Global Dimensions in Engineering:
A guide to running workshops for engineering students

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Why

What

(introduction)

Much recent dialogue has addressed the engineer's role in ensuring the development of an improved worldview for academia. The workshop templates laid out in this booklet are intended to help engineering lecturers foster learning environments in which problem solvers of all types work together in complementary and progressive ways. Equipped with an improved handle on intercultural conflict resolution, ethics and development themes, technical curricula will - ideally - be rendered better able to pair together need and supply.

Workshop One: Diversity and Rights in Engineering Practice

objectives

develop respect for differences in culture, customs, traditions and how societies are organised and governed

question the notion of universal human rights

appreciate the role of engineering in supporting human rights

question the relationship between diversity, human rights and local culture
appreciate the different levels of analysis required (local, national, international)

appreciate and respect indigenous and other forms of knowledge

different and equal

Preventing Tunnel Vision in Engineering Education

This module aims to put technical problems in the context of broader intercultural relations themes. By helping uplift engineers' efforts to express compassion in the language of built form, sponsors aim to encourage a more robust and self-checking sensitivity, conducive to site-appropriate intervention.

One vital dimension to this contextual eduation is diversity-training.

Suggested warm up **exercise**: Gestalt exercise on projection (describing a table)
All participants should be asked to describe what they think of when they see a particular table. [The "table is…."] Next, try to turn responses given into 'I' statements, underscoring the subjective nature of the assignment.

Ask:

How is it that a single object can be accurately described in so many different ways?

diversity within the ranks

Diversity is a theme deeply embedded in conversations about the future of engineering. With the emergence of such schools of thought as “deep ecology,” social ecology,” and “ecofeminism,” a desire to problem-solve humbly and inclusively has gained momentum.[2]

Of particular concern to engineers might be the conspicuous disparity between numbers of men and women in the trade. As Donna Riley puts it, “We have to drive beyond the superficial when it comes to sexism in engineering, to consider how the field is constructed and bounded based on gender, to consider how gender itself is socially constructed, and to consider how our designs are, in turn, influenced by all of these.”[2] There are also alarmingly few non-white engineering students entering the profession, and experience shows that professors can have a significant influence over how comfortable unconventional students feel in engineering programs.[2]

A greater respect for the diversity of distinct career paths available to engineers is also requisite for the community to progress in a balanced way. One may ask, how might professionals emerging from completely different cultural or socioeconomic backgrounds approach an engineering problem differently?

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“Some college-level institutional problems are addressed in admissions policies and scholarships, but only a few have suggested changing the field itself, changing curriculum content, or changing classroom pedagogy and climate.”[2]

-Donna Riley

Debate in groups of four:

Do we want the career progression of engineers and engineering academics to be the same?

What changes if we allow for diversity of values?

How can we encourage diversity to be rewarded in academia and in engineering companies?

What can be done to value those whose work deviates from the status quo?

multiculturalism

Incorporating different views of the world is a vital part of helping the field of engineering evolve into greater diversity. Often we don't want to believe that we have been trained to think in a certain way and we want to believe we are 'open'. However, whereas Western culture tends to place a greater value on personal agency, many indigenous peoples emphasize collective thinking. These are completely different approaches and often lead to misunderstanding.

Key terms to consider:

- 'common sense'

There is also the 'common sense' hegemony: the assumption that everyone shares the dominant ways of thinking (i.e. of course we must try to make money!). However, what we think of as common sense is not common, and this is the most important realisation in diversity training. In engineering there pervades a more narrow definition of this 'common sense.'

- 'globalisation' vs. 'internationalisation'

Globalisation is not internationalisation. Globalisation is a politically-charged economic idea, whereas internationalisation can be viewed as a more innocent term about experiencing other cultures.

indigenous ways of knowing

Ask: What aspects of Western modern science do we see in engineering? What examples might there be of engineering within other knowledge systems? How could we incorporate these within engineering curricula?

In *The Cultural Divide in Science Education for Aboriginal Learners* we learn that there is a need for bridging Western and aboriginal modes of understanding the world in order for individuals from both cultures to successfully collaborate in scientific settings[3], and in "Globalization and Science Education," Cassie Quigley explores in detail the continued relevance to Western culture of native, local ecosystem knowledge after a period of colonization.[4] But what is so different about the ways in which non-western thinkers perceive and process the world?

Ms. Quigley further relates that the relational and collective processes through which aboriginal peoples construct societies are starkly different than their Western counterparts' methods. She states that "even though the indigenous youth are able to function adequately in their fragmented world, science educators need to tap into the important resource of indigenous people and realize the vast knowledge base of science they use in their daily life."[4] Encouragingly, at the 2010 Aboriginal Science Imposium, efforts to recruit Aboriginal students into university programs, nursing jobs and other science-based work positions as a means of interjecting such environments with place-based expertise were detailed.[5] Hopefully, such newcomers will be welcomed to share cultural perspectives on science and engineering as well.

Ask: When minorities enter engineering education, how do we assess them given what we now know about diversity, knowledge systems and issues of meritocracy? If we really want to create engineering products and system which are suitable for the diversity of people in the world, how we do assess and applaud different ways of thinking and being?

(**workshop session one** notes)

diversity of project work

Not only is the encouragement and maintenance of a variety of worldviews important to the health and sustainability of the field of engineering, by helping to improve the profession's ability to communicate internally, engineers are freed to collaborate with a broader variety of cultures and outside disciplines. Such diversification benefits engineers and their clients alike.

In Engineering and Social Justice, Donna Riley reminds us that "the linkages from engineering to racism and colonialism must surely limit the attractiveness of the field for anyone who does not support those ends."[2] Not everyone who passes over the opportunity to become an engineer does so out of a lack of interest or ability in the field. In order to attract a broader array of talent to the profession, current practitioners and educators might do well to consider exposing potential students to a broad array of potential opportunities to make constructive contributions post-graduation.

"The ideal of happiness for indigenous people is often described a life shared within a harmonious social network."

-Cassie Quigley[3]

Ask:

How can universities do a better job of opening students' eyes to opportunities to honor minority traditions through engineering?

In a field sometimes characterized as "militaristic," how can universities do a better job of learning from students how to channel their expertise into a more cohesive, peace-building force?

1 http://www.rachelcarson.org/ accessed on July 28 2011

2 Riley, Donna. “Engineering and Social Justice.” Morgan and Claypool Publishers. 2008: 13+

3 Canadian Council On Learning. “The Cultural Divide in Science Education for Aboriginal Learners” 2007: 1 – 12.

4 Quigley, Cassie. “Globalization and Science Education: The Implications for Indigenous Knowledge Systems.” International Education Studies. Vol. 2, No. 1 2009: 76 – 88.

5 JC Kulig, M Duke, J Solowoniuk, R Weaselfat, C Shade, M Lamb, B Wojtowicz. “Aboriginal Science Symposium: Enabling Aboriginal Student Success in Post-Secondary Institutions.” The International Electronic Journal of Rural and Remote Health Research, Education, Practice and Policy. 2010: 1 – 7.

