Chapter X: Connecting the "Forgotten": Transportation Engineering, Poverty, and Social Justice in Sun Valley, Colorado

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"Yet [Sun Valley] has persisted. Out of neglect. Or the lack of resources and political will. It persists because Sun Valley represents in pure form the daunting legacy of social and economic segregation and the challenge of providing economic and educational opportunity to the neediest among us."

--Tina Griego, *The Denver Post*, 2010

"The light rail stop at this location would be creating a means for companies to move into the community and the Sun Valley residents should not be forgotten when serving the area is concerned…the permanent residents of this area must not be forgotten."

--Student, Sustainable Engineering Design, 2011

Abstract

This chapter explores the role that transportation engineering, economic planning, and community engagement play in the development of a lightrail system station in Sun Valley, Colorado, one of the poorest neighborhoods in the state. It describes how such a case can be used to teach principles of social justice, sustainable community development and sustainable engineering in the undergraduate engineering classroom. Students in the course "Sustainable Engineering Design" at the Colorado School of Mines were asked to study the Sun Valley community, meet with members of the community, and study the lightrail project not only as a sustainability project but as one with significant social justice dimensions. This chapter examines the challenges and rewards of integrating engineering and the social sciences in this kind of real-world context, emphasizing the importance of integrating Cech's critiques of depoliticization and meritocracy in engineering culture.

X.1 Introduction

This chapter describes a particular curricular intervention that was inspired by research in engineering and social justice (ESJ). Students in a Sustainable Engineering Design (SED) course were introduced to a case study describing an actual neighborhood in Denver, Colorado, that is known primarily for its poverty, high rate of single-parent households, and lack of access to jobs and services (City Data 2009; Griego 2010). The neighborhood, Sun Valley, is located near downtown Denver and the Denver Broncos football stadium, yet is also physically isolated from abutting neighborhoods and city infrastructure. Furthermore, we would wager that very few residents of Denver and its environs even know that Sun Valley exists, leading some residents to describe themselves as the

"forgotten" (Griego 2010). Students who participated in this curricular intervention in SED examined the development of a lightrail line through Denver's West Corridor, including a transit stop that would link Sun Valley with the line, and which promises to bring significant economic and social changes to the neighborhood. Students in SED were given a series of newspaper articles about Sun Valley, read planning documents about the lightrail station project, met a former resident of the neighborhood, and were guided through several exercises about the case in an effort to encourage them to think critically about sustainable development processes and goals as well as the strengths and limitations of life cycle analysis software frequently used by engineers involved in planning and decision making. We describe below the outcomes of this intervention.

This chapter is not intended to be a rigorous engineering education study; the SED curricular intervention was a small and preliminary experiment, and we do not make claims about its scalability or applicability in wider contexts. Rather, we see this chapter as a reflection on how we envision engineering and social justice as a concept; as an example of how one might meaningfully integrate social justice into engineering courses whose primary focus is technical; and as a discussion of how we can better make "cultural space," in Erin Cech's words (in this volume), for social justice in teaching engineering. One of us—Jen, whose academic fields are communication and engineering education—has worked on collaborative projects that examine whether engineering and social justice may or may not be "commensurable" as concepts, particularly in an engineering curriculum that frequently is resistant to change (Leydens et al. forthcoming; McKenna et al. 2011). A nagging, unresolved question that has persisted from that work is as follows: it is fairly easy to imagine how social justice might be integrated into humanities and social sciences courses for engineers, and even in multidisciplinary design courses (see chapter by Leydens in this volume). But how do we integrate social justice as a concept into technical courses, particularly those which stress engineering science, and which occupy most of our students' time, attention, and even respect (Downey and Lucena 2003; Lucena et al. 2010)? In posing this question, we hope to enter into dialogue with Erin Cech's chapter in this volume, titled "The (Mis)Framing of Social Justice: Why Ideologies of Depoliticization and Meritocracy Hinder Engineers' Ability to Think About Social Justice." In that chapter, Cech calls on engineering educators to make "cultural space" for social justice in the engineering curriculum by inviting students to analyze and reflect on two main characteristics of engineering culture—depoliticization and meritocracy—that tend to exclude critical appraisals of social justice in engineering work. Although we did not have the benefit of reading Cech's work when planning our intervention, in this chapter, we reflect on the ways in which that small intervention made cultural space for exposing and analyzing depoliticization and meritocracy, and ways in which we could have done this important work better.

Possibilities for integrating social justice concerns more meaningfully into the parts of the engineering curriculum typically considered "technical" are many and varied, and other scholars are beginning to provide practical examples of how real implementation in the technical curriculum might work (see Riley, this volume). Junko, a professor in environmental engineering, has repeatedly committed to teaching technical courses that meet curricular needs but which also experiment with teaching and learning innovations. Her openness and willingness in this regard was essential to moving forward with this experiment. With Jen, Junko participated in a two-day workshop on ESJ, and has been committed to seeing what ESJ might look like in practice inside of an engineering course. We offer the narrative of our collaboration here. It is our hope that sharing this story might illustrate ways in which other engineering faculty members could create spaces, and collaborate with non-engineering faculty, to experiment with social justice concepts in their own courses.

X.2 ESJ in Engineering Education: The Practical Problem

Compared with ten years ago, a relative wealth of scholarship is available about engineering and social justice (see chapter by Nieusma in this volume). This is in large part thanks to the work of scholars in the Engineering, Social Justice, and Peace network (ESJP; www.esjp.org). Caroline Baillie and George Catalano have made foundational contributions in introducing the connections between engineering and social justice in their books *Engineering and Society: Working Toward Social Justice*, Parts 1-3 (2009) in addition to their other work in this area. Donna Riley's book, *Engineering and Social Justice* (2008) proposed critical approaches to thinking about persistent conceptual questions such as how to define social justice, how engineering universities, firms, and other organizations may be structurally aligned—even if sometimes unintentionally so—to support unjust engineering practices, and how a number of "engineering mindsets" shape the ideology of engineering and might blind engineers to see social injustices. Riley has since authored a textbook integrating ESJ and thermodynamics (2011) and has co-edited a

volume with Caroline Baillie and Alice Pawley on ESJ in the university (201). These authors and others highlight the challenges engineers and engineering educators face in their efforts to bring their professional practice in line with social justice values (Nieusma and Riley 2010; Schneider 2010).

