ENGINEERING FOR SOCIAL JUSTICE:

A CRITICAL SEMINAR ON THE POLITICS AND POSSIBILITIES OF ENGINEERING

Seminar, Winter 2014
Time: Mondays, 2:30-4:20
Room: MEB 250
Website: e4sj.wordpress.com

Course Facilitators: Dean Chahim and Daniel Ullom
Email: dean.chahim@gmail.com and ulohdan@gmail.com
Office: Cafe Allegro
Office hours: TBA

Faculty Advisor: Professor Susan Bolton
Email: sbolton@uw.edu

Description

How can engineers work for social justice both at the drawing board and in their daily lives? How are everyday people affected by the decisions and practices of engineers? What is the relationship between engineering, technology, society, ecology, and health? By exploring the social and historical context of engineering, we will ask questions like: For whom is engineering done? Who defines the problems we solve? **Who wins when a dam is built and who loses when an engineer designs a robot?** Whose work is considered engineering? And **why are women and people of color still so underrepresented in engineering classrooms?**

These questions and discussions of the context of the engineering discipline and the values undergirding the work of engineers is notably absent from most skill-focused engineering curricula. This seminar is intended to fill this gap by creating a space to **reflect on the impact of engineers and technologies on society and to imagine a new kind of engineering and technological development for the common good.**

The course is **open to all levels and all majors, including non-engineers.** Freshmen and sophomores considering engineering but with reservations are strongly encouraged to enroll. There are **no prerequisites** other than a desire to learn about the subject and participate actively in class. Course assignments will include readings, reflections, and conceptual designs.

Course Objectives:

In short, this course is fundamentally designed to explore the social, political, and environmental context and history of engineering, inspire critical *inquiry* (questioning) of the assumptions and practice of engineering, and the *imagination* of an alternative culture and practice of engineering rooted in social justice.

After completing the course, you should be able to look at *any* engineered object or a conceptual plan and have new questions to ask:

> *What are the politics behind this technology? Who is affected by its design? How was its design affected by society? Who reaps the benefits, and who suffers the costs of its creation? How might we re-engineer a technology like this in a participatory way that is accountable to the people affected such that it is more ecologically and socially just?*

More generally, at the end of this course you should have new tools and ways to begin answering these questions, as well as being able to:

- Identify and compare the positive and negative impacts of engineering and technology.
- Describe the basic economic, political, and social structure of the engineering field and analyze the motivations and power of key actors and *your role* within this system.
- Identify and analyze implicit assumptions made in engineering, and the assumptions made in your own visions of engineering.
- Reflect on how your life experience, privilege, and culture affect the way you may practice engineering.
- Recommend alternative ways of practicing engineering that challenge injustice.

These questions are of course of great concern to those who wish to become socially responsible and innovative engineers working in the public interest. But they are also crucial questions for *all* citizens in a highly technological society. By the end of this course, you will be a more critical consumer of technology, and have a more grounded understanding of how the seemingly neutral, "technical" decisions made by engineers and technologists have very real social, political, and ecological effects on everyone.

A Note on Pedagogy

"Education either functions as an instrument that is used to facilitate the integration of the younger generation into the logic of the present system and bring about conformity to it, or it becomes the 'the practice of freedom,' the means by which men and women critically and creatively engage with reality and discover how to participate in the transformation of their world" (Freire, 1981: 16).

Paolo Freire's words are arguably as relevant to the education of future engineers as they are to the education of the rural poor in Brazil, the original application of his ideas. The results of engineering, we will find, have always been contested, and many argue it has harmed as much as it has helped. Rather than "bring about conformity" to a flawed system by educating students on the mechanics of engineering and solving "problems," this course aims to help us "critically and creatively engage" at a *personal* level with the macro-level engineering system.

We will seek to understand our *role*, and our *potential* to make change in the deeply-embedded social and economic system of beliefs and institutions that shape and define engineering. In the process, we will start learning how to use our good intentions to reshape not only the practice but the very *idea* of engineering – and in the process, begin to transform our world.

More practically, our focus on critical pedagogy in the classroom means that we come to the discussion as equal partners, and we will learn from one another as much as from our readings. We will focus on our *experiences* and critically reflect on these in the context of each day's topics. In this case "experiences" is not simply understood as our internships, research projects, or formal study of engineering. It is instead the whole of our collective *life* experience that forms our moral compass and our personal direction.

We will strive to create an environment that elicits this kind of sharing in a respectful, safe way. But this requires your active participation, and your willingness to engage with the material on a deeper, more personal level than you may be accustomed to in traditional classes. Our reward will be *empowerment*; we will gain a critical analysis to understand the engineering system, tools to begin to change it, and the hope – through the solidarity of others in the classroom – that such a change is completely possible, absolutely necessary, and already in motion.

Assignments and Grading

The course is credit/no credit in the spirit of critical pedagogy. However, receiving credit requires a significant and sincere effort on your part. The expectations for receiving credit – in short - are as follows:

- **Participate:** Come to all classes prepared (having done the readings and assignment) and participate actively in a way that is comfortable to you.
- **Reflect:** Submit all the assignments with demonstrated effort.

In more detail, what we expect from you to receive credit:

Participation

This course is fundamentally based on learning from one another, and this requires all voices and minds to come together. By not attending and participating in class, you both deny yourself the opportunity to learn from other students and the chance for other students to learn from you. With this in mind, **to receive credit, you must attend and participate actively and respectfully in *all* classes.**

Missing Class

If you must miss class due to extreme circumstances, such as *documented* illness or an emergency, you are expected to contact the facilitators (in advance whenever possible).