6 Engineers Against Poverty & International Alert (2006) Conflict-Sensitive Business Practice: Engineering Contractors and their Clients (pdf)

7 Procedural justice and a constructive approach to negotiating with stakeholders, ppt presentation UWA, 2010 (ppt)

8 Caroline Baillie ‘Threshold Concepts’ (Word)

9 Reed B.J. (ed) (2007) Infrastructure for All WEDC, UK. Download for free from http://wedc.lboro.ac.uk/knowledge/bookshop.html


collaboration
conflict

workshop two (engineers working with conflict)

objectives

move beyond a dualistic outlook / world view to better understand conflict

appreciate that conflict is often inherent in engineering design, it is part of what is ultimately a social and ambiguous project

be respectful, empathetic and tolerant and enter into dialogue, negotiate, compromise and collaborate

appreciate the engineer’s role in conflicts and how this may limit their ability to resolve them

consider situations where conflicts should not be resolved

identifying and building upon common ground

It is vital, when working to set the stage for amicable, productive and progressive dialogue, for facilitators to establish a working environment as free as possible from judgement, suspicion and bias.

Encourage participants to consider others' points of view, be willing to recalibrate previously-held assumptions, speak openly, ask questions and treat other stakeholders with respect.

is conflict always bad? (constructive resolution strategies)

procedural justice

focuses on finding a solution that maximises one's own gain
opportunities for participation (voice)
consideration of the stakeholders's views
the neutrality of the forum
the trustworthiness of the person enacting the process
the degree to which the procedure is dignified, polite and respectful.

positional negotiation

less time-consuming
less preparation required
may offer acceptable short to medium term solutions
useful in one-off situations (no relationship)
risk averse and protects own interests
simple and efficient
good in situations of difficult communications, high conflict or distrust

interest-based negotiation

stakeholders educate one other about their interests and then jointly problem solve on how to meet those interests.

suggested exercise:

Print a large letter “W” on a piece of paper and set it on a large table. Instruct participants to sit around the symbol and to contrast their perceptions of it based on their respective points of view.[4]

identifying and overcoming roadblocks to understanding & types of "troublesome knowledge"

from Caroline Baille's *Threshold Concepts*[3]

ritual (meaningless procedures and mimicry)

inert (not integrative or practical in "real life")

conceptually difficult (often riddled with inaccurate assumptions)

alien (counterintuitive)

tacit (place-specific and inaccessible to outsiders)

poorly expressed (evolved over time in silo-specific jargon)

Ask participants to consider a familiar engineering project in the context of a conflict situation. Discuss how a context of this sort is likely to affect the professional's work and how the presence of an engineer could affect the resolution (or escalation) of a place-specific conflict.[5]

addressing practical needs and strategic interests[4] from multiple points of view

It is vitally important for engineers to understand the long-term implications of the implementation of their designed interventions. Who and what is this system likely to effect, and for how long? How do you know?

Consider: Direct and indirect human, social, economic, environmental and political costs[1], as well as the means by which an engineer might be expected to determine these.

One indispensible tool a good engineer is likely to employ in preparing to formulate a design solution is a stakeholder engagement assessment. In Engineers Against Poverty's *Conflict-Sensitive Business Practice*, we read that "Early, consistent, meaningful and empowering stakeholder engagement processes lie at the core of [conflict-senstive business practice."][1]

Suggest that participants review pages 19 - 20 from Brian Reed's and Sue Coates' *Developing Engineers and Technicians* and ask: what steps could be taken to ensure that all skateholders are heard (and are listening) in this scenerio?

(**workshop session two** notes)

Review the Global Dimensions PowerPoint document entitled "Procedural justice and a constructive approach to negotiating with stakeholders."[2] Ask participants discuss what procedural justice entails. What are the likely effects of a process in which this type of justice is attended to?

(**workshop session two** notes)

what causes conflict?

from Engineers Against Poverty's *Conflict-Sensitive Business Practice*[1]

***Structural/root causes**: Pervasive factors that are built into the policies, structures or fabric of society and may create the preconditions for violent conflict (e.g. illegitimate government, lack of equal economic and social opportunity, lack of political participation).*

***Proximate causes**: Factors that are symptomatic of the root causes of conflicts or may lead to further escalation (e.g. light-weapons proliferation, human rights abuse, objectives of political actors, role of diasporas).*

***Triggers**: Single acts, events or the anticipation thereof that precipitate violent conflict or its escalation (e.g. elections, behavior of political actors, sudden collapes of currency, increased food scarcity).*

Essential Pre-course Reading

1. Engineers Against Poverty & International Alert (2006) Conflict-Sensitive Business Practice: Engineering Contractors and their Clients (pdf), page 4-5.

2. Procedural justice and a constructive approach to negotiating with stakeholders, ppt presentation UWA, 2010 (ppt)

3. Caroline Baillie 'Threshold Concepts' (Word)

4. Reed B.J. (ed) (2007) Infrastructure for All WEDC, UK. Download for free from http://wedc.lboro.ac.uk/knowledge/bookshop.html. p. 50

5. Secion 5 workshop plan

Additional reading

6. Nadja Marie Alexander and Jill Howieson, Negotiation: strategy, style, skills, 2010, Butterworths, Sydney (reference only)

7. Ratnajeevan, S., Hoole, H., Viewpoint: Human Rights in the Engineering Curriculum, Int, J, Engng Ed. Vol 18, No 6, pp618-626, 2002 (reference only)

8. Hamdi N (ed) 1996 Educating for Real: the Training of Professionals for Development Practice IT publications. London UK

9. Reed, Brian and Coates, Sue. "Developing Engineers and Technicians." WEDC, Loughborough University. 2007: 30-32.

10. Howieson, Jill (2002) "Procedural justice in mediation: an empirical study and a practical example," ADR Bulletin: Vol. 5: No. 7, Article 1. Available at: http://epublications.bond.edu.au/adr/vol5/iss7/1

considering long-term and far-reaching consequences of physical intervention

workshop three (development)

objectives

question assumptions surrounding terms such as such as ‘developing’ and ‘third world’ and appreciate the contemporary discourse on the ‘Global South’.

question the role of international organisations such as IMF,World Bank and WTO, as well as governments and NGOs and their impact on engineering practices in developing countries

appreciate the discourse on local versus global and the need to develop local solutions, local technology and local markets where possible

critique the role of engineering in relation to the Industrial Revolution and other historical contexts which affect contemporary process and practices in the North and South.

identify the role of labour in engineering practice and question global labour market practices

characterise the relationship between state policy and technology development

to an engineer, what does development really mean?

Simply considered, development to mean progress, but the barometers different cultures use to measure societal gains vary widely. Generally speaking, when considered in the context of international relations, development involves improvements in a state's ecomonic, social and - increasingly - environmental health. As Donna Riley puts it, "Most commonly, development is understood as historical progress tethered to material advancements serving national strategies that promote economic growth. But development can also be tied to social objectives that enhance participatory democratic processes and empower people to gain a measure of autonomous control over their own lives."[1]

The question for us is how we can use our unique skills set to most effectively support and contribute to a sensible way forward for a diversity of peoples. Vesilind asserts that, in the past, engineers have relied on the directives of politians and companies to guide the direction of their work.[1] But is the relegation of ethical due diligence to corporations and political parties wise? Has it been effective so far? This module will address the importance of putting our work into context so that we know when to say no and when to suggest alternative courses of action.

where do engineers fit in a globalized world economy?