This last area of study—how social justice concepts can be mobilized to intervene in and change the engineering curriculum—is of most interest for this chapter.[1] Despite the significant efforts of the scholars listed above and others, just *how* to incorporate social justice into engineering education and practice remains a very open question. For example, in 2011, Jen worked on an informal video project about teaching ESJ, and asked seven ESJ-committed engineering instructors to provide videotaped narratives describing where their social justice concerns came from and how they changed their teaching to include them (see http://www.youtube.com/watch?v=LbE_AaquL5E). Again, the goal was not to identify humanities and social sciences courses where social justice could be incorporated, but to understand how engineering practices and training might intersect with social justice in the "technical" classroom.[2] Several possibilities for in-class implementation of ESJ emerged, but can primarily be grouped into three categories:

> 1) interventions that incorporate transformational pedagogical approaches, frequently incorporating concepts first introduced by Paulo Freire and bell hooks but not limited to those (e.g., Baillie 2006; Meyer et al. 2010; Riley this volume);
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> 2) service learning and engineering for development projects (e.g., the work done by EPICS at Purdue and projects taken on by Engineers Without Borders); and
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> 3) revision of existing technical curricula to include perspectives or approaches typically excluded from the engineering education canon (such as Riley's supplementary thermodynamics text, mentioned above, or the rewriting of typical engineering problem set questions to include more social justice-oriented contexts or topics).

This typology can be debated, but we would argue that most practical attempts at intervention fall into one of these categories, with the most frequent being efforts in the second category, service learning and engineering for development projects. The fact that many efforts that fall under the umbrella of "engineering and social justice" are typically development projects is somewhat troubling given the fact that such projects are difficult to execute and evaluate successfully and, in some cases, may even unintentionally exacerbate injustices (Schneider, Lucena, and Leydens 2009). Furthermore, all three types of integration in our list seem to require significant commitments to mastering "outside" types of knowledge, training in critical thinking skills, humanities, or social science literature approaches, and risk-taking in curriculum design. It is not inconsequential, for example, to ask an engineering professor to become trained in Freire's techniques from the "theater of the oppressed" or to design a meaningful service-learning project that benefits both students and the host community of the project. For these reasons and others, inviting even interested and sympathetic engineering educators not steeped in the literature of social justice to incorporate social justice principles in their courses—without requiring that they master an entirely new body of literature or fight to revamp the entire curriculum—remains a major challenge. University faculty face significant time pressures and a reward system that often does not recognize these interdisciplinary adventures, while technical faculty may take risks in studying, publishing, or teaching outside their areas of technical expertise. The barriers to inclusion in ESJ, even for those who are ready and willing, are not insignificant (Leydens et al., forthcoming; Riley, this volume).

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[1] This chapter would have benefitted from a review of the work included in the new collection *Engineering and Social Justice: In the University and Beyond*, edited by Caroline Baillie, Alice L. Pawley, and Donna Riley (Purdue University Press: 2012), which was not yet available for review at the time of this writing.

[2] STS scholars and others are quick to point out that it is quite artificial to distinguish between the "technical" and "non-technical" in engineering practice and education. Technical decisions are always informed by and situated in social, economic, political, and other contexts, and vice versa. However, we keep this distinction in place for the purposes of this paper merely to mark the distinction between courses that, at our university, are considered humanities and social science courses, and those that are considered engineering or applied sciences courses. Though we and others work hard to trouble this binary, it is nonetheless descriptive of many of our students' experiences with the engineering curriculum and is further reified by curricular structure, professors' expectations, and so on.

Nonetheless, many engineering faculty *are* committed to and interested in incorporating ESJ practices into their classrooms, and are craving more information about *how* to do this. In 2010, Jen set out with two colleagues, Jon Leydens and Juan Lucena, to try to answer this question of *how*. Funded by a National Science Foundation grant to study "Engineering and Social Justice: Research and Education of (In)commensurable Fields of Practice," one of our goals was to determine the ways in which engineering education and practices erect barriers to enacting social justice values or concerns, and also what opportunities for integration exist.[3] Juan, who has significant interests in the history and culture of engineers and engineering, was committed to researching and writing about case studies of engineers who embodied or enacted social justice values, and one of our initial goals was to develop these case studies into teaching tools that engineering educators could use as exemplars in their classrooms.

As our research progressed, however, Jon, Juan, and I discovered that many barriers of consequence stood in the way of seeing social justice integrated into the engineering curriculum. We saw little problem with teaching a humanities/social science course on ESJ, and in fact a course called Engineering and Social Justice has been offered several times by our Division, Liberal Arts and International Studies, at our technical university, the Colorado School of Mines, and is part of the elective curriculum here. But we asked ourselves: if our students believe they learn about engineering in their "technical" classes, isn't that where we should be teaching about engineering and social justice? In other words, if we believe social justice is a topic students should be considering in their engineering work, shouldn't we be somehow intervening in how engineering science, design, and work are taught?

We had come to the conclusion that we did not want our research in ESJ to be merely descriptive (e.g., writing historical case studies), nor simply analytical (e.g., writing critiques of the engineering curriculum), though both approaches are important in shaping our thinking. Rather, we felt that we wanted the results of our work to be *transformative*. This meant figuring out a way to 1) communicate what we knew about ESJ to those who taught technical courses; 2) articulate to them why social justice is an important consideration, worldview, or set of values for engineers to know about, embody, or enact; and 3) work *as partners* with these educators to develop new activities, lessons plans, or assignments in which social justice became a visible and intentional concept in engineering problem identification and problem solving.

The project that emerged was an ESJ workshop for interested engineering educators at our university. Though a full description of the workshop is beyond the scope of this chapter, we provide the workshop objectives here for context:

> At the end of this workshop, participants will have:
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> 1. Developed a deeper understanding of the role that different forms of individual and institutionalized privilege play in shaping our views of social justice,
>
> 2. Begun to understand how the culture of engineering and engineering education, as reflected through engineering mindsets, can enhance or hinder opportunities to embrace social justice; and
>
> 3. Begun creating curricular interventions that can be taken back to engineering classrooms.

Point 3 is the most salient for the purposes of this chapter; one goal of the "transformative" ESJ workshop was for the three facilitators (Jon, Juan, and Jen, all from the humanities and social sciences) to work as partners with the workshop participants (all from engineering or applied sciences departments or administration units) to co-develop ESJ materials that could be used in the technical curriculum. Our hope as facilitators was that the workshop would have outcomes that lived beyond the two days we were all together, and that ESJ would begin to "live" in the technical curriculum because engineering faculty had begun to own it as a concept, as something they would begin to define, adapt, address, and use in their capacity as engineering educators.

[3] National Science Foundation grant #SES-0930213. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

X. 3 Sun Valley, Social Justice: Intervening in the Technical Curriculum

Junko was one of the participants of the workshop. Another participant happened to be a former resident of Sun Valley, the small community described in the introduction above, and an engineering alumnus and administrator at our university. He frequently shared in the workshop his experiences as a member of the "invisible" Sun Valley community, a community which bore a number of environmental and social ills that are frequently considered among the externalities of industrialization: waste dumping, isolating and consolidated poverty, poor flood management, and a lack of access to necessary goods and services, such as employment offices, banks, and supermarkets. Several weeks after the workshop ended, this participant took most of those who had participated in the ESJ workshop on a tour of Sun Valley, introduced us to residents and organizers there, and invited us to think about how engineering and social justice intersect in what might be considered our own backyard, as Sun Valley is only 13 miles from our campus yet unknown to most CSM students and faculty.

