistence economies, increasing their extraction of natural resources and manufacturing capacities to eventually reach a stage of high-mass consumption.</td>
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<td>Nationalism (except in Africa and some parts of Asia) shaped political, cultural and economic dimensions of new independent countries</td>
<td>Development engineers focused on providing communities’ basic needs in shelter, food, and water with the goal of making them productive and incorporating them into the economy (Rist, 2004).</td>
<td>Communities viewed in terms of what they lacked (deficiencies) and humans in terms of basic need parameters (e.g. minimum body temperature; maximum number of days without water or food).</td>
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<tr>
<td>Engineers and international development redefined in terms of ‘basic needs’ (1970s)</td>
<td>Most US engineers embraced economic competitiveness as Japan emerged as a technological threat (Lucena, 2005); development engineers engaged in structural adjustment – that is, expansion of free markets, reduction of government regulations in the marketplace and encouraging privatisation of public services.</td>
<td>Local communities disempowered as they faced the challenges of free markets under unequal competition and the diminishing of state functions, mainly health, education and other forms of social protection.</td>
</tr>
<tr>
<td>Cold War as foreground for developmentalism and modernisation; many African countries embraced independence and nationalism; other ‘Third World’ countries embraced import substitution and tariffs to protect national economies</td>
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<td></td>
</tr>
<tr>
<td>Engineers and the beginning of international development (since 1950s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineers and the ‘lost decade of development’ (1980s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neo-liberalism encouraged a return to free markets, privatisation and reduction of welfare state; economic nationalism (‘Made in America’ against ‘Made in Japan’)</td>
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</tbody>
</table>

Table 1. A historical overview of engineers’ involvement in development and views of community (continued on page 3)
corporations (MNCs) that span the globe. The design, development and production of technical systems rely on these global arrangements. Yet technical systems sooner or later become grounded in localities as their manufacturing, assembling, implementation, and use happen in specific places, within local ecologies and in interaction with local communities of workers, subcontractors, regulators, users and citizens (Acosta and Leon, 2009). This localisation of human activity – including the making of technological systems – within specific local ecologies has led sustainable development (SD) scholars to conclude that the realisation of sustainable development into actual sustainable practices depends greatly on how local interactions and practices are carried out. Wary that global visions of SD might work against the actual realisations of sustainable practices, Yanarella and Levine argue that 

the very globalising vision of ecological thinking when transferred to strategising can militate against the tacking down and institutionalisation of self-sustaining processes at lower scales where sustainable development may be more realised and the results more palpable. (Yanarella and Levine, 1992: p. 764)

Elaborating further on why the global visions of SD might serve the interests of SD experts, including engineers, SD scholars Jeffrey Bridger and A. E. Luloff argue that those who portray environmental problems in such apocalyptic terms that they sometimes revert to the language of technocratic planning and administration and speak of the need for global ecological planners in international agencies who must work with national political elites and multinational corporate leaders to manage these environmental crises … The problem with this kind of solution is that relations of domination are left in place. Those who control the resources and who are responsible for many of the decisions and actions that have caused insidious environmental damage are generally charged with cleaning up their mess … The result is a crisis mentality which relies on technological solutions for much larger structural problems … (Bridger and Luloff, 1999: p. 380)

This reliance on technological fixes clearly appeals to engineers committed to sustainability, especially if accompanied by substantial funding from international agencies and national governments. Yet these fixes might not lead to long-term sustainable solutions if the practices that support them do not reside at the local level, in the local interactions among engineers and communities. Bridger and Luloff propose that 

[b]y shifting the focus on sustainability to the local level, changes are seen and felt in a much more immediate manner. Besides, discussions of a ‘sustainable society’ or a ‘sustainable world’ are meaningless to most people since they require levels of abstraction that are not relevant in daily life. The locality [community] by contrast, is the level of social organisation where the consequences of environmental degradation are most keenly felt and where successful intervention is most noticeable … sustainable community development may ultimately be the most effective means of demonstrating the possibility that sustainability can be achieved on ...
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Making the human dimensions of sustainable community development visible to engineers
Lucena, Schneider and Leydens

a broader scale, precisely because it places the concept of sustainability in a context within which it may be validated as a process. By moving to the local level, the odds of generating concrete examples of sustainable development are increased. As these successes become a tangible aspect of daily life, the concept of sustainability will acquire the widespread legitimacy and acceptance that has thus far proved elusive. (Bridger and Luloff, 1999: p. 380)

This shift to local interactions among engineers and communities led to the following question: if the future of sustainability resides in local community practices yet the history of engineers in development seems to constrain the ways in which engineers have engaged communities, how might future engineers effectively work with communities towards sustainable solutions?