Societal engineering is not just effected by government and corporate or "top down" forces. Embedded in even small-scale engineering projects are values placed on human and non-human resources. Two schools of thought regarding the way in which development projects ought to be approached by designers represent completely different paradigms. The more simplistic, called "constrained growth," seeks to limit industrial development without regard for a broader context of ecological processes whereas the other, called "strong sustainability," takes into account a deeper understanding of indispensable, interrelated systems.[3] It is important to help engineering students understand the strengths and weakenesses of both approaches.

Ask: What is development? Initiate a "fishbowl" exercise with observers. In this scenerio, a group of "fish," or stakeholders, sit in the middle of a crowd and discuss a problem. Observers sit around the speakers and take note of the primary arguments being made. They summarize these at the conclusion of the discussion and note where the conversation made decisive turns. With participants, use this exercise as a springboard from which to discuss team dynamics.

concepts of government in “the informal economy”

from *Competing Perspectives on the Latin American Informal Sector* by A. Portes and A. Schauffler[1]

dualist Identification of the informal and formal economies as two distinct entities with limited interaction Less concerned with government regulation of the informal sector, and more with available business and social support programmes

legalist Advocates economic deregulation based on the damage state- regulation can do to informal workers’ abilities to move into the inaccessible and self-preserving formal arena

structuralist Recognises intrinsic and potentially damaging links between formal and informal economies;

Focuses on the responsibility of the government to intervene and protect vulnerable informal workers at risk of exploitation or marginalisation by private corporations

Ask participants to read *The Stranger's Eyes* on page 88 of *Engineering and Sustainable Community Development*.

Consider: What could Pierre have done differently to avoid offending the Malian people he had intended to help? Should have Pierre been involved in the villages' affairs in the first place?

how is community defined?

from Engineering and Sustainable Community Development by Juan Lucena, Jen Schneider and Jon A. Leydens[3]

1. **Relationships among its members**. *Belonging to a community means being involved with the other members of that group in some way (Mathie and Cunningham, 2008, p. 7). This may seem obvious, but it's important to realize that the nature of these relationships can be highly variable. Relationships might be new and weak, as in the case of a group of people of different backgrounds coming together for the first time after a disaster (e.g., a tent city created after a hurricane) or old and strong, as in the case of a people from a village with ancestral attachments to each other. In either case, development projects should aim for respecting and strengthening these relationships.*

2. **A relationship with place**. *"Place" is loosely defined. Frequently, members of a community identify with a particular geographical place (like a village or city) where they are from or where they live. But the place can also be virtual (like an online space, or a women's organization; Mathie and Cunningham, 2008, pp. 6-7).We argue that development projects should aim for respecting and strengthening this relationship to place.*

3. **Differences in power and privilege**. *These differences could vary in degree, from small—as when dictated by slight status difference—to very significant, as when shaped by a combination of socio-economic status, gender, race, and caste. In any event, development projects should aim for respecting these differences even when they might seem to go againstWestern ideals of equality.When a particular subgroup of the community appears to be oppressed, it is not the role of theWestern "expert" to relieve them of this oppression but rather to facilitate their seeking alternatives if the members of the subgroups desire to do so (see also Guijt and Shah, 1998/2001, p. 8; Chambers, R., 1997, pp. 162–187).*

4. **Alliances with a common purpose or purposes**. *Communities may come together for a variety of reasons, whether for commerce, kinship, entertainment, or political cause.The rate of participation in these purposes may vary, depending on the needs and desires of individuals involved (Mathie and Cunningham, 2008, p. 7). Development projects should aim for awareness and understanding of these purposes.*

(**workshop session three** notes)

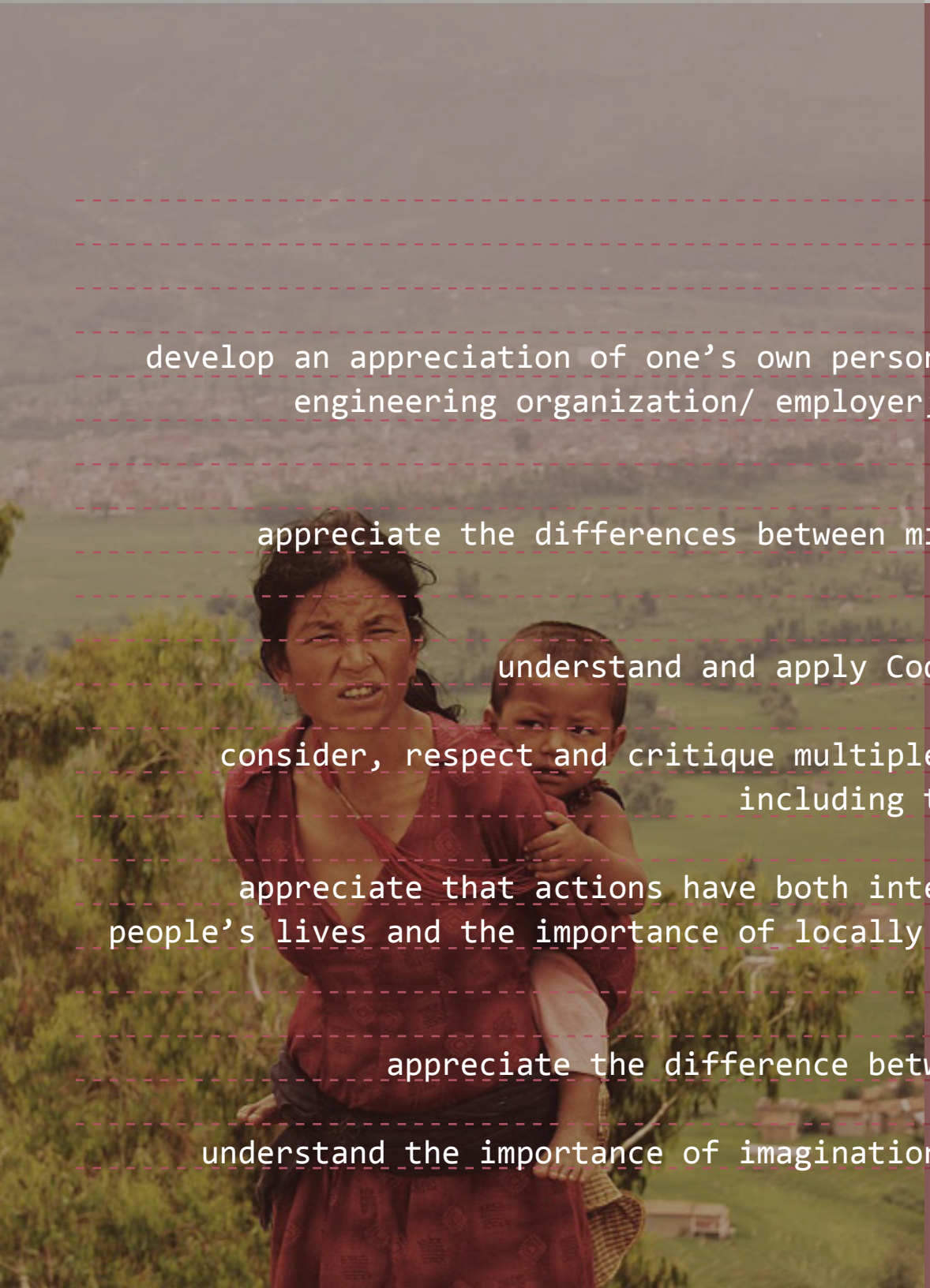
suggested texts + works cited

1 Baillie, Caroline, Feinblatt, Eric, Thamae, Thimothy and Berrington, Emily. “Needs and Feasibility | A Guide for Engineers in Community Projects *The Case of Waste for Life*.” Morgan and Claypool Publishers. 2010: 1 - 66