This was a particularly meaningful invitation for Jen and Junko. Junko had just agreed to teach the SED course, and saw an opportunity to link Sun Valley and the lightrail development with her interest in integrating ESJ in her course. She had also recently learned at a Center for Sustainable Engineering[4] workshop that social considerations are fundamental to sustainable engineering, distinguishing it from "green" engineering, defined by Anastas and Zimmerman (2003) in their seminal article as achieving sustainability through science and technology, though the definition subsequently has expanded to include engagement of communities and stakeholders (Abraham and Nguyen 2003) if not specifically social justice. With Jon and Juan, Jen had been thinking for some time about how ESJ concerns in the engineering curriculum almost always manifested as some sort of development project, and those development projects were frequently located in areas of the global south where engineering professors and their students were interested in "helping" the poor in other countries. Yet a significant body of research exists that suggests that such projects are incredibly difficult to plan, execute, and evaluate well, and—worse—they may even end up doing more harm than good. Furthermore, they require a tremendous amount of resources, may reify stereotypes students from the north have about poverty, development, and privilege, and are time-consuming to plan, conduct, and assess meaningfully (Epprecht, 2004). The literature, including a book written by Juan, Jen, and Jon, details the challenges posed by engineering development projects abroad, including the possible re-creation of injustices in local communities (Lucena et al., 2010; see also Nieusma and Riley, 2010).

Yet studying Sun Valley offered a slightly different opportunity to think about ESJ. Here was a local community with a long history and its own unique culture, not very far from our campus at CSM. It is a community that has a number of needs (some of which might be addressed through engineering practice, many of which would not) and which is typically referred to in local news stories as "impoverished," a place where most kids receive free or reduced school meals and which is remarkable primarily for its low voter turnout. And it was about to be transformed—perhaps dramatically so—by a major engineering project: the light rail system connecting downtown Denver with nearby suburbs.

Approximately 1,500 residents live in Sun Valley, considered the "poorest neighborhood in Colorado" with average annual *household* incomes ranging from $4,400 to $8,000, many times below the poverty level defined by the federal government (Griego 2010). The majority of the residents in Sun Valley live in public housing. According to journalist Tina Griego, "more than half of Sun Valley residents are 18 and younger, and most are toddlers and elementary school kids. No other neighborhood in the city comes close to this ratio of child to adult" (2010). 85% of the homes in Sun Valley are headed by single mothers, and many of those mothers are teen mothers.

Furthermore, as noted above, Sun Valley is physically and geographically isolated from downtown Denver and surrounding neighborhoods. It is bounded on the west side by a large, busy thoroughfare called Federal Boulevard; on the south side by industrial warehouses; on the north side by the Denver Broncos football stadium; and on the east side by the South Platte river, which is both difficult to access for residents of the neighborhood and, paradoxically, prone to dangerous flooding, which killed a Sun Valley toddler in 2007 (Griego 2010). The neighborhood also abuts aging rail yards and their waste along with a retired electrical substation. Relatively well-to-do neighborhoods aren't more than a few miles away.

[4] The Center for Sustainable Engineering is an NSF- and EPA-supported partnership led by Syracuse University and including Arizona State University, Carnegie Mellon University, Georgia Institute of Technology and University of Texas at Austin.

Within its boundaries, Sun Valley primarily features housing projects—two-story dwellings built very close to one another in block-like fashion, separated by yards and other green spaces; a large, apartment-style complex for young mothers called Decatur House; and a number of single-family homes in varying states of disrepair. There is an elementary school and a convenience store but no supermarket. Sun Valley also contains a sprawling office complex and parking garages owned by the Denver Housing Authority (DHA), though residents cannot access the DHA directly—thanks to a perverse design that literally denies direct access to some of the very residents it serves, the only entrance is on the far side of Sun Valley, facing Federal Boulevard. According to Griego, "More than nine of every 10 people in the neighborhood live in subsidized housing, and that not only makes Sun Valley unlike any other neighborhood in Denver, it makes Sun Valley homes unlike any other housing project in the city. It exists unto itself, not part of any larger residential neighborhood" (2010). Poverty, isolation, and the physical composition of Sun Valley make gaining access to amenities and opportunities—such as fresh food, banking, and employment—difficult.

However, these facts offer only a partial view of Sun Valley as a community. Sun Valley is racially and ethnically diverse, featuring a number of immigrant populations and a complex demographic make-up. Its population could be considered transient, with many of its residents staying only a short while in the neighborhood until they can transition into other neighborhoods or forms of housing. Also within its boundaries is the Sun Valley Youth Center, a recreational center that provides after-school activities for the neighborhood's young people (http://sunvalleyyouthcenter.com/), meeting spaces for community government organizations and other political gatherings, and professional training and a computer lab for adults seeking employment development. Tha Myx, a community church, is also a powerful force in Sun Valley, organizing residents both culturally and politically and providing needed services (http://www.thamyx.org/get-involved/). Furthermore, a broad array of non-governmental organizations (NGOs), governmental organizations, and volunteers are active in Sun Valley community organizing efforts. For such a small community, it has a very active community government and a relatively high number of organizations who are actively community organizing and advocating for Sun Valley residents, though it should be noted that many of these organizations are subject to the vagaries of funding cycles and grant support.

While many residents stay in Sun Valley only for a brief time, others have lived in Sun Valley for decades. It is possible that this fact of life in Sun Valley—its physical constancy—is poised to dramatically change, largely thanks to the development of the "west corridor line" of the FasTracks lightrail system in Denver.

X. 4 Sun Valley and the RTD Lightrail

In 1994, the Regional Transportation District, or RTD, began developing "fixed-guideway transit" (primarily lightrail, in this case) in the Denver metropolitan area, and has since constructed Central, Southwest, and Southeast Corridor lines. Further lightrail construction was approved in 2004 by voters who agreed to an increased sales tax: this approval was called FasTracks and includes new rail and bus lines and expansions of the existing Corridors. The development of the West Corridor line is a significant element of the FasTracks project (CTOD 2011, p. 15).

However, FasTracks, though an RTD project in the technical sense, is not "owned" by RTD if considered as a social and economic development project. A number of other organizations, agencies, businesses, and coalitions are involved in the project's planning and implementation. These organizations and stakeholders include, but are not limited to, cities (such as the City and County of Denver and the City of Lakewood); housing agencies (such as the Denver Housing Authority and Metro West Housing Solutions); nongovernmental agencies and organizations (such as the Urban Land Conservancy) and government agencies (such as RTD and the U.S. General Services Administration). For example, the nonprofit Center for Transit-Oriented Development (CTOD) has been a major player in FasTracks at the planning stages.

