# Work in Progress: Contextualizing Engineering Service Learning by Applying the Practices of Community Organizing

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## Introduction

Service learning projects are recognized in engineering curricula as an excellent means of tangibly applying fundamental concepts, as well as allowing students to see a greater purpose behind their studies[1]. However, the implementation of an infrastructure within an unfamiliar community, whether domestic or international, requires not only an understanding of technical concepts and constraints, but also the non-technical factors such as global context, power dynamics, and culture[2]. This research seeks to demonstrate that community organizing projects are comparable to engineering service learning projects in that they both involve engaging a community towards a common objective, even if it may be a social, political, or environmental objective in lieu of infrastructure. The platform of collaboration between the engineering team and the client community must be built on trust and communication[3]. Without this platform, projects stand little chance of meeting the client community's goals. This paper will explore the possibility of adopting the approach of community organizing in order to more effectively implement engineering projects with regard to gaining trust, establishing a common objective between stakeholders, and ensuring that projects are driven by the client community.

Within engineering service learning projects, two approaches will be discussed: the traditional humanitarian engineering model [4], as well as the contextual engineering model [5], which will serve as the bridge between the approach of community organizing and the objective of humanitarian engineering, as shown below in Figure 1.
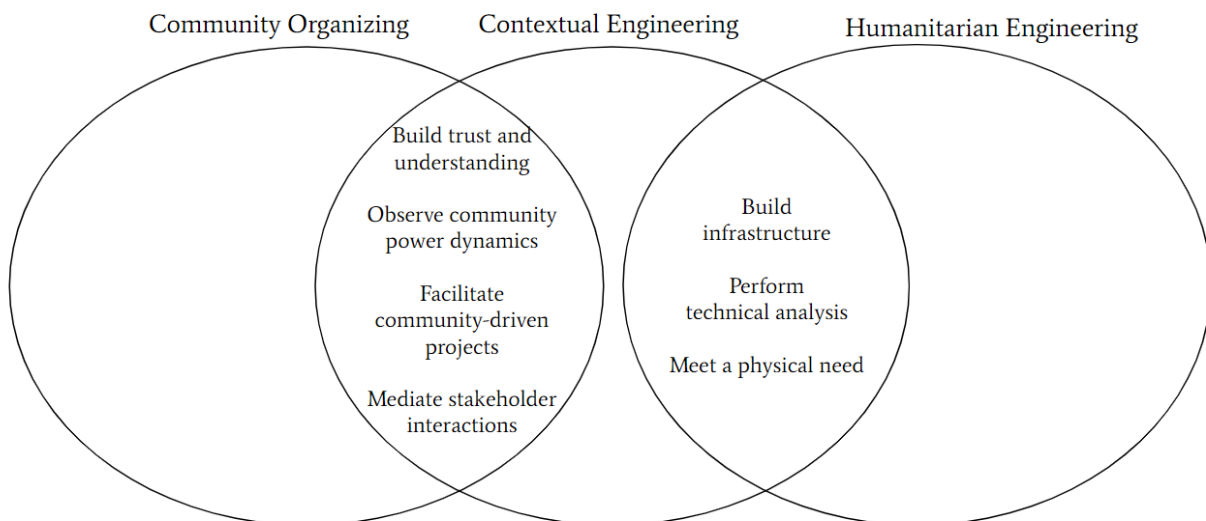


*Figure 1. Relationships among community organizing, contextual engineering and humanitarian engineering*

*Humanitarian Engineering and Contextual Engineering*

The humanitarian engineering model, often the basis for service learning project approaches in engineering, arose from the broader objective of improving the quality of life for non-industrialized communities deemed as underdeveloped by industrialized countries[6]. This objective, while well-intentioned, can often overlook the important cultural, economic, and political factors that characterize the indigenous communities engineers seek to help[7]. As a result, the focus may shift away from the client community and their goals and towards the pre-established agenda of "developing" communities and alleviating human suffering[8].

The humanitarian engineering model recognizes the importance of context and community engagement in the implementation of infrastructure. However, the literature also recognizes that the manner in which engineering students are taught to engage the community is ineffective and sometimes counterproductive[9]. In both international and domestic humanitarian engineering projects, it is imperative that the infrastructure for the recipient community is implemented in a manner that considers the multiple facets of a community's context[10]. Failure to do so could severely compromise the unique identity and well-being of the community the engineers strive to help[11].

Recognizing that engineering projects must be sensitive to the local conditions and needs of the client community, the concept of contextual engineering surfaced at the University of Illinois at Urbana-Champaign. It is a newer, more holistic approach to engineering that seeks to better integrate both technical and client community goals when pursuing projects. Using contextual engineering, the engineer is more likely to create a solution that is fitted to the particular conditions of a community, and therefore is more resilient to changes over time[12]. This approach encourages trust-building and an understanding of stakeholder interactions to a higher degree than the classic humanitarian engineering approach.