2 Reader, John. “Globalization, Engineering and Creatvity.” Morgan and Claypool Publishers. 2006:

3 Lucena, Juan, Schneider, Jen and Leydens, Jon A. “Engineering and Sustainable Community Development.” Morgan and Claypool Publishers. 2010: 33-34, 86-87


what (& who) should practicing
engineers be keeping in mind?



workshop four (ethics)

objectives

develop an appreciation of one's own personal values as well as those of one's engineering organization/ employer; decide on priorities in respect of differences in value systems

appreciate the differences between micro and macro ethics in relation to engineering practices

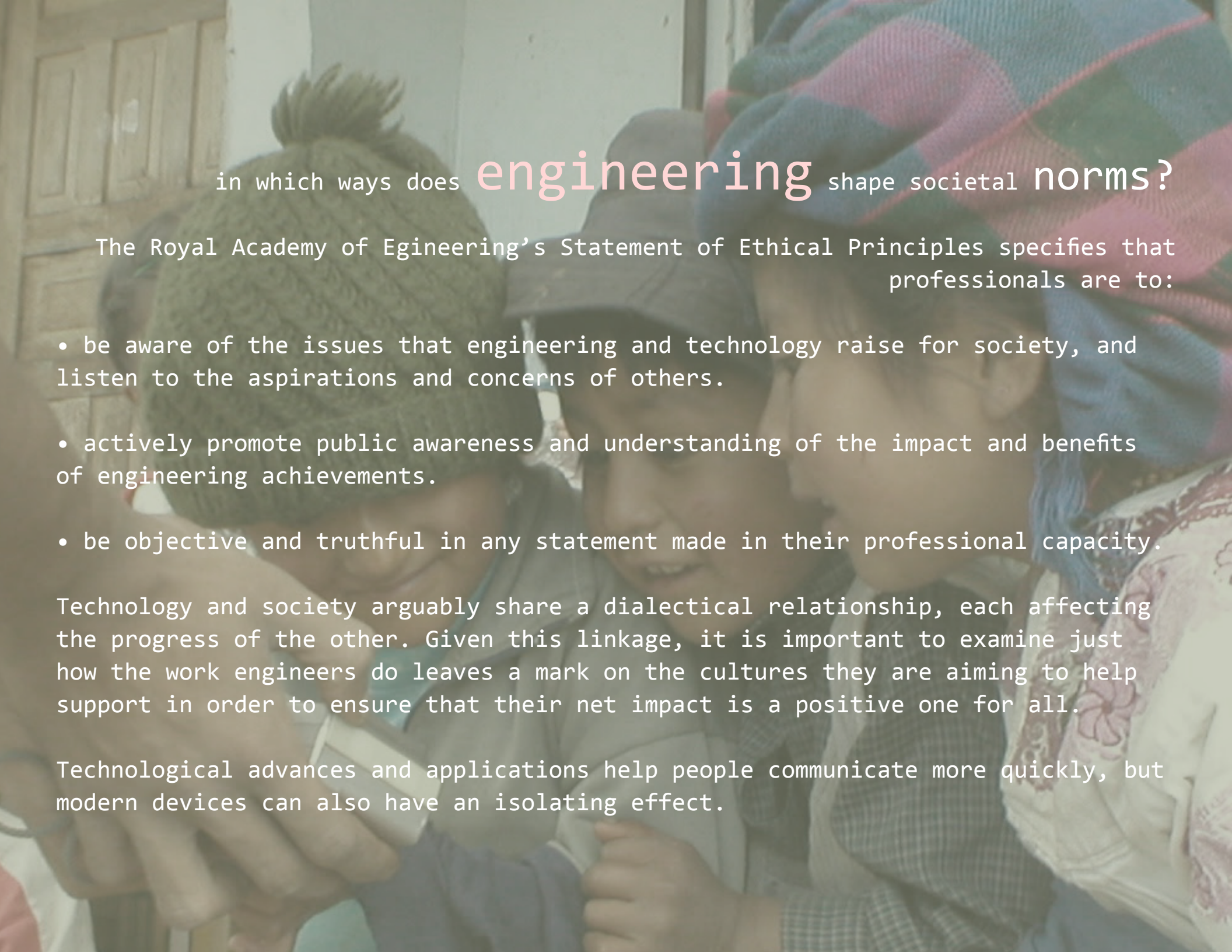
understand and apply Codes of Ethics in practical scenarios

consider, respect and critique multiple values, attitudes and perspectives including those of engineers and non engineers

appreciate that actions have both intended and unintended consequences on people's lives and the importance of locally negotiated, participatory decisions about engineering practices

appreciate the difference between legal systems and ethical codes

understand the importance of imagination, and of making connections between apparently unconnected cases



in which ways does engineering shape societal norms?

The Royal Academy of Egineering's Statement of Ethical Principles specifies that professionals are to:

• be aware of the issues that engineering and technology raise for society, and listen to the aspirations and concerns of others.

• actively promote public awareness and understanding of the impact and benefits of engineering achievements.

• be objective and truthful in any statement made in their professional capacity.

Technology and society arguably share a dialectical relationship, each affecting the progress of the other. Given this linkage, it is important to examine just how the work engineers do leaves a mark on the cultures they are aiming to help support in order to ensure that their net impact is a positive one for all.

Technological advances and applications help people communicate more quickly, but modern devices can also have an isolating effect.

Ask participants to try to think of a single product that is totally free of an insight into the society in which it was produced. Is this possible?

h

what is “deep morality” and how can it be applied to the ethical solution of engineering problems?

In Engineering Ethics, George Catalano reminds us that “in biology or ecology, community refers to an interacting group of various species in a common location... Extending the notion of community in this way is consistent with the pattern evidenced in human society over the centuries.”[1] Through the lens of the intricate ecological system, it is perhaps easier to conceive of social, economic and ecological forces as being both interconnected and interdependent. When an engineer, therefore, designs a physical intervention - even at a very small scale - it is likely that his or her choices will affect the well-being of numerous people and ecological networks. Catalano adds that “a shift to a morally deep world-view in engineering would have a profound impact on the sense of ethical responsibility that the engineering profession would embrace.”[1]

Ask participants to consider which types of contextual systems they think need to be accounted for when formulating the solution to an engineering problem. How can the profession better streamline the process of interrogating the motves behind - and the potential impact of - future projects?

Instruct participants to imagine the following scenerio from Caroline Baillie's ethics PowerPoint presentation:[3]

You are the manager of the division which makes a new control module for X car company which is intended to cut down fuel consumption. This is part of a strategy to reach a lower income bracket consumer and ultimately sell more cars. What are the potential impacts of this new development on society and the environment?

gauging values

Before an engineer can effectively improve her or his ability to operate harmlessly and sensibly within the context of ecological, economic and social systems, s/he needs to recognize and evaluate her own system of values.