If you do not attend class without a valid excuse, you must **complete a substitute assignment to expand your own learning and those of other students around the theme of the day's class.** This will likely involve a short presentation to the next class session or a blog post related to the day's class.

Weekly Assignments

Each week, you will be expected to complete a unique, short reflective assignment, grounded in the readings. These assignments will be a maximum of one page. Specifics for each assignment are detailed in the schedule. These will be **due the Friday immediately before the class at noon.** The assignments should:

- Clearly answer any assigned questions or complete any assigned exercises.
- Demonstrate comprehension of the key ideas of the day's readings.
- Show a sincere effort to reflect on the implications and limitations of the readings for your own life and work.

Unlike most courses, *purely* academic critiques or analysis of the readings are not acceptable. Academic critique *alone* - without reflection - demonstrates only an intellectual reading of the texts, and does not show that you have actively *engaged* with the ideas in relation to your own lived experience. You are encouraged to bring in your prior academic knowledge, but you should also bring in your prior life experience.

Grading and Credit

Reflection assignments that fulfill all the above criteria will receive one point. Assignments that miss one or more of the criteria will receive a zero. **To receive credit, you must complete *all* of the assignments and receive an overall grade of 9 points (out of a possible 11).** Everyone who completes the pre- and post-class surveys receives one point for each.

If you receive a zero, the facilitators will provide a clear explanation as to what you missed. You may redo the assignment once and turn it in *before the following Friday at noon.* You will receive half a point if the assignment fulfills all the above criteria.

Late Work

Reflective exercises are most useful for the class's learning when done before our class session. Therefore, late work will be accepted without penalty *only* in cases of documented illness or emergencies – please contact the facilitators to arrange make up due dates.

If you miss the deadline for a reflection assignment without a valid excuse, you must *make up the assignment before noon the following Friday*. You will receive half a point if the assignment fulfills all the above criteria, and zero otherwise.

Course Project: The Artifacts of Engineering

Go out into Seattle and obtain or take a picture of any human-made object or substance (hereafter referred to as your "artifact") that is not typically found in your backpack. You will be analyzing this object carefully throughout the course, so be sure to pick something you're interested in!

Requirements:
- Engineered or whose manufacture requires engineering (define this for yourself but be prepared to justify your choice)
- Located or can be found/purchased in Seattle (you must be able to bring it to class or take *your own* photo of it – not from the internet)
- Design, creation, or manufacture is not older than 1900 (exceptions possible – ask)
- Not immediately hazardous (no toxic waste or weapons!)

Suggestions:
- An object that is a symbol of your chosen engineering/technological/scientific field or area of interest
- Not so rare or unique so as to make researching it difficult
- Simple is good (don't need to be clever)

Throughout the course, we will investigate the context of the engineering of this artifact further. In Week 3, we interrogate its relationship with society and politics. In Week 4, we draw its relationship with the environment. In Week 6, we look at its connection with the economy and potentially war. In Week 6, we ask how its benefits and costs are distributed across class, race, ability, gender, and so on. In Week 7, we consider how the artifact has shaped cultures, and how other cultures might have reimagined, repurposed, or happily lived without the same artifact. In Week 8, we begin to redesign the artifact (conceptually) and reconsider its utility using the tools of alternative design and the framework of social justice. In Weeks 9 and 10, we will consider ways to move forward and reflect on our learning journey.

Each week, starting in Week 3, two to three students will briefly present their reflections on their artifact to the class, based on the week's theme. We will have signups for weeks and more details during Week 2.

Public Forum

During week 9, we will hold a public forum where you will be able to share your work with the broader university community and engage them in the themes of the course and what you learned about your artifact. This forum is "the final exam." There will accordingly be no exam during finals week.

Date and Time (tentative): Monday, March 3rd, 5-8PM.

Course Outline

1. Imagining Engineering for Social Justice

Class overview:

- Introducing the class and pedagogical method; introducing one another, what we each hope to share, teach, and learn.
- Create class agreements
- Brief overview of problems we have each seen in engineering.
- Imagine what "engineering for social justice" might look like.

2. Engineering Methods and Mindsets

Learning Objectives:
- Identify and analyze the assumptions of the engineering mindset and design process, situate them in history
- Begin to critically analyze the objectivity of engineering decisions, calculations, and designs

Readings
- Riley, D. (2008). Engineering and social justice. *Synthesis Lectures on Engineers, Technology, and Society*, *3*(1), 33-44, Chapter 2: Mindsets in Engineering
- Stevens, R., Amos, D., Jocuns, A., & Garrison, L. (2007, June). Engineering as lifestyle and a meritocracy of difficulty: Two pervasive beliefs among engineering students and their possible effects. In *Proceedings of the American Society for Engineering Education Annual Conference, Honolulu, Hawaii* (pp. 24-27).
- Waller, S. (2013, October 23). "Boeing Engineer Reveals Secrets Behind Cold War Missile Program." KUOW. http://kuow.org/post/boeing-engineer-reveals-secrets-behind-cold-war-missile-program

Assignment:
1. Engineering Mindsets in Jest: What was your favorite engineering joke? Why? Have you seen this mindset in yourself or fellow classmates? How would such a mindset affect one's approach to education? How could it affect outcomes of projects?

2. Meritocracy: How has meritocracy affected your relationships with other students? Could you still be motivated to work without an assurance of a good paycheck?