*Community Organizing*

Most documented approaches to community organizing fall within two categories: conflict organizing[13] and consensus organizing[14](Table 1 in the Appendix). Although both of these techniques are demonstrated as valuable in engaging community voices, the literature suggests that an effective organizer will not work entirely within one approach or the other, but instead use a blend of both to best accommodate the particular context of a project[15]. This blended approach becomes the most useful for community organizers, who now have the dexterity to adapt their plan to changing situations. A flexible approach is also beneficial in standard engineering practice because an effective engineer will know how to adapt their approach for the nature of a specific project — an idea that contradicts the tendency for engineers to follow a consistent framework that can be applied to all projects[16].

In addition to a flexible approach, community organizing can provide a helpful perspective to the engineering approach for several reasons. The need to connect with an unfamiliar community in order to exchange information and complete a project is shared between community organizers and engineers alike. Consequently, they share a need to build trusting relationships with stakeholders and collaborate effectively towards a common goal, ensuring that the focus remains on the client community objectives. While engineers may be aware of this need, they are often ill-equipped to take the necessary steps towards building that essential project communication network[17]. Thus, investigation of community organizing practices could potentially be very beneficial for the improvement of humanitarian engineering practices.

**Analogy Overview and Methods**

In order to create the foundation for comparison between community organizing and service engineering projects, service engineering is further broken down into two approaches. While the contextual engineering approach and humanitarian engineering approach have a similar objective of implementing an infrastructure, they differ regarding community engagement and incorporation of context. In contrast, contextual engineering and community organizing utilize very similar approaches to engaging and incorporating community perspectives, despite having very different objectives. Thus, an analogy will be drawn between contextual engineering and community organizing, wherein they have different objectives, but a similar reliance on community input.

This analogy will be illustrated through a diagram that captures the project definition phase, or the process from project initiation to the beginning of implementation. The turning point between the project definition phase and the design and construction phase is not always well defined, but for the purposes of this comparison, it will be the point at which the overarching plan is ready to be executed.

The diagram will illustrate the key milestones of a project, as well as the approach, which will carry the project from one objective to the next. A model will be used for both contextual engineering and community organizing, as they both utilize a similar process for accomplishing and developing objectives (Figure 2). The approach is illustrated with a cloud shape in order to convey the vaguely defined nature of considering context. The contextual process is not a linear sequence of events, but rather a web of interconnected efforts. Contextual approaches will focus on the stakeholders within the client community through every step of the process, not only through conversations, but by placing decision-making in their hands. There is also the important component of self-reflection, which involves the assessment of one's motivations and objectives for the project, so that they can be distinguished from the client community's goals.
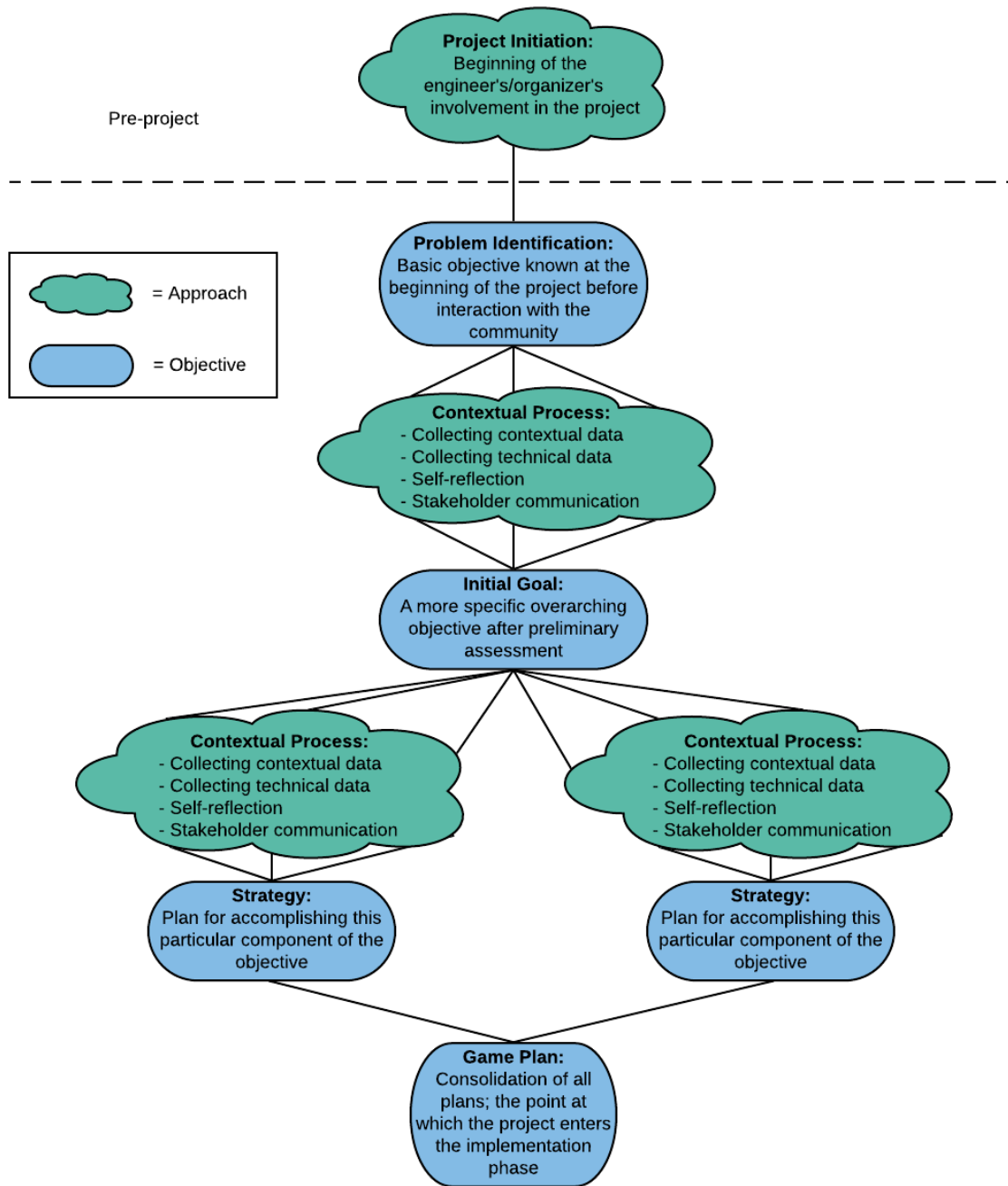
*Figure 2. Example model for community organizing and contextual engineering*