2. Engineering with community
After researching the literature on community development and developing two case studies on SCD, the authors adopted a flexible definition of ‘community’, identified the main challenges for engineers who work with communities and provided an outline for engineers preparing to work in SCD.

‘Community’ has multiple, competing definitions and meanings, depending on the context. Definitions that are dynamic are valued (not drawing fixed boundaries between inside against outside) and, when flexible enough to account for variable contexts (e.g., temporary against long-lasting communities), can also provide some guiding principles for engagement and reflection. As a result, community-development practitioners are sided with, who define community according to the characteristics in Table 2.

Following a comprehensive literature review in the history of technology and engineering studies, scholarly fields devoted to the study of engineers and engineering in context, a number of barriers were identified that hinder engineers’ ability to engage communities.

(a) Engineers’ beliefs about development, including that a socially engineered order, informed by science and realised through technology, will bring progress to all of those involved in this new order (Adas, 1989; 2006).
(b) Engineering problem solving (EPS), the dominant method for solving textbook problems in engineering education, makes it difficult to put community at the centre as it forces engineers to draw a technical boundary around problems and become suspect of those perspectives that do not use EPS for problem solving (Downey et al., 2009).
(c) Engineering mindsets – such as reliance on the scientific method as the primary way of knowing the world to the exclusion of other ways of knowing – make it difficult for engineers effectively to consider community, especially when intertwined with issues of social justice (Riley, 2008) and/or the perspectives of other disciplines which might provide holistic and qualitative views of communities, social justice and the environment.
(d) ETH-related courses, projects and programmes tend to be more about students’ learning and desires to help and/or about universities’ philanthropic ambitions than about the welfare of communities (Schneider et al., 2009).
(e) Engineers’ beliefs about community, including that communities are homogeneous entities that can be treated as a client or customer in a for-profit relationship or in design for industry projects (Mathie and Cunningham, 2008).

For a full analysis of these challenges, see Chapter 4 in Lucena et al. (2010). It is proposed that in order for engineers to overcome these challenges and move towards effective, ethical and meaningful work with communities, engineers need to find ways to learn about the communities they are working with – their history, language and values – by learning to listen in context.

3. Listening to community
The most important activity in dialogue is to listen. Yet most of us in personal, family and professional relationships have forgotten, or really never learned how to listen (Nichols, 2009). Since listening is the bedrock of dialogue, the analysis of how engineers try to dialogue with others involved in SD focuses on listening. From exploring a number of development projects – large and small – a recurring lesson emerged: that failure to listen to and meaningfully address community perspectives played a significant role in the failure of such projects (e.g. Burkey, 1993; Easterly, 2006; Salmen, 1987; Salmen and Kane, 2006). Of all skills for SCD, listening is one of the most important yet one of the most undervalued in engineering education and practice.

In another study, two of the authors found that, in engineering education and practice, listening is often conceptualised as basic listening: that is, hearing or paying attention to the verbal and non-verbal messages of any speaker, such as a client, customer, local community member, coworker or instructor. Basic listening is thus framed as a dyadic process of speaking (output) and hearing/receiving information (input) (Leydens and Lucena, 2009).

Unlike basic listening, the authors developed the concept of ‘contextual listening’ as a multidimensional and integrated understanding of the listening process. Such listening facilitates meaning making and social learning, enhances human potential and helps foster community-supported change and trust among all participants in SCD projects. The characteristics and desired outcomes of ‘contextual listening’ are

(a) integrating history and culture
(b) being open to cultural difference and ambiguity
1. Relationships among members

Belonging to a community means being involved with other members of that group. This may seem obvious, but it is important to realise that the nature of these relationships can be highly variable and complex. Relationships might be new and temporary, as in the case of a group of people of different backgrounds coming together for the first time after a disaster (e.g. a tent city created after a hurricane) or old and durable, as in the case of a people from a village with ancestral attachments to each other.