3. Deconstructing the Texts of Engineering: Read the introduction to an engineering textbook, preferably one for a 200 or 300 level course. How do they define engineering? What assumptions do they make about the work engineers do? What skills and mindsets, which Donna Riley identified, do they encourage?
   a. Find a homework problem from another class or select a few pages of your textbook to "deconstruct," paying close attention to the ways in which the engineering mindsets described by Riley are expressed in the language and concepts presented as objective fact.

3. Unpacking Privilege, Discrimination, and Power in Engineering

Learning Objectives:
- Reflect on your multiple identities (e.g. profession, race, gender, citizenship, ability, class, sexual orientation), family history, and life experiences and how these contribute to the way you interpret the world.
- Analyze how privilege, discrimination, and unconscious bias are manifested not only *within* engineering education and practice, but how these biases affect what engineers *do* and the differential benefits to people for whom engineering is done *for* or done *to.*
- Analyze how you got to where you are; the truths and myths of meritocracy in engineering.

Readings:
- Hossfeld, K. J. (2001) "Their logic against them": contradictions in sex, race, and class in Silicon Valley," in *Technicolor: Race, Technology, and Everyday Life*. Edited by Nelson, A., Tu, T. L. N., & Hines, A. H. New York: New York University Press.
- McIntosh, P. (1988). White privilege: Unpacking the invisible knapsack. Race, class, and gender in the United States: An integrated study, 4, 165–169.
- Scalzi, John. Straight White Male: The Lowest Difficult Setting There Is. Whatever.scalzi.com. 15 May 2012. http://whatever.scalzi.com/2012/05/15/straight-white-male-the-lowest-difficulty-setting-there-is/

Assignment:
1) **Implicit Bias:** Take the Implicit Bias Test for Race here: https://implicit.harvard.edu/implicit/takeatest.html (Optional: take more tests that are of interest to you.) Were the results of the test surprising? How did they make you feel?
2) **Defining Privilege:** Drawing on McIntosh's article, what does privilege mean? What kinds of privilege have you benefited from? Please write a brief narrative of a specific time when your privilege - or lack thereof - was apparent to you, and how it affected you.
   a. Think about your own path to studying engineering. Write 3-5 different privileges white, able-bodied, heterosexual, male, middle-class, or young people might enjoy when pursuing the preparations for, study of, and practice of engineering. Write these in the style of McIntosh's list of white privileges. We will share these with the class. (For example: *White engineers can be pretty sure that they will be working in an engineering office where their boss, co-workers, and clients look like them.*) Please be creative.
3) **Technicolor:** What examples of *privilege* and its corollary, *oppression,* do you find in the stories of the immigrant factory workers, their managers, and the "white boy wonders" described in Hossfeld's chapter? Which stories made the greatest impression on you? What was surprising about this portrayal of the hidden workforce that makes Silicon Valley tick?
4) **Artifact:** How do different segments of society (different classes, genders, orientations, ethnicities, abilities, etc) *experience* your artifact? *Whose* **values** does it represent? Who uses it? Who makes it? Who throws it away? How are the ***benefits and costs*** of your artifact distributed amongst these various groups of people?

4. Society, Technology, and Engineering

Learning Objectives:
- Explain the dialectical relationship between technology and society; how society shapes technology and vice versa.
- Interrogate the social and political values underlying common technologies.
- Begin to critically analyze the relationship between technological "progress" and social changes.

This week's readings build directly on Week 3's, even if may not be immediately apparent. Think about the way privilege, power, and discrimination play into the discussions of society and technology that each of these authors brings forth. Winner's reading is a foundational text for the course, and one we will refer back to over and over again – so pay special attention and read it closely. It is somewhat dense, but it is well worth understanding his arguments, which transformed the field of Science and Technology Studies after its publication in 1980.

The readings and questions are more involved this week, given that it's the heart of the course and we missed two hours of class time. But it's not as much as it looks; pay attention to the page numbers – only parts of Illich and Wheeler's essays have been assigned, though you are encouraged to read more.

Readings:
- Winner, L. (1980). Do artifacts have politics?. *Daedalus*, 109(1), 121-136.
- Illich, I. (1974). *Energy and Equity*. Sections 2-6, pp. 7-13
- Gandhi, M. (1997). "The Quest for Simplicity: 'My Idea of Swaraj'." *The Post-Development Reader*. M. Rahnema and V. Bawtree, ed. pp. 306-307.
- Wheeler, T. (2013) Net Effects: The Past, Present, and Future Impact of Our Networks. pp. 1-13 and 17-22. http://transition.fcc.gov/net-effects-2013/NET_EFFECTS_The-Past-Present-and-Future-Impact-of-Our-Networks.pdf
- Markoff, J. "Skilled Work, Without the Worker." New York Times. August 18, 2012. http://www.nytimes.com/2012/08/19/business/new-wave-of-adept-robots-is-changing-global-industry.html?pagewanted=all&_r=0

Optional:
- "Will GPS change our standards of privacy?" National Public Radio. September 13, 2013. http://www.npr.org/2013/09/13/219325617/will-gps-change-our-standards-for-privacy

Assignment:

1) <u>Reflection:</u> Pick a technological change you've watched in your lifetime. How did this change impact you and those you know positively? What are some (intended or unintended) negative consequences on you or others you may or may not know personally?

2) <u>Automation and Work:</u> Technologies, like the automatic tomato harvester described by Winner or the robots described by Markoff, often result in job losses or job degradation (from high-skill to low-skill work) as efficiency increases.
   a. What is the social impact of such changes? Who wins and who loses? Draw on the readings from Week 3. Why did Gandhi take issue with "the craze for machinery"?
   b. When are these changes desirable or justifiable? How might such losses be mitigated? What jobs ought to be automated, and what jobs should be preserved for humans? Why?