The portion of the FasTracks project that has the most relevance for the residents of Sun Valley is the planned Decatur/Federal Station, located in Sun Valley and targeted for completion in 2013. According to an RTD fact sheet, by the year 2030, more than 4,000 riders per day could exit and enter the lightrail system at the Decatur/Federal Station; this number could substantially increase on days when there are NFL games at the football stadium or other local events: stadium turnstile gates are located right off of the stadium (RTD, n.d.). Furthermore, 2,000 parking spaces are planned for this station, bus access will increase, and there will also be pedestrian and bicycle access and accommodations.

It could be argued that development stemming from the new Station has the potential to improve the quality of life for Sun Valley residents. It could, for example, create more job opportunities. The industry- and warehouse-intensive areas that surround Sun Valley now are not conducive to diverse forms of employment, and increased development would undoubtedly create jobs in the service sector, in particular, which could be useful for Sun Valley residents who need to find work that is close to their homes, rather than transportation-intensive jobs elsewhere. Development could also provide amenities, such as grocery stores, banks, and so on, to residents. It is currently inconvenient or quite difficult to access such amenities in Sun Valley. Finally, the CTOD plan calls for the "redevelopment of public housing (Sun Valley) into mixed-income, mixed-use development" (p. 24). Ideally, this would include newer, more modern housing that does not carry the stigma of being "the projects" and which improves the quality of life for low-income residents.

But even with the best intentions in place, growth like this can sometimes happen with little concern for issues of social justice. It may ignore cultural and social outcomes for current residents that are difficult to predict or measure, such as the threats of displacement, disenfranchisement, and alienation. As Valderrama argues in this volume, the "technical" assumptions behind the planning of transportation models are not neutral and have built-in biases towards certain population groups that have the potential to create or exacerbate injustices. These outcomes are often a result of rapid gentrification, which ignores social inequities, relocates them to other areas, or otherwise exacerbates them, even if inadvertently. At the very least, the construction and completion of the station will lead to significantly increased foot traffic in and around Sun Valley, which could have several unintended consequences, some positive and some harmful. Or as Valderrama shows, the design of access roads and parking nearby the station could be made for people who own cars.

According to Griego, the history of Sun Valley has given its residents a number of reasons to be wary of grand social and economic plans: "That many residents doubt they will have a genuine say in shaping the neighborhood's future is not surprising. History, after all, has taught them so. But, they also have a hard time envisioning that future and they're sure as heck not convinced it will be brighter" (Griego 2010). As a result of these historical practices of exclusion and segregation, some community members have seen the lightrail project as evidence that gentrification is part of a larger development plan intended to drive the housing projects out of the area, and they fear that no- and low-income families will be excluded from the benefits of development, as frequently happens with technological and economic developments such as this one (Decatur discussion group summary 2007; Ottinger 2011).

X.5 Sustainable Engineering Design

Through our colleague at the ESJ workshop who had lived in Sun Valley as a young person, we began to make connections with people who worked in Sun Valley for a long time and who understood both its challenges and strengths. We wanted to explore the opportunity to get our students thinking critically about social justice in their own city, and about their relationships to technological progress, community development, and engineering design. Motivated by a desire to work together following the workshop and with a shared commitment to sustainability and social justice, Jen and Junko decided to develop an introductory module related to Sun Valley that could be piloted in Junko's Sustainable Engineering Design (SED) course in the fall of 2011. [5]

The SED course is designed to provide a comprehensive introduction into sustainability concepts from an engineering point of view, and acts as a complement to the undergraduate capstone design course, which includes only a single lecture about sustainability during its two-semester course sequence. This course includes work with Life Cycle Assessment (LCA) software. Social considerations, a key aspect of sustainable engineering design, are integrated throughout the course. The textbook (Graedel and Allenby 2010) explicitly considers individuals and society from beginning (Chapter 1: Humanity and Technology) to end (Chapter 27: Looking to the Future), and closes with the following:

[5] The Sustainable Engineering Design (SED) course was originally developed by Dr. David Muñoz, a mechanical engineering professor who was also the director of the Humanitarian Engineering program and passionate about teaching students to think more broadly about engineering. Dr. Muñoz piloted the course twice before offering SED as an official course in Fall 2009. After Dr. Muñoz's retirement, Junko volunteered to teach the course in Fall 2011 and, with Jen, modified the course to explicitly include social justice considerations, e.g. by adding language to the course learning outcomes as detailed below.

> …We must approach the technology-society-environment web…in a *holistic* fashion, a *connected* perspective, a *parsimonious* use of resources, and a *metabolically benign* approach to design and use…. The twentieth century has turned out to be one of major anthropogenic change on the planet on which we live. The twenty-first century must be one in which we do better—measuring our every action against its impacts on the environment, on society, and on sustainability….

The textbook was augmented with additional reading that, for example, examines the roles of economics, governance, and community in sustainable development (Ramaswami et al. 2007).

Learning outcomes for the SED course include that students will demonstrate the ability to:

- Display sufficient familiarity with the terminology associated with sustainability and sustainable engineering to write effectively about the topic,
- Compare and contrast traditional engineering design and analysis approaches with those associated with sustainable design, in particular those that go beyond the triple-bottom-line approach to include considerations of social justice and socio-technical integration,
- Apply a working knowledge of SimaPro, a commercially available LCA tool, and
- Work in teams to effectively write a project report and give a presentation that describes the connection between the concepts of sustainable engineering and their work, the approach they took and their conclusions and recommendations for future work.

Twenty students enrolled in the course: 13 were senior undergraduate engineering students (nine environmental, three civil and one mechanical), seven were graduate students (four environmental, two mechanical and one civil). Eight of the students were female, evenly split between graduate and undergraduate students.

X.6 The Sun Valley Module: Engineering Practices, Social Justice Practices

One particularly sticky point for engineering faculty intrigued by *social justice* and wanting to figure out ways to study it or incorporate it in classes is that it seems to defy definition. The range of groups, individuals, and movements who are or who claim to be fighting for social justice is vast, and as a concept, one of its strengths is that it is somewhat fluid. A group fighting against a municipal waste facility being sited in a low-income neighborhood already over-burdened with toxic or industrial processing and waste is fighting for social justice, just as a collection of parents arguing for a more equitable taxation system to rectify problematic distribution of textbooks or computers at their children's under-resourced elementary school are. As Donna Riley argues, narrowing social justice to *one* definition of social justice restricts its usefulness (Riley 2008, p.5).