Ask participants to consider what they think their strategies in the previous exercise reveal about their own personal values. Consider referencing the "Emergent themes" and emergent values" handouts as analysis tools. Use questions such as:

What is the main aim of your work?

What is the potential impact of your work both positive and negative?

How might the source of funding for your work affect what do you do and how you do it?

If you do not know how your work will be used, does it matter?

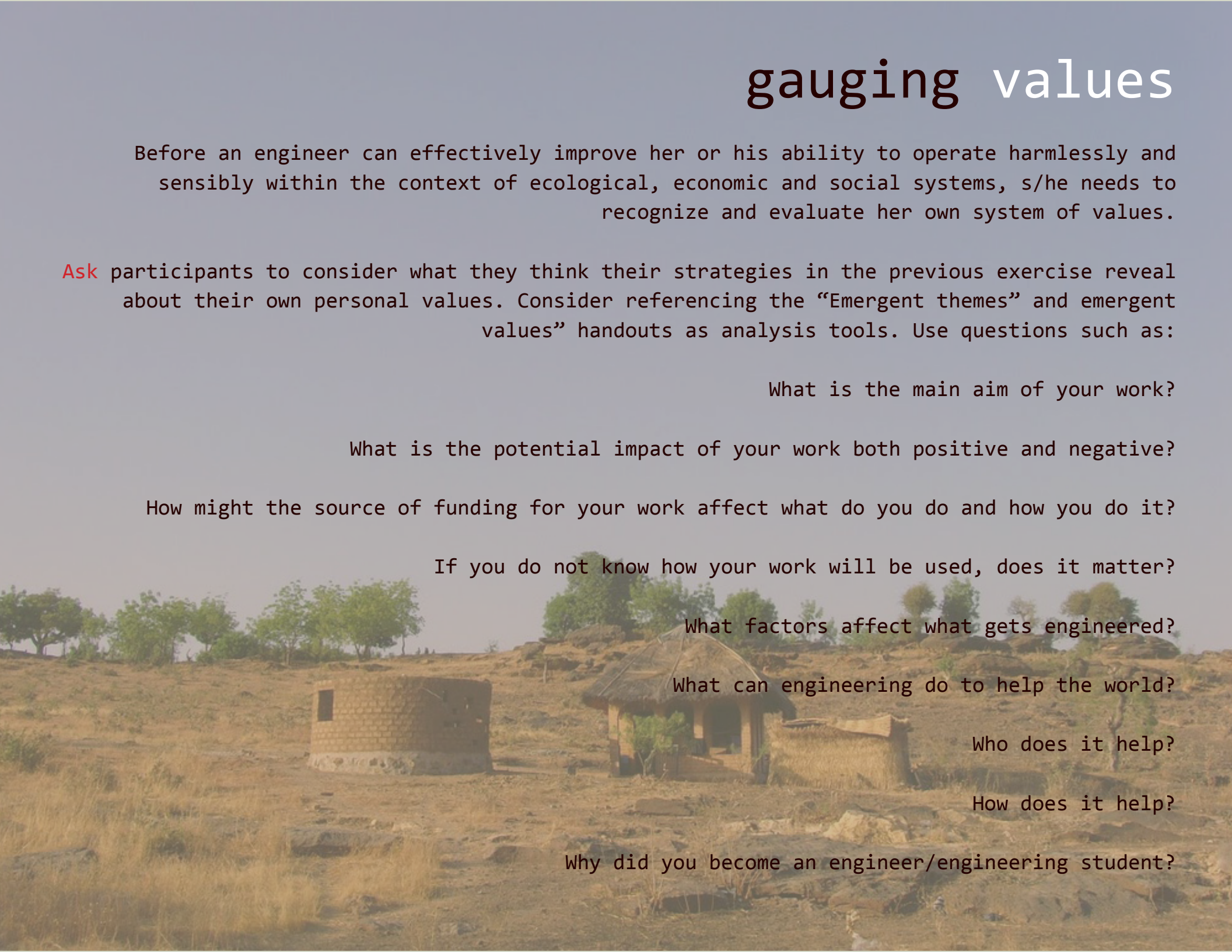
What factors affect what gets engineered?

What can engineering do to help the world?

Who does it help?

How does it help?

Why did you become an engineer/engineering student?



what is a participatory code of ethics?

In *Engineering and Society: Working Towards Social Justice*, Caroline Baillie points out that "it is now largely considered irresponsible to blame the boss for decisions. They may be doing terrible things but you don't have to work for them."[4] Engineers are responsible for the impact they have on the world around them. More than ever, it is incumbent upon the professional to ensure the work s/he is doing is in line with a code of ethical behavior. Later in *Engineering and Society*, Baillie reminds us that "engineers contribute more than possibly any other profession (apart from business itself) to the movement of capital throughout the world which causes all developing countries to become increasingly market driven. These are what we need to guard against, are responsible for and can do something about."[4]

Instruct participants to read The Institution of Mechanics' Code of Ethics, as well as the ICE Code of Professional Conduct, and ask that they collaboratively generate a brief group covenant covering similar topics.

(**workshop session four** notes)

Ask participants to read the grape workers case study on pp. 47 - 51 of *Engineering Ethics* and consider the questions provided by Ursula Franklin on page 26 of *Engineering and Society*.[2] Did the project:

1) promote justice?
2) restore reciprocity?
3) confer divisible or indivisible benefits?
4) favour people over machines?
5) minimize or maximize disaster?
6) promote conservation over waste?
7) favour reversible over irreversible?

suggested texts + works cited

1 Catalano, George D. “Engineering Ethics: Peace, Justice and the Earth.” Morgan and Claypool Publishers. 2006: 34

2 Riley, Donna. “Engineering and Social Justice.” Morgan and Claypool Publishers. 2008: 26

3 Royal Academy of Engineering Statement of Ethical Principles

4 Baillie, Caroline. “Engineering and Society: Working Towards Social Justice | Part I: Engineering and Society.” Morgan and Claypool Publishers. 2009: 74, 81

5 Baillie, C., An approach to explore values in education and practice , 2009, talk and ebook chapter http://learningtobeprofessional.pbworks.com/Caroline-Baillie (handout)