3) <u>Distance and Time:</u> Both Illich and Wheeler are concerned with how technology shapes society, especially under the changing constraints of geography.
   a. What parts of their arguments are similar to each other? Where do they disagree?
   b. What kind of society do you think each of the authors was imagining while writing? What type of social systems do they advocate for, implicitly or explicitly? Read between the lines as needed.
   c. What physical constraints, such as time or distance, does your artifact manipulate to achieve its effect? How did this constraint limit people previously? How does changing that constraint affect how people live today?

4) <u>Political Artifacts or Artifacts of Politics</u>: Winner divides technologies roughly into two types: those that are flexible, and reflect particular – but changeable – "forms of order" (123) and those that are rigid, and "inherently political" (128). Any given technology, he reminds us, is made up of components that may represent either type of technology. As he writes, "Indeed, it can happen that within a particular complex of technology – a system of communication or transportation, for example – some aspects may be flexible in their possibilities for society, while other aspects may be (for better or worse) completely intractable" (135).
   a. **Which aspects, if any, of your artifact represent the first type (the flexible), and which aspects, if any, represent the latter (the rigid)?** Justify and explain your assertion, drawing comparisons to the example technologies Winner describes for each category and citing Winner's definitions, other readings, or your own experiences where appropriate.
   b. **What social systems are *necessitated* to control, produce, use, or design your artifact? What social systems does it encourage? What social/political relationships and systems influenced and encouraged its production?** Justify and explain your assertion, drawing comparisons to the example technologies Winner describes for each category and citing Winner's definitions, other readings, or your own experiences where appropriate.

5. Engineering Nature and the Nature of Engineering

Learning Objectives:
- Critically analyze the relationship between engineering innovations, economic growth, resource consumption, and ecological systems, and health.
- Unpack the discourse and values regarding nature in engineering practice

This week's assignment builds closely off of the discussions of the past few weeks. In considering these articles, think carefully about the *mindsets* of the writers, and the mindsets of the engineers and technologists they describe. Similarly, consider the recurring question of the course (at the core of any consideration of *justice*): who wins and who loses? But even more importantly than this simplistic analysis: what changes? How does the work of engineers change our relationship with nature? And *whose* relationships are changed? Is it for the better?

Lastly, going back to Winner's dense reading, *Do Artifacts Have Politics?*, try to think about how to deepen his argument to assess how the work of engineers not only changes how we relate to our government (e.g. nuclear power's "authoritarianism") or who controls a market (e.g. the tomato harvester's concentration of wealth in large agribusinesses), but also how we relate to nature. When a dam is built, what is *rigid* – or inherently political – about its construction? What can be modified to lessen its negative effects – in other words, what is *flexible*? Or when a chemical is produced, or a genetic organism modified, what social systems can control its negative effects – and what cannot be controlled, once the technology is adopted?

These are the kinds of questions we will discuss in class.

Readings/Media:
- Hawken, P., Lovins, A. and Lovins, L.H. (1999). *Natural Capitalism: Creating the Next Industrial Revolution*. Little, Brown and Company. **Chapter 1 (pp. 1-21) & pp. 48-53.**
- Sachs, W., Loske, R., and Linz, M. (1998). "Greening the North: A Post-Industrial Blueprint for Ecology and Equity." *New Perspectives Quarterly.* Spring 1998. **pp. 48-53**
- Murphy, T. (2011). "Galactic Scale Energy." *Do the Math.* http://physics.ucsd.edu/do-the-math/2011/07/galactic-scale-energy/
- Pick *one* or more:
  - **Chemicals:** Carson, R. (2002). *Silent spring.* Houghton Mifflin Harcourt. **Chapter 1, pp. 1-13**
  - **Dams**: Leslie, J. "The Struggle Over Dams, Displaced People and the Environment." AlterNet. January 26, 2007. http://www.alternet.org/story/46809/the_struggle_over_dams,_displaced_people_and_the_environment
    - Also available as a video (select Chapter 3, the epilogue is also interesting): http://fora.tv/2006/12/12/Jacques_Leslie
  - **GMOs/Genetic Engineering:** Pollan, M. "Playing God in the Garden." *The New York Times Magazine*. October 25, 1998. http://michaelpollan.com/articles-archive/playing-god-in-the-garden/

Assignment:

1) <u>Our Ecological Footprint:</u> Calculate your ecological footprint online: (http://www.footprintnetwork.org/en/index.php/GFN/page/calculators/)
    a. How many earths would it take to sustain a world of you? Was this surprising?
    b. How have engineers and works of engineering facilitated (increased or decreased) your consumption of resources?

2) <u>Techno-optimism and Sustainability:</u> Compare and contrast the arguments of Hawken et al and Sachs et al.
    a. Sachs' puts forth the key question: "how can we extend hospitality to all the people on the planet, expected to double in numbers, without jeopardizing the natural resource base for subsequent generations?" How do Hawken and Sach's answers to this question differ? How are they similar?
    b. What role to they each assign to engineers and technologists in bringing about a sustainable future?
    c. How do their ideas of *equity* and *justice* in pursuing a "sustainable" world compare?