Yet to retreat to a "we know it when we see it" definition of social justice may prove alienating or inaccessible in an educational setting, particularly with engineering educators, who may feel the need to "operationalize" challenging concepts. We resist the scientistic desire to both concretize the definition for and "measure" social justice, but we think it makes sense to provide our own working definition here, if only so that our assumptions are made clear and our commitments transparent. For the purposes of this chapter, we think of struggles for social justice as being struggles that attempt to redress the unequal distribution of goods, rights, or opportunities, or to challenge policies or practices that exacerbate inequalities among groups of people. The emphasis in our definition is not necessarily on individual cases of rights, difference, or inequality (one person being poor and one being rich, say) but on the *systems* and/or practices that create, exacerbate, or conceal inequalities for particular groups or classes of people. For that reason, we find that it may be counter-productive to focus only on rights or laws, for example, because cultural or legal definitions of rights may themselves be unjust and require challenge.[6]

[6] We are indebted to Brian Barry's excellent book *Why Social Justice Matters* (2005) for shaping our thinking on this topic.

In addition to this definition and based on our review of the literature and our own experiences, we are further guided by a few important principles related to ESJ and engineering education:

1. Engineering students working on SED projects who wish to emphasize social justice are most effective when they partner with other professionals or students from relevant disciplines, such as social scientists, social workers, or community organizers. This offers engineering educators and students an opportunity to experiment with supportive, meaningful ways to teach students about humility, privilege, and multiple forms of expertise. Unfortunately, this is not possible at our own institution given the school's sole focus on engineering and applied science; this is one area in which creative partnerships beyond the walls of the university may be particularly valuable.
2. Engineering educators must work to trouble a "linear model" of engineering and social justice, wherein the equation "good engineering + willing community = social justice" is complicated. In other words, it is important to acknowledge that good intentions when paired with good technical skills do not automatically produce equitable outcomes for society. Courses at our own institutions such as Engineering and Social Justice and Engineering and Sustainable Community Development are good examples of where this kind of questioning is occurring in engineering education.
3. One of the great challenges of SED work that wishes to incorporate social justice is that students and faculty must focus on small, achievable projects, while at the same time keeping in mind large-scale system inequities that created the need for the project to begin with. Similarly, students must focus on individual projects and individual needs, getting to know community members on a personal level, *while at the same time* keeping in mind the complex social systems and organizations that affect individuals. Furthermore, individuals might experience social injustices as members of disenfranchised social groups; all of these factors may make SED projects difficult.

Keeping our working (flexible) definition of social justice in mind, along with these three guiding principles, we designed the following three-step module for students in Junko's SED class. Each step of the module was scheduled to take place during a 50-minute class period:

X.6.1 First step

Students were assigned to read Tina Griego's three-part series on Sun Valley (at http://www.denverpost.com/sun_valley) as well as a chapter on "Engineering with Community" from the book *Engineering and Sustainable Community Development* by Lucena, Schneider, and Leydens (2010). They were then given the following assignment:

> Imagine that your professor and a professional from the Denver Housing Authority have been awarded a small community improvement grant for the area of Sun Valley. Your professor and the DHA professional ask you to brainstorm ideas for how small-scale engineering projects might improve the lives of Sun Valley residents, based on what you've read in Tina Griego's 3-part series. Write about how you might begin brainstorming and planning for such a project, using Lucena, Schneider, and Leydens as a guide.

During the class session, students discussed their responses to the assignment above, and then shared their responses with the class. Then Jen and Junko asked the students to form groups and create a "needs and capacities map" of Sun Valley, wherein they graphically sketched out the community's strengths and challenges (see Figure 1). The emphasis in the discussion was on guiding students to see *what they did not yet know* about the community but would need to know, and on deepening their understanding of the structural bases of particular "problems" of social justice in the community.

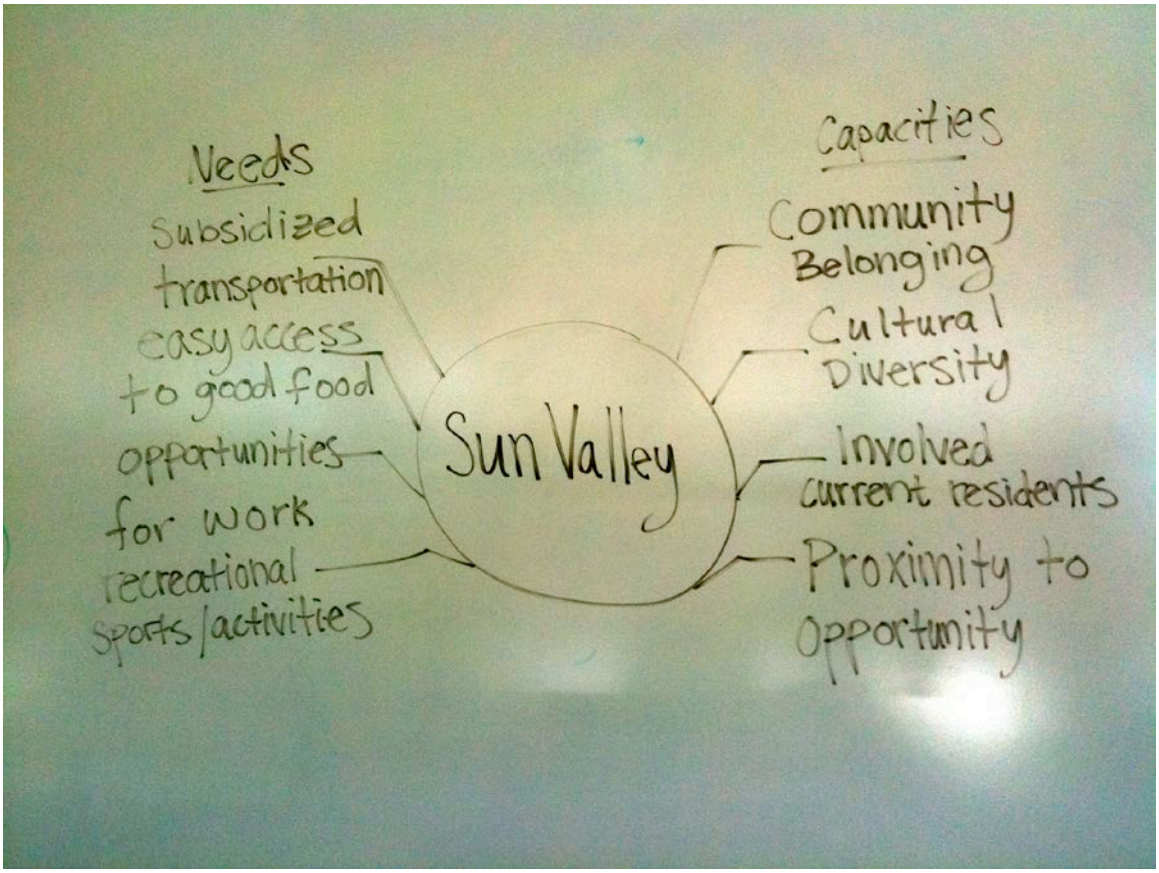

Figure 1: Example of one needs and capacities map for Sun Valley from SED.