In either case, engineers should respect and try to strengthen these relationships in ways that are appropriate to the communities.

2. Relationships with place

‘Place’ is loosely defined. Frequently, members of a community identify with a particular geographical place (such as a village or city) where they are from or where they live. But the place can also be virtual (such as an online space, or a women’s organisation). Engineers should respect and try to strengthen this relationship to place as defined by community.

3. Differences in power and privilege

These differences could vary in degree, from small – as when dictated by slight status difference – to very significant, as when shaped by a combination of political power, socio-economic status, gender, race, and caste. In any event, engineers should understand and respect these differences even when they might seem to go against the engineers’ preconceived ideals of equality. Understanding these differences allows for creative approaches that can transform power relations in beneficial ways for communities, for example by a more equitable distribution of capacity-building benefits (Rambaldi et al., 2006).

When a particular subgroup of the community appears to be oppressed, it is not the role of the ‘expert’ to relieve them of this oppression but rather to enable them to seek alternatives if the members of the subgroups desire to do so.

4. Alliances with a common purpose or purposes

Communities may come together for a variety of reasons, whether for commerce, kinship, entertainment or political cause. The degree of participation in these purposes may vary, depending on the needs and desires of individuals involved.

Engineers should aim to understand these purposes.

Table 2. Key characteristics of community (summarised from Mathie and Cunningham (2008))

| (c) building relationships and trust and enabling social learning |
| (d) minimising deficiencies and recognising capacities |
| (e) foregrounding self-determination |
| (f) accentuating shared accountability: how the ‘ours’ against ‘theirs’ becomes OURS. |

4. Civil engineers, contextual listening and boundary crossing

4.1 Sika Dhari windmill project

Implemented in Sika Dhari village in western India, this actual project involved a civil engineering professor who teamed up with a non-governmental organisation (NGO), the US Environmental Protection Agency (EPA), a group of her graduate students and others to work with the villagers in project design and implementation. Originally, the civil engineering team was expecting to build a waste-water system and provide the village with Western-style toilets. But as the engineering professor solicited community perspectives and participation in all stages of the project, the original plan changed. She and her students participated in community meetings with the villagers, where the villagers demonstrated a significant familiarity with development projects, and communicated this knowledge and their desires to the engineering team. Their commitment to contextual listening allowed this engineering team to learn that, owing to deeply rooted cultural factors, the village did not want a waste-water system.
treatment system or toilets but a windmill to generate energy for powering flashlights. As this team of civil engineers began to cross disciplinary boundaries into electrical engineering, they learned that the technological choice of wind energy generation was dictated by local political considerations that became visible through contextual listening. After multiple meetings with different groups in the community, the engineering team found out that, as a sign of protest to a nearby hydroelectric project the community wanted to be self-sufficient in energy production and remain off the grid. They wanted a windmill to symbolise both environmental sustainability and political resistance to the hydroelectric dam.

In the implementation stages of the project, the team ran into some problems, including technical failure of the charge controller and safety testing. Both problems were mitigated thanks to the involvement of Anil, one of the villager’s residents and a professionally trained electrical engineer. However, his involvement brought new difficulties to the project. Professor Natarjan found that Anil was not willing to acknowledge the intellectual work of the windmill designer or the rest of the design team in newsletters he sent out about the project, nor would he acknowledge EPA funding, perhaps because he was wary of US governmental organisations. Committed to a Gandhian philosophy that emphasised the decentralisation of wealth, anti-materialism, the preservation of tribal cultures and ways of life, Anil resisted the idea of intellectual property, feeling that all ideas should belong to all people. Anil’s status as a political outsider in India also made funding the project difficult because he could not officially register to receive money on behalf of the villagers for the project. And finally, he was reluctant to sign the group’s contract. ‘What we found,’ said Natarjan, ‘is that their politics are so difficult that you couldn’t take any steps forward because they don’t want to acknowledge foreign support even if they get it.’ Yet her commitment to contextual listening allowed Natarjan to see how political differences between her engineering team and the local engineer were getting in the way of making this project sustainable. So Natarjan facilitated the construction of the windmill and left the village. Given these difficulties, Natarjan is no longer in contact with the villagers of Sika Dhari. She claims that the windmill is indeed up and running, and that the villagers see the project as a success. It is difficult to determine if this solution was the most sustainable in the long run. Yet this solution, grounded on contextual listening, provided the village with self-determination and energy independence from the hydroelectric dam.