3) <u>Engineering Nature:</u> Rachel Carson's *Silent Spring* is credited with driving the national discussion that led to the most of the environmental regulations we know today. Leslie's article is one example of one of engineering's "greatest" marks upon the land: dams. Pollan, the famed writer on food and agriculture, considers the next phase of high-tech manipulation of nature by engineers.
    a. How do Carson, Pollan, and/or Leslie contend engineers and scientists view nature? Has that view of nature changed significantly since Carson was writing in 1962, since Leslie described the era of the Hoover Dam or since Pollan was writing in 1998? How so? Give examples of what has changed/not changed in recent decades (across any field of engineering).
    b. Murphy's *Galactic Scale Energy* calculation shows how thermodynamics and nature constrains growth in the exploitation of a particular resource: energy. Many other limits have been calculated for other resources, and many of these resources are themselves dependent on energy. Are these limits valid? Do these matter for engineers? Why?

4) <u>Ecological Footprint of an Artifact:</u> Look at the discussion of the "ecological footprint" of a can of cola from the selected pages from Chapter 3 of *Natural Capitalism* as an example and then do some of your own quick research on your artifact. Look at the materials and chemicals used in its extraction, manufacture, and processing.
    a. How does your artifact use resources at each stage of its production and shipment? Where do these come from? *Whose* resources are these?
    b. Overall, qualitatively or quantitatively (if you can find the data easily from Google), what is the ecological impact of your artifact? What view of nature (as a resource, an obstacle, etc.) does its design reflect?
    c. What lifestyles and systems of resource consumption does your artifact *necessitate*, *facilitate*, or *encourage*? Overall, does it encourage or discourage the increased consumption of resources?
    d. How might it be modified or replaced to reduce our ecological footprint?

6. Power, Politics, Profits, and Engineering

Learning Objectives:

- Describe the engineering economy and critically analyze the power structures and incentives of actors at each level; where the money comes from and what motivations underlie this system.
- Describe how the engineering economy is situated within the broader economy and related to the economic problems of inequality and poverty; how engineering reproduces inequality
- Critically analyze the relationship between engineering innovations, profits, and politics.

In the previous weeks, we have spent a good deal of time describing social injustice, but we are frequently left asking "Why can this not change?" Essentially, we are asking, "Why do we not have the power to change this?" During week 6, we will discuss who wields power in our society and how they influence our work. Engineers have obvious skills and potential which could change the world for the better, but what powers are restraining us from pursuing those endeavors? What are the motives and incentives that guide those to whom we sell our labor?

Two optional readings have been attached. For those who are unfamiliar with how capitalism functions and its relationship with class privilege, we've included a short and very readable chapter which should provide a good overview. For those who finish the assigned Naomi Klein chapter and still want to read more, we recommend Chapter 15, which exposes conflicts of interest held by many senior officials in the Bush administration.

Readings/Media:

- Lewis, J. (2012). "Consumer Capitalism." TEDxCardiff 2012. http://www.youtube.com/watch?v=zf-s7ndfWKM
- Wisnioski, M. (2012). *Engineers for Change: Competing Visions of Technology in 1960s America.* The MIT Press. Chapter 2: From System Builders to Servants of the System
- Klein, N. (2008). *The Shock Doctrine: The Rise of Disaster Capitalism.* Picador. **Chapter 17 (pp 341-360)**

Optional Readings:
- Johnson, A. (2005). *Privilege, Power, and Difference*. McGraw Hill. Chapter 3: Capitalism, Class, and the Matrix of Domination. **pp. 41-53**
- Klein, N. (2008). *The Shock Doctrine: The Rise of Disaster Capitalism.* Picador. **Chapter 15 (pp 308-325)**

Assignment:

1) <u>Consumer Capitalism:</u>
   a. What were your reactions to this video? What arguments or facts interested you the most? What connections can you find between Lewis's arguments and those of Hawken and Sachs?
   b. What could an engineer do to implement any of the changes Lewis suggests or to address his concerns?

2) <u>Where Do We Fit In?:</u>
   a. According to Wisnioski, how and *why* did engineers change from "system builders" to "servants of the system"? What "system" is he referring to?

b. What were common perceptions of engineers and their work in 1960's? How did these perceptions compare to the actual field of engineering? Does any of these images or ideas still influence our education and work today?

3) <u>Engineering and the Military:</u>
    a. What *shocked* you about Klein's chapter?
    b. Pick one of the engineering companies mentioned in the chapter and look at their website. How do they portray the engineering profession? How do they portray their work? What values do they seem to hold? Does this conflict with what you read? If so, explain how it conflicts.
    c. Where do engineers fit into this story? Where do they stand in the chain of command of these engineering companies? Are they responsible for actions of their managers and CEOs?

4) <u>Connecting to Your Artifact:</u>
    a. How did Lewis's talk or the chapters by Wisnioski and Klein change your understanding of your artifact's relationship to consumer capitalism, corporate power, the military-industrial complex, or any other system of political and economic power?

7. Engineering from Below

Learning Objectives:
- Begin to analyze relationships between power and knowledge production in engineering
- Identify the diversity of knowledges and visions of progress of people from different backgrounds and begin to describe how these could be integrated into engineering practice at home and abroad
- Identify other means of assessing technologies and measuring progress

Figure 1. "Design for the First World logo" Source: http://designforthefirstworld.com/

What – and who – defines what *is* and *is not* "engineering"? As Alice Pawley (in the optional reading) discusses, if engineering is just "problem solving" or the application of scientific principles to create something that has never been, then home economics could have just as easily been considered as "engineering." As Pawley writes,