As might be expected, the majority of student homework from this first stage emphasized the abilities that engineers or engineering solutions have to reverse the "disrepair and dilapidation" of Sun Valley itself and to decrease the "feelings of isolation" the community members there feel. This group of students—representing more than half of the class—immediately began "brainstorming solutions." Some proposed projects included redesigning roadways or footpaths to improve accessibility and transportation; developing community gardens; or designing systems to collect and distribute graywater. One student brainstormed a long list of projects and explained that after doing some initial research, he would "take this much shorter list and determine general cost and implementation strategies for the neighborhood. […]. Depending on budget and available manpower/machinery needed, I would take a revised list back to the community leaders and get their input, maybe even have a vote." In this scenario, the engineering student would be in charge of determining the needs/problems faced by Sun Valley residents, an approach supported by the way the homework question is phrased (i.e. "your professor and the DHA professional ask you to brainstorm") but then seriously critiqued in the reading. One student felt that engineering the neighborhood more effectively would create a "feeling of class" in Sun Valley, not meaning socioeconomic "class" but rather an elevation of "classiness," a raising up: "While these [proposed engineering] changes could be surface only, if engineered correctly, a feeling of class could be injected into the community. This class could in turn lead to a change in the perceived general societal ranking, improving the way the community sees itself."

But there was also some acknowledgment that typical engineering problem-solving (EPS; see Lucena, Schneider, Leydens 2010) approaches might not work well in Sun Valley. Two students didn't identify engineering solutions at all, but felt that social solutions—such as improved education—were the only way to "improve" life in Sun Valley. Approximately 1/3 of the student responses noted that they did not have enough information to design a project, and would need to get to know community members better first. In fact, one student noted,

> The community appears to consist of people from many different cultures and histories. Singularizing the community to be a low income one that makes X thousand dollars on average annually, would be dismissing the various concerns that cultural differences may bring about. No

> problem can be summed up as an income issue. The one thing that would not be defined [by engineers] however is the problems. Defining the key groups of people should be followed with interacting with them and having *them* define their problems.

This quotation is remarkable because it acknowledges the importance of asking who defines the problems to be solved: in engineering education, typically, *engineers* define problems, or solve problems given to them by industry, corporations or the military. In a case such as Sun Valley, problem-definition may be much more complex. Similarly, another student wrote:

> Based off of the readings, it is easy to come up with problems that actually are not the primary problems of the residents. Having also travelled to various countries I have seen this. The other problem is [that] social constructs are often ignored by the EPS method of solving problems. Engineering needs to be incorporated with communities and not separate from them.

Two students said that they would begin the project with "self-reflection" before beginning to do research in Sun Valley itself and trying to understand effective ways to engage the community.

X.6.2 Second Step

Students were asked to complete a second set of readings, this time focusing on materials produced by those developing the lightrail line through the west corridor of Sun Valley, including a station in Sun Valley, and RTD's community meeting summary with the residents of Sun Valley, wherein residents expressed their concerns about the lightrail development. During this class period, students discussed the regional and local planning documents, and asked key questions related to ESJ, namely, who benefits and who loses from such projects (see Baillie 2006)? In what ways might different social values, such as environmental sustainability, economic development, and social justice, collide?

For example, students pointed out that, from an environmental policy standpoint, the lightrail system would most likely ease traffic burdens and therefore the types of pollution that contribute to poor air quality and climate change. It could also provide needed transportation access for community members seeking employment outside of Sun Valley. At the same time, many Sun Valley residents worried that the lightrail station and development plans so near the Broncos' football stadium would lead to rapid gentrification, which might displace their residences and lead to a disruption of their community life. They were concerned that residents' voices were not adequately being considered in planning processes, and that the development efforts were an example of wealthy developers aiming to become even wealthier. Although we did not come to any satisfactory answers to these questions, the discussion indicated that students were beginning to think more critically about who might benefit and who might lose in the case of Sun Valley's lightrail development. In short, they were beginning to think about social justice.

The former resident of Sun Valley who initially had introduced our faculty ESJ workshop to that neighborhood also visited our class during this second session. He talked about his experiences as an immigrant living in Sun Valley for many years, and sensitized students to a number of factors they had not considered when devising solutions to the problems they identified in Step One. Meeting this former resident also personalized the problem-solving process for the students; he encouraged them to think of Sun Valley not as a community of "others," but as a community made up of individuals subject to a number of social challenges and opportunities, both in and out of their control.

The second set of student homework emerging from this step of the module acknowledged the ways in which the lightrail station could be a "win" for some community members in Sun Valley and a "loss" for others. An example from a student response in Figure 2 illustrates:

Possible Impacts:

Positive	Negative
• Increase of people in area • Economic benefits, more people using lightrail • Area will begin to develop- more job opportunities	• People who live in Sun Valley do not have the funds to ride lightrail • Increased people in their community who do not belong there • Potential to lose homes and have to move • If area begins to grow, real estate prices will increase

Figure 2. Excerpt from SED sample homework for Step 2.

One student acknowledged that, given Sun Valley residents' treatment in the past and their lack of access to systems of privilege and power, the hoped-for benefits from the lightrail station might not accrue to the community:

> In my opinion one of the largest risks is that the goods of the addition of the light rail [are] unable to trickle down to the Sun Valley residents. Whether this is due to access limited by money or otherwise, if the addition of the rail is unable to help them it will just further leave their needs unmet.

Most student responses argued that Sun Valley residents needed to be meaningfully included in decision-making processes about the lightrail station, though a number of students also acknowledged that the residents would be at a disadvantage when compared with other, potentially more powerful, players. For example, one student wrote that the critical issue in the Sun Valley project was involving multiple stakeholders in decision-making processes:

> For the Sun Valley community, the stakeholder that has been least involved in the planning of development has been the residents. Whether intentional or not, this group potentially has the most to gain or lose from this development, and should be considered as such.

This student also acknowledges that not all stakeholders are treated as equals, and that some may have a more powerful say than others in determining their future.

However, this student finishes his homework by suggesting that what is needed is more and better education; he does not address the issue of the lightrail project head-on. His response is typical of many of the responses; these circumvent the role of engineers and engineering in their critiques or concerns of the lightrail process. While responses such as this student's acknowledge an important structural problem—the inequities inherent in our education system—they do not address the role that engineering or technology may play in perpetuating such inequalities.

Such a gap in student understanding is most likely directly related to Erin Cech's conceptualization of "depoliticization" as being a central feature of engineering culture. Cech argues,

> Because science and mathematics knowledge is understood to be the basis of engineering expertise, engineering work is assumed to be carried out objectively and without bias. Indeed, this is the foundation of logical positivism, the belief that science and engineering work can be separated from messy "social" concerns as long as proper scientific and engineering methods of inquiry and design are followed (p., in this volume).