For her part, Natarjan has moved on to plan a new wind project in a neighbouring country and begun to devote significant energy to urban sustainability projects in the US, in her home city. There is a part of her, she indicated, that questions the feasibility of SCD projects abroad. She has come to question who in fact benefits more from these projects: the villagers, or the students who are sent there? During an interview for this case study, she acknowledged that:

‘What I found is people in the villages are smart, they know what’s happening, they know what they need. They may not have funds to do certain things that they want to do, but you know this whole thing of going and doing all this is actually benefiting our students more [than the villagers] because it’s opening their eyes. So let’s be honest and say ‘Yeah it’s a good international exposure for our students but do we contribute that much to these communities?’ I don’t know. I don’t know. I seriously don’t know …. I still wonder if [we] left [the villagers] alone, if they would be just fine.’

In short, her commitment contextually to listen from the beginning of this project led this civil engineer to cross disciplinary boundaries to address villagers’ desires. Natarjan and her team came in as civil engineers and ended up doing electrical engineering work. But more importantly, she came to recognise the agency of the villagers and that they did not need her help after the windmill was built. In this case, contextual listening might not guarantee long-term sustainability of an energy solution, but it ensured the self-determination and autonomy of the village. For a full description of this case study, see Chapter 6 of Lucena et al. (2010).

4.2 Community mapping in Honduras

This is an abbreviated case study of a civil engineer who effectively incorporated communities as a central part of her work. Born and raised in Honduras, Elena Rojas trained as a civil engineer under a curriculum that mostly included courses in mathematics, physics, structures, hydraulics, hydrogeology, water supply, sewage and sewage treatment, mechanics of soil, roads, pavement, and other structures: a typical curriculum for a future engineer. But Rojas does remember one course that was different. Her water supply systems course was taught by a dynamic professor who used methods that were unusual for that time. He actually took his students out of the classroom and into the field, where students identified local water sources, walked the lengths of pipe, identified tank locations and walked through local communities to understand how houses were distributed, yet all the while ignoring the people living there. Rojas clearly remembers the field exercise in this course:

[It] consisted in designing a rural water system but didn’t have contact with the community at all. It was just the technical part of going to the field, identifying the water source, walking all through the pipe, the location for the pipe line, the tank location and we went through the community just to have an idea how the houses were distributed … we didn’t talk to anybody. So our professor gave us the topographical survey and some guidelines to design the rural water system. That was all (Lucena and Schneider, 2009).
While it was unusual and forward-thinking for her professor to take them into the field, Rojas noted that she and her engineering classmates were learning how to design a technology to move and store water from point 1 to point 2 efficiently without communicating with members of the community.

After securing her first job in civil engineering, Rojas found out that if she wanted to be respected in a male-dominated field she needed to earn a graduate degree. This decision led her to cross boundaries into environmental science, a move that allowed her to see water not as a physical object to be moved across space but as a resource to be protected (See Figure 1). This new way of seeing water allowed her to introduce her colleagues to new concepts such as water quality, pollution and sanitation. By helping her colleagues to see water as a resource, they configured a watershed protection unit and brought it together with hydrology, water control and effluent control units under a new name ‘Department of Hydrologic Resources’. This organisational reconfiguration was quite significant because ‘unit’ was elevated to ‘department’ and ‘water’ elevated to ‘resource’. This civil engineer had become an agent of organisational change.

Later Rojas drafted national legislation to protect water as a resource, engaged social scientists in her attempts to communicate with communities and more recently developed a community-based process to map communities and their water use: an innovative form of contextual listening.

To do community mapping, Rojas begins by holding a series of one-day workshops with local water committees and municipal representatives. Members of local water committees are essentially volunteers from the local communities that have a vested interest in water while municipal representatives are officials at the county level. Both community and county are contained within the local ecology of a watershed. Local volunteers are typically ‘natural leaders’, says Rojas, and as a result are typically well trusted and respected in their communities. At those workshops, she challenges participants with simple questions about water quality: How many communities have operational systems? How many existing systems need rehabilitation? What is the actual coverage in each area? What can be done to increase coverage sustainably? She then encourages the water committees to develop and voice their concerns. After all, the committees are in charge of the process.