> What is crucial about this history with respect to the construction of engineering is the realization that the actual tasks awarded to home economics could easily have been considered "science" or "engineering" tasks had they been in a different context. Nutrition can be characterized as a combination of chemistry, biology, and food engineering, except when in the context of feeding a family. Sanitation engineering forms a large portion of civil engineering and is often considered its own discipline, but in the home it is morphed into basic hygiene and cleanliness. The characteristics of "hygiene" have been adopted by medicine and biomedical engineering, except in the context of women's health and menstruation (Appel, 1994). Developing lighting systems in industry is considered electrical engineering—and, indeed, is largely the reason for electrical engineering's initial existence—but is characterized as home economics in the context of electrifying (especially rural) private homes.[1]

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[1] Pawley, A. (2008). "What Counts As Engineering: Toward a Redefinition." in Baillie, C.. and Riley, D.. and Pawley, A. (ed.), *Engineering and Social Justice: In the University and Beyond.* West Lafayette, IN: Purdue University Press. Pg. 63

Perhaps even more importantly, *who* has the power to make the definition of what knowledge, methods, and applications are considered "engineering"? What are the implications for engineers and society? What do engineers – often referred to as "experts" – have to learn from, and what do we have to teach to, everyday people here and abroad? *(The picture in Figure 1 above is from a design competition in which designers from the "Third World" created products to solve "First World" problems.)*

This week is the culmination of our critique of engineering's place in the world. (In the following weeks, as we have been alluding to, we will begin to consider how to change it.) Last week we investigated the ways in which engineering and engineers are situated in relationships of power and political systems, from the military-industrial complex to consumer capitalism. We also considered the ways the culture of engineering has evolved over time, from the early days of pioneering (male, upper-class) "system builders" to the modern cog-in-a-machine "servants of the system" performing specialized tasks in large corporations.

The readings this week continue to investigate this idea of the *culture* around modern technology – and by extension, the engineers and societies that create it. However, critical to our understanding of culture is an understanding of *knowledge* and its relationship with the unequal power structures in our society that we discussed in Weeks 3, 4, and 6.

We are all familiar, whether we recognize it or not, with how *power affects knowledge*. As small children, we know only that which those with power (our parents) are willing to teach us (or the media, via the TV, shows us). The beliefs of these powerful figures forever shape our worldviews, even if we can and do change. But less familiar is the way in which *knowledge affects (and is itself) power*. As Wolfgang Sachs writes in the *Development Dictionary*,

> Knowledge, however, wields power by directing people's attention; it carves out and highlights a certain reality, casting into oblivion other ways of relating to the world around us.[2]

Sachs urges us to think about how what we know – or don't know – reinforces the position of those with power, and erases other "ways of relating to the world around us."

The challenge this week's readings pose for engineering "experts" is this: How did Western technical knowledge become hegemonic (dominant) over all others? **What (and *whose*) knowledge is *valid*?** Is the "validity" of our technical knowledge *socially constructed* or *objectively* defined? When does the knowledge of the powerful erase other, similarly valuable local knowledge? When does the power of our particular form of knowledge over another change cultural values, norms, and ultimately – people's lives?

These questions should unnerve, humble, and unsettle us as technical experts. But they are not intended to dismiss the value of the knowledge we have. Thus, as we move forward in the course, the guiding question will be: **how can the technical knowledge of engineers support, rather than replace, local knowledge?**

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[2] Sachs, W. (2010). *Development Dictionary: A Guide to Knowledge as Power*. Zed Books. Pg. XIX.

Readings:

- **Fischer, F**. (2000). Citizens, experts, and the environment: The politics of local knowledge. Durham, NC: Duke University Press. "Ordinary Local Knowledge: From Potato Farming to Environmental Protection." pp.193-218
- **Shrestha, N.** (1995). "Becoming a Development Category." In *Power of Development*, edited by J. Crush. Routledge, New York. pp. 266-277
- **Huff-Hannon, J.** (2004). "The pollen and the bees." *New Internationalist*. 368. http://newint.org/features/2004/06/01/factory-occupations/

Optional Readings:
- **Pawley, A.** (2008). "What Counts As Engineering: Toward a Redefinition." in Baillie, C.. and Riley, D.. and Pawley, A. (ed.), *Engineering and Social Justice: In the University and Beyond.* 59-85. West Lafayette, IN: Purdue University Press.

Assignment:

1) <u>Defining local knowledge:</u>
    a. Think of an example of "local knowledge" you have seen in your life. How was it different from "technical knowledge" on the same topic/problem? How was each form of knowledge perceived by different people/groups in society?
    b. What kinds of knowledge do the workers in Huff-Hannon's article demonstrate? How did this article make your feel? What connections can you draw to other things we have read? What role might engineers have played in this story?

2) <u>"Development" and Technological Progress:</u>
    a. What were your reactions to Shrestha's story? What arguments, stories, or facts interested you the most? Was there something you agreed or disagreed with strongly? Why?
    b. Shrestha and Fischer both do not mention engineers by name. How were engineers and the *knowledge* systems of engineering implicitly involved in the Shrestha's story and Fischer's examples?

3) <u>Knowledge and Power</u>
    a. *How do* we *know what we know* as engineers? How are knowledge and power related in engineering (and more generally, if you wish to abstract)? Draw on the readings from throughout the course in answering this question.
    b. Is our knowledge objectively "better" than local knowledge? How do we know if and when it is, or isn't?