The student responses that do not connect social justice and engineering directly, but rather see them as discrete subjects, suggests an internalization of depoliticization. Students are not always sure how to evaluate or critique technological inequities, may see them as outside their domain of interest or expertise, and may instead shift their concerns to other systems in which engineering is not so complicit. It also suggests that the module needs to do a

better job of highlighting the role that engineers and engineering play in decision-making when it comes to designing sociotechnical systems, of creating "cultural space" for overt discussions of depoliticization and its effects.[7]

X.6.3 Third Step

Finally, we challenged students to consider how social considerations might be quantified in sustainability analyses. Students were asked to read about different measures of social sustainability (Hutchins and Sutherland 2008), including the United Nations Division for Sustainable Development framework (summarized in the table below). Hutchins and Sutherland, after reviewing a number of efforts to assess business sustainability, ultimately define and demonstrate the use of indicators of labor equity, healthcare, safety and philanthropy in evaluating the social sustainability of supply chains.

Theme	Sub-theme	Indicator
Equity	Poverty	Percent of population living below poverty line
		Gini index of income inequality
		Unemployment rate
	Gender equality	Ratio of average female wage to male wage
Health	Nutritional status	Nutritional status of children
	Mortality	Mortality rate under 5 years old
		Life expectancy at birth
	Sanitation	Percent of population with adequate sewage disposal facilities
	Drinking water	Population with access to safe drinking water
	Healthcare delivery	Percent of population with access to primary healthcare facilities
		Immunization against infectious childhood diseases
		Contraceptive prevalence rate
Education	Education level	Children reaching grade 5 of primary education
		Adult secondary education achievement level
	Literacy	Adult literacy rate
Housing	Living conditions	Floor area per person
Security	Crime	Number of recorded crimes per 100,000 population
Population	Population change	Population growth rate
		Population of urban formal and informal settlements

After reading this manuscript, students were asked to discuss the following:

> This manuscript describes a variety of social indicators that may be used to quantify the sustainability of supply chains. Which indicators do you believe are most important? How can these be quantified? What issues might you anticipate in applying these indicators? How could these indicators be applied to the light rail station in Sun Valley?

During the class session, students shared their responses to the assignment above. The discussion centered on prioritizing indicators and issues related to quantifying these indicators in Sun Valley. In particular, the lightrail development was difficult to link directly to changes in indicators, primarily because the types of indicators identified by LCA software and in the reading had to do with analyzing company or supply chain performance rather than a public-works project like the lightrail.

[7] As far as we are aware, the institutionalization of such discussions regarding the politicization of engineering are relatively absent from engineering education, save in program's such as Rensselaer Polytechnic Institute's design studio program (see Nieusma, this volume).

The majority of responses for this third step were often illustrative of the sort of technical/social binary we noticed above and which Cech (this volume) has theorized, where students were challenged by having to think about ways in which engineering practices (such as LCA) might ignore, if not contribute to, the creation of social inequities in a place like Sun Valley. Several responses took for granted the social indicators proposed by the article, simply listing those that they thought would be the most important for a quantitative social sustainability or LCA approach to examining the lightrail project. Some of these responses suggested that measuring the safety records or philanthropy rates of particular companies or organizations would be the best approach; others suggested that health and education metrics would work best in Sun Valley. A number gave carefully thought-out and reasoned support for why access to clean food and good education were useful indicators, and several noted that these indicators were difficult to adapt to an urban environment in an industrialized country, noting that they would have to be used with careful judgment.

The homework prompt invited students to do this sort of analysis, and certainly grappling with appropriate measurement is something that engineers, scientists, and social scientists strive to do. However, focusing only on the particular indicators proposed by the assigned reading has its limitations. It may encourage engineers to zero in on needs rather than capacities, for example, or to make inaccurate or problematic assumptions about groups, social class, behaviors, and motivations. For example, one student arguing that health was a good indicator wrote,

> One of the main issues in applying health is getting the people to care about themselves, it seems as though there may be a lot of depression in lower income families and to get them to understand the quality of life would be a major step. The main issue that would arise in Sun Valley for education would be getting quality teachers who are able to motivate the children to learn and create a better life for themselves.

It is possible that some of these assumptions are true, or contain some truths, but it is equally possible that they are not accurate and that acting on them could promote unjust ways of seeing, thinking about, and treating others. We see here evidence of Cech's second characteristic of engineering culture, meritocracy. According to Cech, meritocracy is a widespread belief among engineers, and can be defined as, "the belief that success in life is the result of individual talent, training, and motivation, and that those who lack such characteristics will naturally be less successful than others" (this volume, p. 7). The problem with this belief—which is held not just by engineers but by many Americans—is that it "denies the structural foundations of inequality—foundations that may include the work of engineers" and furthermore "frees engineers from the responsibility to design accessible or inexpensive products that alleviate social problems but may have little profit potential" (this volume, p. 9). A more sophisticated social justice lens, on the other hand, would invite this student to think critically about his own assumptions and to examine whether structural factors, rather than individual or personal flaws, might be at the root of the issues facing Sun Valley residents. We reflect further below on how space for this kind of discussion can be made in certain kinds of engineering classrooms more easily than others.

On the other hand, there was also significant awareness among several students that not only were social factors frequently difficult to quantify, but that the proposed model from the reading and the LCA software itself would not be up to the task of measuring social sustainability. Indeed, the field of social and socio-economic life cycle analysis (S-LCA) has emerged within the past decade and has not yet developed to the level of establishing databases with even generic background information regarding social impacts, readily evaluating qualitative data, or considering chains of causality for social, environmental and micro-economic impacts (UNEP 2009). Rather than taking the method from the article at face value, nearly half of the students adopted some critical distance from the approach and questioned whether social indicators could or should be accurately or usefully quantified at all. According to one student,

> These indicators have a number of flaws, which leads to a conclusion that no social rating may suffice or result in useable data […]. In the same way that 'natural' and other green washing words and images have harmed the concept of environmental sustainability, tacking labels on companies based on surface-level indicators may ruin the point of social analysis.

Similarly, another student argued,

> Although quantifying the indicators mentioned in the text may give an overall feel of the social sustainability within a place, I think that they are quite sterile and oversimplify the social and cultural ethos within a society and nation. I do not believe that one can quantify social sustainability with ONE general number and apply it to a group of INDIVIDUALS. So perhaps these indicators are better used in a corporate rather than a cultural setting.

Two students, including this one, acknowledged that the LCA approach suggested by the article would be most appropriate for corporations interested in supply-chain-type analysis, not for examining community impacts more broadly. Several suggested that it is perhaps for this reason that corporations are unable to think meaningfully about social sustainability broadly defined.