**Figure 1.** Conceptualisations of water in environmental science are complex and often include relationships among water, atmosphere, vegetation, and soil at different stages of a river flow. For Rojas, this conceptualisation of water allowed her to see water as a resource to be protected (Source: Radboud University Nijmegen)
The workshops also serve a strategic function in that they raise the visibility of her NGO in the region so that they can build trust with locals. Then, using the information gathered at the workshops, Rojas and her NGO begin to gather specific information about local communities. Truly committed to contextual listening, Rojas and committee members interview health workers, school teachers and community members about their water and sanitation uses, habits and infrastructure. They verify the community location using a global positioning system (GPS), and take and analyse samples of each single water source being used by the community. Using this information, the organisation begins to build a database containing information about water and sanitation in multiple communities; this information can be used to prioritise projects across the region, and is an integral part of the community mapping process. Rojas describes the process as follows:

We know how many communities in [a given municipality] do not have at all any water or sanitation system. We know which committees ... need some training in different areas, we know right now which communities are paying a tariff, which ones are paying a very low tariff. So we got very key information for us to be able to plan what we’re going to do over the next four years. And of course, that is a kind of planning tool because we are not going to develop any project just because the mayor tell us, ‘Oh we need this project here.’ We will do it according to the priorities we have identified together with the water committees. (Lucena and Schneider, 2009).

This strategy of community mapping empowers communities to take control of their own water consumption, sanitation, treatment and conservation and removes water allocation from insidious local politics. Throughout these experiences she learned the importance of listening to communities:

Just by having the challenge and learning everyday that if I don’t talk to people, if I don’t come to people, and if I don’t convince [them] of what they need to do in order to maintain and operate their system, we are not going to succeed. They are not going to succeed and we are not going to succeed ... Because first of all you start understanding the connection that you can be a very good technical engineer and do your technical projects, your water projects in a very neat way, and you can implement them, that’s not really a challenge at all. That’s easy to do somehow, you only need to assure the resources, the economic resource. But that challenge [can be stated like this:] once those projects are implemented, what is the key issue to make sure that they will last the time you have planned they should last? So that’s something that you as a technical person cannot solve if you do not take into account the people that are going to be taking care of or using those systems. (Lucena and Schneider, 2009).

In this case, by crossing boundaries into environmental science, this civil engineer’s discovery of water as a resource led her to become an agent of organisational change, develop a strong commitment to listening to communities, who in the end take care of the resource, and deploy community mapping as a strategy to take greater control of their own destiny. Here contextual listening holds more promise for a long-term sustainable solution than in the Sika Dhari village as Rojas continues to build the community’s capacity to map its own water use, habits and conservation into the future. More than a technical system, Rojas implemented a process – community mapping – that the community controls. In short, it seems that when contextual listening yields a process, not just a technical artefact, the long-term sustainability of a technological system is enhanced. For a full description of this case study, see Chapter 7 of Lucena et al. (2010).

5. Beyond engineers and community: a path forward

The focus of the research was mainly the relationship between engineers (E) and sustainable community development (SCD). The importance given to community and engineers in all stages could give engineers the impression that these two are the main elements that matter in SCD. So far readers might have created a mental model of SCD that looks like this

Engineers ← Community

Although community should always be central, engineers and community are not the only elements in SCD. The relationship between them is only one among many in the larger context of SCD. So what other actors and relationships might be important for engineers to know, understand and value in SCD? Engineers are invited to consider a more complex model of SCD that might look like Figure 2.

5.1 Context

We have learned that in the relationship between engineers and development, historical context and socio-political drivers matter. For example, the Cold War served as a context for post World War II international development until 1989. Similarly, there are currently a number of contexts that shape what is and is not possible in SCD, and engineers need to pay attention to these. ‘Geopolitics’ is one of them. What happens between guest/donor and host/recipient countries shapes the conditions for SCD. For example, given the current troubling relations between the US and countries such as North Korea, Iran or Venezuela, it would be next to impossible for US engineers to initiate SCD projects in those countries.