4) <u>Artifacts of Culture:</u>
    a. Fischer mentions a number of inventions that came long before the codification of engineering and science. What pre-modern technologies and concepts or local knowledge is your artifact built on? Think about the basic components (e.g. wheels!), the essential principles (e.g. the number *zero*, which has a storied history). What part of the world did these come from?
    b. Where was the object engineered? What cultural values does the artifact represent? Are these the dominant cultural values of the place it was engineered? If you have experience with another culture – be it Zimbabwean, Chicano, or Midwestern – how do you imagine it might have been *designed differently* in that context? *Would it have been designed at all?*

8. Rethinking "Given…": Designing for the World You Want

Learning Objectives:
- Explore alternative, community-driven and ecological design methods
- Rethinking the bounds of engineering's definition of "problems" and "solutions"
- Explore ways that engineering can challenge injustices and realign power relations

Readings:

- **Spencer, B., Bolton, S., and Alarcon, J.** (n.d.). "The Informal Urban Communities Initiative: Lomas de Zapallal, Lima Peru". Draft manuscript—not for circulation
    - **Note:** This article is primarily focused on "urban design" in a specific context, so feel free to skim through some of the specific project details, but pay special attention to the overall *philosophy* towards design that the authors convey.
- **Nieusma, D**. (2004) "Alternative Design Scholarship: Working Toward Appropriate Design". Design Issues: volume 20, Number 3 Summer 2004. Massachusetts Institute of Technology

Assignment – Part One: Readings
1) Design and its Discontents (Nieusma's article):
    a. Why does the *process* and paradigm used by the designer matter?
    b. How do the different design paradigms relate to some of the problems in engineering we have discussed in class?

2) Emergent and Participatory Design (Spencer et al.):
    a. Spencer et al. brought up an interesting idea of emergent design, but they only showed its application in regards to the urban environment. How could your own discipline utilize such a design process? How could your artifact have incorporated an emergent design process?
    b. Ben Spencer and Susan Bolton will be joining us in class this week. Write out three questions which you would like to ask them. Make sure that at least two refer to specific parts of their chapter.

Assignment – Part Two: Redesigning Your Artifact

At this point, we have discussed many different ways that technology can have an impact on people, from displacing workers, facilitating imperialism, or disrupting ecosystems that communities depend on. You might very well be frustrated with all of the injustices we can bring up, but instead of dwelling in frustration, we want to focus your creative energy upon solutions. **This piece of the assignment will form the basis for your "presentations" on March 3ʳᵈ, from 5-7pm.**

The following is a suggested process to approach the redesign of your artifact:

I. Define the Problems.

What are the principal injustices your artifact instigates or perpetuates? (Note that this discussion needn't be necessarily only the "positive" case – i.e. *what it does* – but also the "negative" case – i.e. *what it does not do* or what it ignores.)

Review your prior reflections, and **think** about the following questions from each week:

1) What problematic mindsets does your object represent – and what are the effects of that mindset? (Week 2)
2) How does your artifact privilege or oppress different groups of people based on their citizenship (e.g. 'developed' vs 'developing world'), race, class, gender, orientation, or ability? (Week 3)
3) What social systems are necessitated to control, produce, use, or design your artifact? What social systems does it encourage? Does it concentrate power in certain hands? (Week 4)
4) What lifestyles and systems of resource consumption and ecological degradation does your artifact necessitate, facilitate, or encourage? (Week 5)
   a. Can (or should) everyone in society use and manage this artifact sustainably?
5) What kinds of economic systems (e.g. consumer capitalism) or political arrangements (e.g. the military-industrial complex) are necessitated, facilitated, or encouraged by your artifact? (Week 6)
   a. What economic interests lie behind your artifact? Is the artifact satisfying a genuine need?
6) What cultural values or dominant knowledge systems does your artifact impose, necessitate, or encourage? What forms of knowledge does it erase or marginalize? (Week 7)
7) Were those affected by the artifact involved in its design? Does its design challenge the status quo? (Week 8)

WRITE: Summarize the key injustices and how they are related to your artifact in a short paragraph. <u>You do not need to address every question above</u>, just those that are most relevant to your artifact. You can supplement your paragraph with a diagram if it is helpful. This paragraph should be accessible to a general audience (not just classmates).

II. Technical Solutions: Engineered Changes

WRITE: (1) List the constraints – the "givens" that you imagine an engineer involved in the project considered. (2) Then list the other "givens" that likely went unstated – the assumptions about market demands, social relations, political systems, cultural values, etc.

DIAGRAM: Within these constraints, attempt to *conceptually* redesign your artifact to address one or more of the key injustices you described in Part I, using the tools and techniques that would be available to an engineer and within their purview. You can target the site of your "redesign" specifically at location of parts and functionalities *within* the device, or more broadly at the level of the design process, supply chain, planning process, or disposal system. This list is not exhaustive – use your imagination and an overall optimistic view of what is possible, but stay within the realm of technological realities and the "given" constraints you list.

Be creative! This is your time to shine.

For this section, submit a conceptual diagram of your artifact, with the original design and the new modifications, or a relationship diagram of the manufacturing/distribution/disposal/etc. process, with arrows representing the material transformations involved in producing your artifact (If a diagram doesn't make sense, you can provide a written description instead.)

WRITE: Describe your changes – what they do, what effect on social justice they will have, and why.

III. Redefining the "Givens": Social Changes

WRITE: In one paragraph, describe what "givens" would you like to change in order to allow for a more just design. This discussion is naturally about the broader social, political, economic, and cultural forces and relationships. How might changing the "givens" allow for a more just design than was possible in Part II – or *eliminate the need for the artifact altogether*?

What can engineers do to change the "givens" and what must society do collectively? What might such a partnership look like?

IV. Discussion

WRITE: In one paragraph, compare and contrast the possibilities presented by technical and social changes for your artifact. What are the limits to each? How can they be complementary?