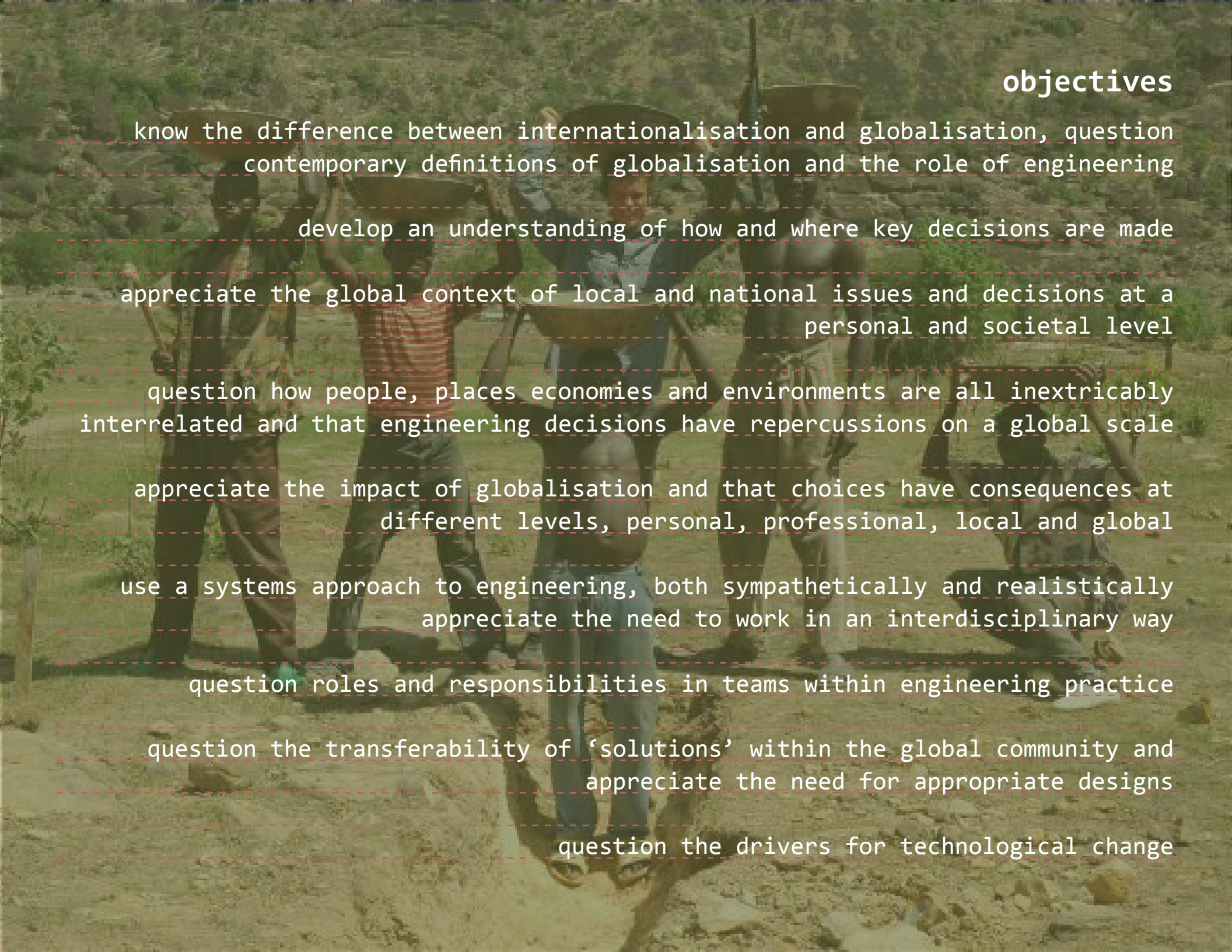
6 Caroline Baillie, Engineering and the Public, in ‘ Engineering and Society: working towards social justice, pp 29-67 2009, Baillie and Catalano, Morgan and Claypool (handout)

7 The Institute of Mechanical Engineers Code of Conduct (handout)

8 The Institute of Civil Engineers Code of Professional conduct (handout)

9 Questionnaire and selected responses categorised from raw data related to page 7 (handout)

Workshop Five: **interdependence** and global professionalism in engineering



objectives

know the difference between internationalisation and globalisation, question contemporary definitions of globalisation and the role of engineering

develop an understanding of how and where key decisions are made

appreciate the global context of local and national issues and decisions at a personal and societal level

question how people, places economies and environments are all inextricably interrelated and that engineering decisions have repercussions on a global scale

appreciate the impact of globalisation and that choices have consequences at different levels, personal, professional, local and global

use a systems approach to engineering, both sympathetically and realistically appreciate the need to work in an interdisciplinary way

question roles and responsibilities in teams within engineering practice

question the transferability of ‘solutions’ within the global community and appreciate the need for appropriate designs

question the drivers for technological change

understanding and synthesizing global and local systems

How should an individual's right to wealth be determined? (a summary of some fundamentally different opinions from Engineering ... Peace, Social Justice, Sustainability, Security[1])

Utilitarian view: "'a given amount of wealth will produce more total happiness if its spread out more evenly' (Gensler, 1998, p165) and for those already rich a little extra does not make as much difference as for the poor."

Nonconsequentialist view: "question[s] whether if one family gets more pleasure out of a given amount of money, that it should get more money.

Rawlsian view: "equal liberty and the difference principle – that society should promote distribution of wealth except for inequalities that serve as incentives that benefit everyone.

Nozick's "**entitlement view**": "Whatever you earn should be yours."

ASk participants to consider whether any of the preceding models appeal to them as engineers and whether

(**workshop session five** notes)

Instruct participants to read the Lesotho case study on pp. 19 - 32 of *Engineering ... Peace, Social Justice, Sustainability, Security* and ask them to consider whether they think intervention in the community's building material supply chain was wise in the first place. Was enough contextual information taken into acocunt?

“global” vs. “local”

Interdependence is a fundamental notion in the realization of balance between place-specific information and broader economic forces. As so much knowledge relevant to the ethical development of societies relates precisely to local customs and resources, it is important that this knowledge be respected and, when appropriate, shared.

One arena in which the local-global dichotomy is most important to consider is in production cycles for consumable goods. Here it is obvious how vital local knowledge is to the sustainable harvesting and reuse of items such as food and recyclable products. Because traditional and place-specific knowledge can sometimes be considered less valuable, it is helpful to help instill in students a respect for non-scholastic learning.

Consider tying to track an item from cradle to grave. Who is involved? Which countries? What are the potential impacts? What impact does a product have on a local community?

Ask participants to examine their clothing labels. Does each know what resources were consumed and/or reused in the production and transportation of each product? What might have been the working conditions of the factory workers employed?

Ask: what measures might be taken to make the processes involved in the production of internationally-exchanged goods more transparent?

global economies and the development of a social justic index (SJI)

The world's economy continues to become more and more interconntected, but some question whether the trend of business streamlining is leaving vital communities out of the process of development.

Ask participants to consider whether they agree with the principle of free trade. What ethical restrictions on free trade might an engineer need to keep in mind?

What are the advantages and disadvantages of globalization for engineers?

Instruct participants to read the Coca Cola case study and discuss.

Ask: What would you do if you were engineer working in Kerala for the bottling plant?

(**workshop session five** notes)

Ask participants to form two to three-person teams to develop a quality of social justice index (SJI) modeled on the development of the EU's QOL (Environmental Quality) measure for the environment. (Please reference the following page.) Their models must identify at least 5 properties similar to the way the QOL identified the various Y properties.Using available data, each team should develop a model which calculates the social justice index (SJI) based on properties it has identified as important.