‘Internal conflict’ is another. Even within countries with friendly and stable relationships with the US, there might be internal conflict that would make it extremely difficult to
initiate SCD projects. For example, certain regions of Colombia – a country with which the US and most European countries have excellent relations, making it a prime candidate for SCD project funding – are immersed in armed conflict where SCD initiated by outsiders would be quite dangerous if not impossible.

Engineers should also pay attention to ‘local governance’. Even within countries that exhibit relative peace throughout their territory, local governance practices might play a determining role in SCD projects. Highly bureaucratised practices, corruption and nepotism, for example, would make it difficult to obtain permits, data, access to resources and so on.

Engineers should not forget about ideology. Donna Riley has shown how the ideologies of militarism, colonialism, racism and sexism have influenced engineering practices (Riley, 2007, 2008). More recently, Riley and Nieusma have shown how the ideology of neoliberalism has influenced engineering projects for community development (Nieusma and Riley, 2010). Everywhere engineers go, they will likely find pervasive ideologies shaping assumptions and constraints for SCD projects.

5.2 Institutions
In all SCD projects and related activities, engineers will encounter a wide array of institutions and need to be very aware that the kind and size of institutions involved greatly influence the resources available to and the constraints placed upon specific SCD projects.

(a) Probably engineers will find development banks that can be large and with lots of political and economic power that would allow them to impose conditions on countries and local governments.

(b) Small micro-loan organisations may hold more equitable and just lending practices, and hence be more conducive of SCD.

(c) International organisations, such as the UN programmes and specialised agencies that make up the UN system, might also be present in the locality where it is planned to develop an SCD project. Their presence, practices, rules of operation and so on facilitate or constrain what can be done on the ground.

(d) Over the decades, NGOs and relief organisations have become important actors in SCD, especially in areas where government presence and services to civil populations are tenuous. NGOs play a central role in facilitating and continuing SCD projects.

(e) Government agencies such as the UK Department for International Development (UK Aid), Agence Française de Développement (AFD, France) or USAID and Peace Corps (US), just to name a few, will likely be present.
through funding and technical personnel in the communities where engineers want to do SCD work.

5.3 Actors

Context and institutions will determine to a large extent what kind of actors engineers will find on the ground to assist (or resist) in SCD efforts. Even within the same organisation, engineers will find a diversity of actors such as anthropologists, rural sociologists, economists, scientists, technicians, nurses, doctors and so on. Engineers will also find a complex diversity of actors within a community. Women, children, elderly, clans, traditional families, kinship groups and so on would probably want different things from an SCD project and diversity of perspectives generally exists within each of these groups; hence, each would likely define problems and propose solutions differently. Understanding, respecting and valuing the role of each of these perspectives, through contextual listening, for example, becomes important in the success of SCD projects. It is not expected that engineers should become experts on each one of these elements of SCD. Yet if engineers ignore them it would be at their own peril – and that of the communities they intend to serve. For a detailed analysis of the network of interrelationships among principal stakeholders in SCD contexts, see Chapter 9 of Lucena et al. (2010).

6. Recommendations

In Lucena et al. (2010), a number of recommendations are proposed for those engineers who want to commit to SCD work for the long term. The main recommendations are outlined below:

(a) Engineers are invited to complement their engineering training and develop a life-long learning attitude by taking courses related to SCD, such as those found at the Institute of Development Studies at the University of Sussex, that will help them further understand, appreciate and deal with the context, institutions, and actors that make up the world of SCD.

(b) If committed to a career in SCD, engineers are encouraged to embark on a graduate programme related to SCD such as those available at the Centre for Sustainable Development at Cambridge University Engineering Department.

(c) Engineers are invited to enrol as interns or as unpaid volunteers with SCD-related institutions. Make sure that the organisation the engineer is volunteering with has an institutionalised programme to recruit, train and mentor volunteers so as to not become a burden to the organisation. For UK’s most comprehensive development job and internship guide, see http://www.experiencedevelopment.org/.

(d) Engineers are encouraged to develop and enhance their ability to listen contextually. For a full description of contextual listening, see Chapter 5 in Lucena et al. (2010).

REFERENCES


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