9. Organizing and Living for Change

Learning Objectives:
- Identify examples of engineers organizing, living, and working for the change they want to see
- Describe the methods and potential of alternative engineering practices and organizing inside and outside of work
- Identify ways that engineers can support social change

Readings/Media:

- **Experts and Political Action:**
    - Klein, N. (2013). How Science Is Telling Us All to Revolt. *New Statesman.*
      http://www.newstatesman.com/2013/10/science-says-revolt
- **Apartheids, Boycotts, Engineered Technologies, and Resistance:**
    - Democracy Now. (2013, December 13). "Polaroid & Apartheid: Inside the Beginnings of the Boycott, Divestment Movement Against South Africa."
      http://www.democracynow.org/2013/12/13/polaroid_apartheid_inside_the_beginnings_of
    - Journeyman Pictures (2005, October 31). "Caterpillar Bulldozer – Israel/Palestine."
      http://www.journeyman.tv/?lid=19199
    - JTA (2012, June 23). "Decision to oust Caterpillar from influential ethical investing index linked to Israeli use of tractors." *Haaretz.* http://www.haaretz.com/business/decision-to-oust-caterpillar-from-influential-ethical-investing-index-linked-to-israeli-use-of-tractors-1.440509
- **Green Bans and Worker Power:**
    - Watch first two minutes of video: http://www.greenbans.net.au/green-bans-art-walk-2011
    - Libcom.org (2006, September 10). "1971-1974: Green bans by builders in Australia."
      http://libcom.org/history/articles/green-bans-australia-construction

Optiona readings:
- **Accounts of engineers resisting in the 1960s and beyond:**
    - Wisnioski, M. (2012). *Engineers for change: Competing visions of technology in 1960s America.* The MIT Press. Chapter 5: The System and Its Discontents.

    - Riley, D. (2008). *Engineering and Social Justice* – Chapter 5.
- **More on challenging oppression in everyday life:**
    - Johnson, A. "What Can We Do?" *Privilege, Power, and Difference.*
      http://www.cabrillo.edu/~lroberts/AlanJohnsonWhatCanWeDO001.pdf
- **More details on Green Bans:**
    - Burgmann, Verity and M. Burgmann (1999). "'A rare shift in public thinking': Jack Mundey and the New South Wales Builders Labourers' Federation." Labour History (77), pp.44-63.

- **Alternative workplaces:**
  - Democracy At Work (2 min)
    http://www.youtube.com/watch?v=8xGY6Lc71ns&feature=plcp

Assignment Part One: Reflection

1) <u>General Reflections</u>
   What stories or ideas stood out to you from the readings/videos this week? What inspired you? Which methods of organizing appealed to you the most? Why? Which do you think are most effective?
2) <u>Living Your Life</u>
   a. What are the issues you feel strongly about? What things do you want to change with your life?
   b. How will you live your life, outside of your education and career, to create change? Will you participate in broader social movements? If so, in what capacity? How will your training and work as an engineer be helpful and how will it be a hindrance?
3) <u>Just Health Action:</u> We will have Linn Gould from Just Health Action (JHA) http://justhealthaction.org/ come and talk with us next week during class. JHA is a Seattle-based non-profit and Linn is a great example of an expert and scientist using their knowledge to improve the community, through education and advocacy. They have most recently been involved in the Duwamish clean-up and its effects on the local community. Check out their website and write a question or two you have for Linn, whether about her work specifically or about the intersection of scientific expertise and advocacy more generally.

Assignment Part Two: Preparing a Handout for the Presentation Forum

Building on or modifying what you created for Week 8's assignment, **prepare a short** (one, at *most* two pages) **handout** that you can give and/or show to attendees at the forum who come to your table. Incorporate the feedback you received in class.

<u>Things to include:</u> **What are the key ideas, facts, arguments, and redesign possibilities you want attendees to leave thinking about your artifact, or engineering and social justice generally?** What is surprising or exciting that you want to share with attendees?

<u>Structure:</u> While we suggest, as a starting place, that you follow the structure of part two of Week 8's assignment in creating your handout, you are welcome to structure it differently and include different themes. It can be mainly words, or mainly a diagram – whatever works best for your artifact and theme.

We can make copies of these for you and will bring them to the forum.

10. Reflections and Moving Forward

Learning Objectives:

- Reflect on your own learning in this course.
- Chart a way forward for yourself and our generation of engineers.

Readings:

- Graeber, D. (2013). "A Practical Utopian's Guide to the Coming Collapse." The Baffler. No. 22. http://www.thebaffler.com/past/practical_utopians_guide

- Riley, D. (2008). *Engineering and Social Justice*. Chapter 6.

- Hawken, P. (2009). "Healing or Stealing?" Speech delivered for the commencement of the University of Portland Class of 2009. Retrieved from http://www.up.edu/commencement/default.aspx?cid=9456

Assignment Part One: Personal Learning Journey

1. **Looking Back:** Read your old reflections and write a **one page narrative** explaining what changed in your thinking each week (including the presentation forum). A couple questions to prompt your thinking (no need to answer these precisely):
   a. How did you view engineering and your role as an engineer before? How do you view it now?
   b. What ideas have become clearer, what issues have become more complicated, and what questions are still left unanswered?
2. **Moving Forward:** What concepts or ideas interested or inspired you from this week's readings? Overall, how will carry the ideas and questions raised by this class into your work and life as an engineer and citizen in the world?

Assignment Part Two: Questions for Other Engineers

Create 3-5 thoughtful questions that you think engineers should ask themselves in their lives and work in order to further social justice. These compiled and put on the web as a resource for other students and professionals.