Theoretical Foundation:

The following theoretical framework has been applied in the case of EU member countries. To compute the environmental quality, EQ, for each EU member state, the following variables of the natural environment of a country were available and considered:

Y1,i: Emissions of traditional air pollutants in kgs per 1,000 people
Y2,i: Fresh water recourses per capita
Y 3i: Annual internal renewable water resources per capita,
Y4,i: Wilderness area as a % of total land area,
Y5,i: % of national land area protected for wildlife and habitat,
Y6,i: Endemic flora as a % of total,
Y7,i: Number of botanical gardens,
Y8,i: Forest area as a % of land area,
Y9,i: Average annual deforestation,
Y10,i: Municipal waste generation per capita
Y11,j: Industrial waste per unit of GDP (tons per million US$),
Y12,i: Hazardous and special waste generation (metric tons per km2),
Y13,i: Waste paper recycled as % of paper consumption,
Y14,i: Average annual fertilizer use (kgs per hectare of cropland),
Y15,i: Average annual pesticide use (metric tons of active ingredient)

The environmental quality can be defined as follows:

QOL = Σ (wk aki) / Σ (wkj)

for i = 1,2,…m

where aki is the kth environmental characteristic of region i, wk is the weight for the characteristic k, N is the number of environmental and other characteristics considered, and m is the number of regions being examined. The weights wi can be all equal to 1/N or be assigned a-theoretically using principal component or survey results. However, in all cases the weights should be the same across regions, that is, they should not be indexed by *i*.

multiculturalism and globalisation

One definition that Merriam Webster gives for culture is “the set of shared attitudes, values, goals, and practices that characterizes an institution or organization.”[2] Because it can be difficult to discern the characteristics of a culture from within, it is sometimes helpful to interrogate the degree to which our words, products and actions are charged with unintended meanings.

Invite participants to consider what culture is to them. How is it transferred? Reproduced? Embedded? Passed on? Ask them to try to think of an engineered item that carries culture with it. US? UK? Lesotho? Can they imagine a neutral item? What would it look like and why?

(**workshop session five** notes)

How can we benefit educationally from globalisation? What lesson structures can make use of global diversity?

suggested texts + works cited

1 Baillie, Caroline, Nieisma, Dean, Riley, Donna and Catalano, George D. *Engineering ... Peace, Social Justice, Sustainability, Security*. p. 17

2 “culture.” Merriam-Webster.com. Merriam-Webster, 2011.Web. 17 August 2011.


engineering and **social justice**

workshop six (social justice)

objectives

question assumptions and ‘common sense’ and appreciate that ‘our’ way is not the only way

critique the different models of human rights, ethics, justice and freedom as ways of questioning values in society

support ‘at risk’ marginalised groups affected by engineering projects

recognise the impact of unequal power and access to resources including engineering services

critique the difference between charity and social justice and their relation to engineering practices

appreciate feminist perspectives on technology

analyse the relationship between technology and racialisation

consider alternatives to oppressive management practices

appreciate the importance of needs analysis and participatory design

how might we define social justice?

Definitions of social justice are just about as variied and nuanced as the field of engineering itself, but common threads include:

- the equality of all human beings[3]

- the rights all people to basic necessities as food, clothing and shelter[3]

- the importance of responsibly stewarding the natural environment[3]

Ask participants to review the definitions of social justice listed by Donna Riley on page 4 of *Engineering and Social Justice*. Do students agree or disagree with the requirements described? What, if anything, is missing?

what about the engineering mindset helps us seek social justice? (and what doesn't?)

An engineer might well get into the field out of a desire to put her or his skills to use where they are most needed. It is natural for engineers to be helpful to others. The ways in which we are trained to channel this desire and ability, though, can sometimes steer us away from supporting what may be termed genuine social justice.[3]

Ask participants to read sections 2.2 and 2.3 of Engineering and Social Justice and ask them to consider what, if any, effect they consider engineers' professional relationships with governments and corporations have on their ability to direct their expertise where it is most needed. Next, ask the group to discuss how a curriculum which privileges quantitative knowledge over qualitative thinking shapes their abilities to promote social justice effectively.

(**workshop session six** notes)

appreciating a variety of perspectives

(why is it so important to work together?)

What is teamwork in the field of engineering? In *Engineering and Social Justice*, Donna Riley questions how directly applicable the traditional, game-based notion of team play is to engineering practice (see page 115).[3] Ask students to read section 4.8.3 of *Engineering* and discuss the following questions:

- How might a model based on interpersonal or team competition be transformed into a paradigm more condusive to collaboration?

- How might a team be more deliberate about including female and non-white members?

- What might be an effective way to identify and capitalize on each team member's individual strengths and capacities?

- How might a team make sure that every member has a voice in the decision-making process?

Hegemony and common sense

In *Heterotopia*, Caroline Baillie John Reader and Jens Kabo remind us that "If engineers blindly accept, and do not question the "common sense" that they work within, they will be part of a thought collective that they were not even aware of. All too often engineers are not in a position to do this critical questioning as they did not learn the skills in school."

In groups of three, ask participants to consider: what is common sense to an engineer? What is common sense in our engineering classes? Create a mind map of common sense values. Label the links as assumptions. What are hegemonic values? What might an alternative mind map look like?

(**workshop session six** notes)

how are ethics and justice related?

(and how is an engineer to address the world's multiplicity of perspectives?)

Personal and professional ethics are inextricably related and are communicated implicitly by the projects engineers and engineering firms choose to take on. It is therefore vitally important for individuals to independently understand the motive behind - and the likely impact of - the work they do. In taking this type of initiative and responsibility, one is better able to ensure that her actions are actually helping to improve the lives of others, as well as the engineer herself. Ask participants to read secion 1.2 of *Engineering* and discuss:

What is an "ethic of care?"[3]

How have various critical theorists historically explained the architecture of social relationships, specifically as they relate to geneder, race and ethnicity?

How might a sensitivity to these views help engineers today value their diversity and work together toward clearly-defined and constructive common goals?

Cultural Relativism

Ask participants to consider what they consider to be the difference between coersion and socialization. Is the perceived difference contingent upon region? Does it affect the legitimacy of participatory processes? What about the behavior of multinational companies?

(**workshop session six** notes)

suggested texts + works cited

1 Reader, John. “Glabalization, Engineering and Creatvity.” Morgan and Claypool Publishers. 2006:

2 ‘Heterotopia Crossing the threshold: a journey into new ways of thinking’ Baillie, C., Reader, J., Kabo, J., to appear 2011 Zero Books.

3 Riley, Donna. “Engineering and Social Justice.” Morgan and Claypool Publishers. 2008.


engineering and
sustainable development

workshop seven (sustainable development)

objectives

recognise the importance of environmental sustainability in impoverished communities as well as developed nations

critique the environmental, economic and social impact of a development and its sustainability in all three domains and appreciate the connections in relation to engineering practices

question what is being sustained and for whom with any engineering project

ensure full participation with any affected community

question whether local communities lifestyles will be maintained or improved

critique the difference between environmentalism and environmental justice in relation to engineering practice

appreciate the connections between social, environmental and economic spheres in relation to engineering practices

know the interrelationship between poverty reduction and environmental sustainability

how is environmental sustainability linked to social sustainability?

In this module, we will focus on the relatedness of responsible environmental stewardship and community. To do this, we will need to consider what it means to be a "community." Ask students to review section 4.1 of *Engineering and Sustainable Community Development*.[3]

Which constituents of a community must an engineer preparing to design an intervention consider?