X.7 SED Assessment

A detailed description of our assessments for the module and for the course is beyond the scope of this chapter, but we briefly describe some of the student comments to our pre- and post-surveys here, simply to give a sense of the strengths and weaknesses of incorporating social justice into an engineering classroom the way we did with this module. Cech advises in her chapter for this volume that social justice cannot be addressed briefly or willy-nilly; no single lecture or assignment suffices to undo the deeply held ideologies of depoliticization and meritocracy. Rather, argues Cech, sustained and meaningful openings must be made in engineering courses in which these ideologies are discussed. We agree wholeheartedly with Cech, and hope we began some of that work with our brief module.

At the same time, we are sympathetic to the time pressures and other demands on engineering faculty, and also wonder how many engineering faculty would feel comfortable teaching about topics such as these. This is not a reason to withdraw from such efforts, but merely an acknowledgment of the barriers that exist to "making cultural space" for such discussions in engineering classrooms. In some ways, our task was easy: SED already lent itself, in terms of subject matter, to discussions of sustainability and social justice. We are not sure such efforts would be as easy in other courses where the "social" seems extraneous or unconnected, even though we understand that it is not.

Twelve students total completed both an initial and a final survey. This is a very small sample, but some tentative generalizations can be made by comparing the two sets: At the beginning of the course, students on the whole had a vague sense that social justice has something to do with rights and fairness, and that these were terms that were agreed-upon by society. By the end of the course, we can find some evidence that suggests that students were embracing a more complex definition that also included problems posed by unequal access to opportunities and the cumulative or targeted impacts of injustice. For example, a student who we will call John defined social justice at the beginning of the course as "based on a large-scale agreed upon set of moral and other philosophical norms that can be applied preemptively/proactive[ly] to adjust anything that may not best fit the survival of said society." Similarly, "Peter" initially argued that social justice is simply "treating individuals according to their natural and civil rights." And "Margaret" early on defined social justice as "Equitable or fair baseline for all humans and their interaction with each other and their environment." Nine of the 12 responses on the initial survey contained references to rights or fairness.

Some of these rights-based definitions persisted at the end of the semester as well, with three of the final responses looking very similar to the initial rights- and fairness-based definition. But several other responses suggested a shift in student thinking from simply defining justice within a legalistic (often known as retributive justice), rights-based framework to thinking also about access to opportunity, resources (or distributive justice), voice in decision-making (or procedural justice), and technology. For example, John, who provided the fairly abstract definition of social justice above, shifted his end-of-semester definition to include environmental aspects of justice and an emphasis on those who might be disadvantaged by decision-making: "Fairness in both societal and environmental aspects, not unfairly disadvantaging group/locale." Similarly, "Bill" who had initially defined justice as just being on a "society wide level," by the end of the course pointed to social justice as being the need for "protection of [the] needy against [the] more powerful." Peter also noted that social justice must do something about "correcting injustices created by hierarchical class, race, and other structures," arguably a more nuanced and sophisticated definition than his simple rights-based one above. Margaret also referenced the importance of paying attention to equality among "stakeholders" in a given situation—a more contextualized definition of social justice than she began with. Finally,

"Sam" initially defined social justice in a market-based sort of way, as "the ability for society to push the development of a particular issue. If society wants sustainable development they create a demand for it and that becomes a norm." By the end of the course, he too had moved to a definition of social justice that emphasized not just rights but also opportunities: Social justice is "the thought that all people deserve the right to access basic necessities. Also that people will do what is right for them given opportunities."

X.8 Conclusion

These are subtle rather than dramatic shifts. In order to further support our inferences from these surveys, we would need to complete student interviews and more rigorously analyze student homework from the Sun Valley module. We also wish we had provided students with our working definition of social justice during the module, and/or had them complete a reading or readings more geared to social justice and not simply focused on sustainable development; our colleague Juan Lucena does this kind of work in his course Engineering and Social Justice, and this could be a model to consider for future modules. In that course, he defines social justice practices as "attempting to an equal distribution of rights, opportunities, and resources in order to enhance the capabilities and reduce the risks and harms among the citizens of a society." Such a definition could provide students with a basic point of discussion. Furthermore, the way we structured the module may have exacerbated the blurring of the lines between "development" and "social justice," which we are actually interested in teasing apart, conceptually. If we use the module again, we will also rewrite the prompts such that students are encouraged to look more specifically at the engineering aspects of the case, and will guide them in a more careful discussion of the role engineering and technology can play in perpetuating (in)justice. Given unlimited time and resources, a more complete study of the Sun Valley case would also have led us to complete interviews with Sun Valley residents and community planners to gain more insight into the impacts the lightrail project is having and will have on life in that community. It may also be interesting, in the long run, to explore possible partnerships or deeper relationships between our university and the residents and organizations of Sun Valley. We believe strongly in the importance of encouraging students to look near their own universities and communities as they think about who and what needs to be "developed" or better yet, where social justices might be occurring. Perhaps most importantly, we will brainstorm ways in which both of Cech's ideologies—depoliticization and meritocracy—can be examined critically in some way, and incorporated into our discussions of social justice.

Nonetheless, we would argue that this cursory analysis of the homework and initial and final surveys points to an increase in complexity and sophistication with regard to thinking about social justice among some students, and suggest possible mechanisms that engineering educators might consider for incorporating social justice into their classrooms. These findings suggest that students began to move away from simply defining social justice as the distribution of "rights" or as a bland dispersal of "fairness," and moving toward more nuanced definitions that include critiques of social systems rooted in particular contexts; such a move may indicate cracks—however minute—in student beliefs in meritocracy.

Similarly, students' final definitions of social justice suggest an awareness that social structures—constructed by politicians, policymakers, engineers, and others—may lead to a lack of access to opportunities as well as rights, and therefore perpetuate *injustice*, a beginning awareness of flaws in the ideology of depoliticization. Although we never provided students with a definition of social justice, nor gave them specific readings on social justice, the inclusion of the Sun Valley case seems to have motivated students to think more critically about how justice and injustice are created by human decision making, and to think more carefully about how to involve citizens in such decisions. For many students over the course of the semester, social justice shifted from being about the rights of individuals to being about the inequities created by systemic imbalances, which is an awareness we hoped to foster through the inclusion of the module. While there is room for improvement and expansion in terms of how we delivered the module, we believe that these initial indicators of student learning are positive, and may provide one model for thinking about how to make social justice live in the technical curriculum.

Finally, we would encourage other engineering educators to consider ways in which they might team with their colleagues in the humanities and social sciences to design modules that will work in their own engineering classrooms. Our collaborations revealed to us the ways in which we might learn from each other as we endeavor to break down the walls between "engineering" and the "social"; the ways in which our students both hunger for and resist discussions of fairness and equity; and our own beliefs about what is possible in the engineering classroom.

We believe that our students lost nothing by taking the time to consider the social in their engineering coursework—except perhaps for some potentially problematic beliefs about what engineering is and does—and may have gained a deeper appreciation for social justice concerns.

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