Humanitarian engineering, however, cannot be represented by the model above. Even though its objectives may compare to contextual engineering, the process followed between objectives, specifically regarding community input, is not similar (see Preliminary Analysis). The humanitarian engineering diagrams will be shaped on a case by case basis instead of following a template, due to the broad nature of its model. Whereas contextual engineering is a specific and recently-emerged practice, humanitarian engineering has accumulated several definitions and models over decades that would be unreasonable to generalize.

**Data Collection**

Data collection for both community organizing and humanitarian engineering was conducted similarly, including case study investigation[18] and interviews. There were six community organizing interviewees selected for interviews based on snowball sampling. The six interviewees for humanitarian engineering were selected through blind solicitation within an Engineers Without Borders communication platform. See Table 2 in the Appendix for sample interview questions. Community organizing case studies [19, 20] demonstrating a similar structure to engineering projects were selected — specifically, projects that involved a community organizer from outside of the community. The selected humanitarian engineering case studies [21, 22, 23] were international projects with the objective of providing an engineering solution to meet a physical need. The case study diagrams are used for direct comparison between practices, while any information gathered from interviews was used for the conception of the diagrams as well as analysis following completion of the diagrams.

Data collection for contextual engineering involved only case study investigation. The case studies consisted of final reports for a large midwestern public university course, which requires students to provide an engineering solution to drinking water problems for communities in Honduras. This course strictly adheres to contextual engineering methods, and therefore the reports can be considered case studies for this approach. A total of six case studies were observed, one for each year that the course was offered between 2014 and 2019[24].

**Preliminary Analysis**

Following interviews and the investigation of several case studies, community organizing revealed common trends regarding project approaches that hold relevance to engineering. One is that community organizers work within the community's established networks of communication in order to accomplish tasks. This is critical in engineering practice, as understanding the pre-existing power relations and dynamics can give the engineering team leverage for working within the community's current functionality.

Most prominent in the community organizing approach, however, was the focus on community participation and involvement. Community organizers work to ensure that they are peripheral to the stakeholder interactions they facilitate, creating a communication network that remains stable after the community organizer has left. The organizer provides only a facilitative role within decision-making and ensures that the client community is the strong hand behind any action. The common themes of community involvement, trust-building, and facilitating a community to be the driver of their project remained unchanged across a diversity of community organizing projects, which was also the case with contextual engineering projects. Sustainability needs to be considered from the very beginning in an engineering project. While the infrastructure must be

reliable and durable, that quality is irrelevant unless the community is well-equipped to operate and maintain it without regular contribution from the engineering team. This is a common source of error in humanitarian engineering projects[25], and community organizing can provide a clear perspective by putting stakeholder relationships at the foundation of a project.