Given the experience of "Pierre" in the narrative provided, how important is it for visiting engineers to have a basic understanding of a host community's social norms, customs and beliefs? (please reference *The Stranger's Eyes* on page 88 of Lucena, Schneider, and Leydens' *Engineering and Sustainable Community Development*.[3])

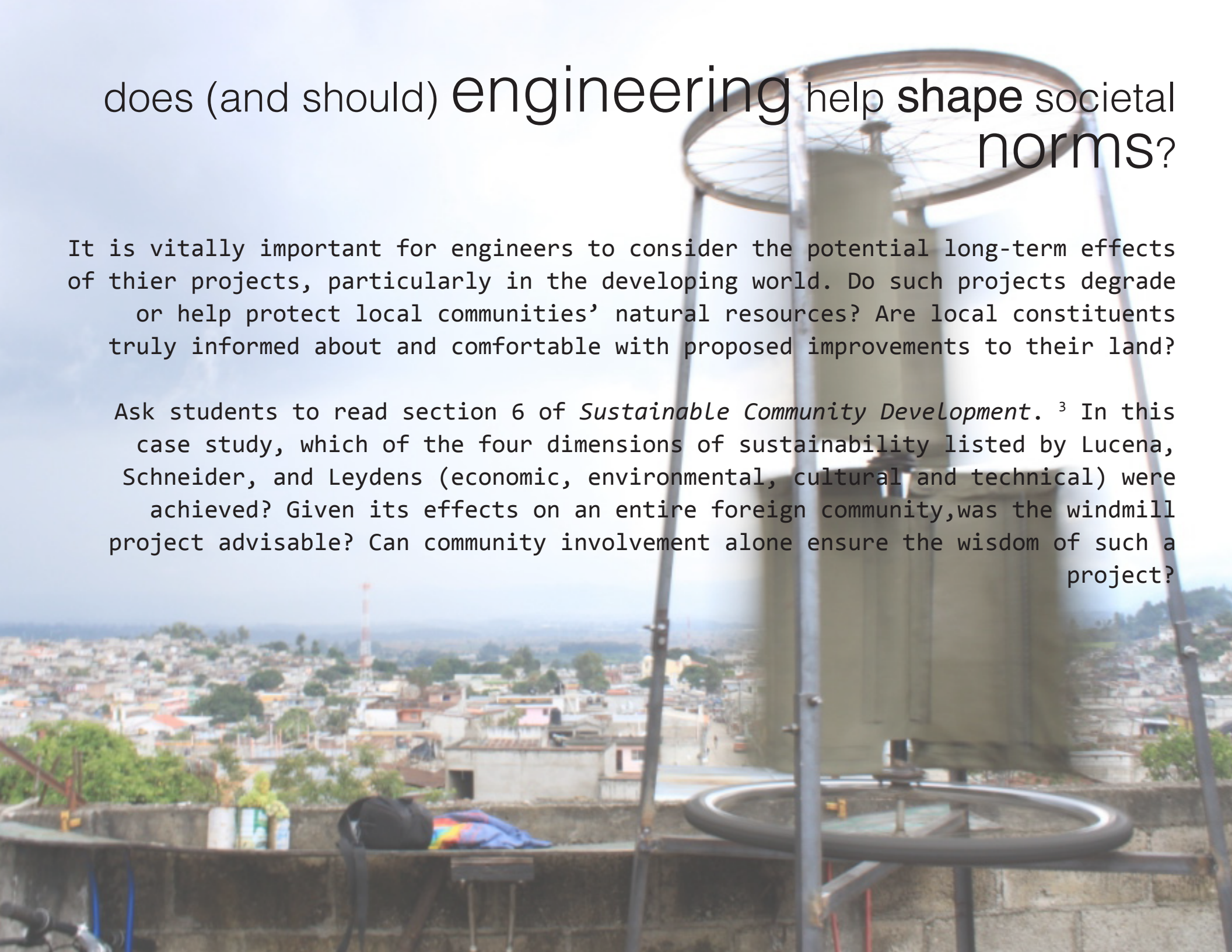
What types of cultural research should an engineer consider performing before agreeing to take on a project in a foreign culture? What questions should she ask before attempting to problem-solve?

Ask participants to consider how sustainability might be perceived differently by members of different socioeconomic groups. What does “environmental justice” mean?

does (and should) engineering help shape societal norms?

It is vitally important for engineers to consider the potential long-term effects of thier projects, particularly in the developing world. Do such projects degrade or help protect local communities' natural resources? Are local constituents truly informed about and comfortable with proposed improvements to their land?

Ask students to read section 6 of *Sustainable Community Development*. [3] In this case study, which of the four dimensions of sustainability listed by Lucena, Schneider, and Leydens (economic, environmental, cultural and technical) were achieved? Given its effects on an entire foreign community,was the windmill project advisable? Can community involvement alone ensure the wisdom of such a project?



(**workshop session seven** notes)

Instruct participants to jot down their first-impression definitions of sustainability on sticky notes. Next, group these topically and initiate a discussion of topics that come up most frequently. Do students first think of environmental, social or economic sustainability?[8]

(**workshop session seven** notes)

how can engineers **help** impoverished communities without detracting from **cultural** and **environmental** health?

This is a major challenge. Ask students to review section 9.1 of *Engineering and Sustainable Community Development*.[3] Thankfully, engineers are not tasked with implementing sustainable development initiatives all on their own. In places where intervention is determined to be advisable - close to home or not - engineers have the privilege of working with other citizens and professionals from a variety of sectors specifically focused on needs and the most effective ways to meet them.[3] Ask students to familiarize themselves with the lists of institutions and development mechanisms listed on pages 207 - 208.

What new ways can they consider offering their unique skills to the world with the help of organizational structures already in place? In what ways might they also apply these aspirations, perhaps on a smaller scale, closer to their own homes?

(**workshop session seven** notes)

Divide participants into groups of threes and instruct them to consider and analyze the sustainability of the “iPhone” using Ursula Franklin’s table prototype below.[5,8]

	who benefits?	who pays?
social		
environmental		
economic		

(**workshop session seven** notes)

suggested texts + works cited

1 Catalano, George D. “Engineering Ethics: Peace, Justice and the Earth.” Morgan and Claypool Publishers. 2006: 7.

2 Riley, Donna. “Engineering and Social Justice.” Morgan and Claypool Publishers. 2008.

3 Lucena, Juan, Schneider, Jen and Leydens, Jon A. “Engineering and Sustainable Community Development.” Morgan and Claypool Publishers. 2010: 33-34, 86-88.

4 Shilling, John D. with input from Chomitz, Kenneth and Flanagan, Ann E. “The Nexus Between Infrastructure and Environment.” Independent Evaluation Group. Washington, D.C., 2007.

5 Franklin, Ursula. “The Real World of Technology.” CBC Massey Lectures Series. Toronto: CBC Enterprises, 1990.

6 Steiner, Simon and Penlington, Roger. “Introducing and embedding Sustainable Development into your Engineering Curriculum.” The Higher Education Academy. (PowerPoint presentation)

7 Dawe, G., Jucker, R. and Martin, S. (2005) Sustainable Development in Higher Education: Current Practice and Future Developments. A report for the Higher Education Academy. www.heacademy.ac.uk/resources/detail/ourwork/sustainability/dawe_report_2005

8 Global Dimension for Engineering Education – Workshop 7. Belfast – 25th February 2011

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