After evaluating humanitarian engineering case studies and conducting interviews with professionals, a spectrum of approaches surfaced between humanitarian engineering practice and contextual engineering practice. At one end of the spectrum lies projects that are driven by the infrastructure being built. Thus, most of the project's decision-making focused on technical constraints and the problem from the engineer's perspective. At the other end of the spectrum lies projects that are driven by the client community and other contextual factors. This end of the spectrum is where contextual engineering projects settled, because decision-making was in the hands of the community. However, most of the observed humanitarian engineering projects fell somewhere in the middle rather than being concentrated at one end. The previous assertions rest upon certain limitations and assumptions, detailed in Table 3 of the Appendix.

Investigation of community organizing practices has revealed multiple concepts that would be useful to an engineering project approach. Acknowledging that both community organizers and engineers must build trust with their client community for optimal outcomes, community organizing practices provide a new perspective on listening skills and a guide to building trust in an environment of generalized distrust [26]. In addition, community organizing provides a helpful perspective on stakeholder communications. The network of stakeholders in a community organizing project is often much larger than in engineering projects, and therefore organizers must develop skills for uniting a broad diversity of motivations and objectives towards the common interest of a project. This is a struggle faced in engineering as well, and engineers must facilitate a network of collaboration that will sustain throughout operation and maintenance of the newly implemented technology. Furthermore, community organizing exemplifies that project milestones cannot proceed without heavy participation and genuine contribution from the client community stakeholders. Community organizers ensure that the client community is driving the project and completing a majority of the work. Likewise, engineers can strive to keep the client community at the center of decision-making, allowing their technical expertise and engineering design to play a facilitative role towards the community's objectives.

This research's preliminary assertions can only be strengthened by more case studies and interviews from each practice. Nevertheless, it is clear from this investigation that there is significant potential for community organizing practices to help mitigate the struggles faced in engineering with regard to community engagement. Moreover, the exploration of community organizing strategies for engineering purposes has demonstrated that disciplines with different objectives can still find common ground for beneficial information exchange.

# Appendix

*Table 1. Glossary*

| Term | Definition |
|---|---|
| Contextual Engineering | The creative application of science, mathematical methods, societal understanding, and indigenous knowledge to address a physical need that serves the user of the innovation while recognizing the influence of stakeholder motivations and objectives[27]. |
| Humanitarian Engineering | 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 communities[28]. |
| Community | A population defined by physical, political, or social boundaries. While a community is often referred to as a single entity, it is important to recognize that communities are very diverse and multi-faceted[29]. |
| Stakeholder | Any individual, business, organization or government entity who participates in an engineering project. |
| Community Organizing | Mobilizing a group or set of people towards a social, political or environmental objective within a defined community. |
| Conflict Organizing (Alinsky Organizing) | An approach to community organizing built on the idea that power cannot be created, but must be redistributed; often involves riots, protests, and forceful measures in order to accomplish objectives[30]. |
| Consensus Organizing | An approach to community organizing built on the idea that power can be grown and shared among people, and that harmonious relationships can be built between the powerful and the powerless[31]. |

*Table 2. Sample Interview Questions for Community Organizing and Humanitarian Engineering*

| **Community Organizing Sample Interview Questions** |
| --- |
| 1. Can you define community organizing? What kind of community organizing projects do you work on? |
| 2. How do you become involved in a community organizing project? What are some typical stakeholders in these projects and to what extent do you interact with them? |
| 3. Are you familiar with conflict and consensus organizing? If so, which one do you practice? |
| 4. Does your approach in community organizing change depending on the project? |
| 5. Do you seek to build trust and understanding with the community? How? |
| **Humanitarian Engineering Sample Interview Questions** |
| 1. Describe your experience within Engineers Without Borders. |
| 2. Does your project approach change depending on the project? |
| 3. What are the ingredients to starting a project on the right foot? |
| 4. What role do the non-technical factors play in projects, and how might they change design? |
| 5. What role does trust play in these projects and how is trust obtained? Can a project function without this trust? |

*Table 3. Assumptions and Limitations of this Research*

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| --- |
| 1. Community organizing interviewees and case studies were all based on domestic work, while most of the engineering interviewees and case studies pertained to international aid. |
| 2. All of the contextual engineering case studies came from the same course taught by the same instructor. As it is only an emerging practice, there is limited availability of data. |
| 3. Data from interviews relied on the participant to bring their honest opinion and views. However, phrasing of the questions can affect how the interviewee frames their response. |
| 4. Case studies do not always provide the necessary detail to understand the process between objectives. Consequently, certain actions needed to be implied. |
| 5. There are several different perspectives involved in defining project success[32], but this investigation considers solutions that best represent the goals of the client community to be favorable. |

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