

EXPANDING ENGINEERING LIMITS: SOCIAL JUSTICE IN ENGINEERING

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BLUM CENTER
FOR DEVELOPING ECONOMIES



DESIGNATED EMPHASIS

**DEVELOPMENT
ENGINEERING**

UNIVERSITY OF CALIFORNIA, BERKELEY

HAPPY
INTERNATIONAL
WOMEN'S
DAY





“

I have the audacity to believe that peoples everywhere can have three meals a day for their bodies, education and culture for their minds, and dignity, equality, and freedom for their spirits. ”

Martin Luther King, Jr.

Nobel Peace Prize acceptance speech • Oslo, Norway, 1964




Defining Engineering

~~ENGINEERING: (1) To lay out, construct, or manage as an engineer (2a) To contrive or plan out usually with more or less subtle skill and craft (b) To guide the course of~~

on your own terms

Dr. Catherine Newman

A photograph of a man, a woman, and a child in a rustic kitchen. The man stands in the background wearing a purple and green striped shirt and a light-colored dhoti. The woman sits in the foreground wearing an orange sari. A young child sits to the right, eating. The kitchen has a brick wall, a green pot on a stove, and various items on shelves.

Development

Engineering:

Designing products & services
that improve the lives of people
with resource constraints at scale



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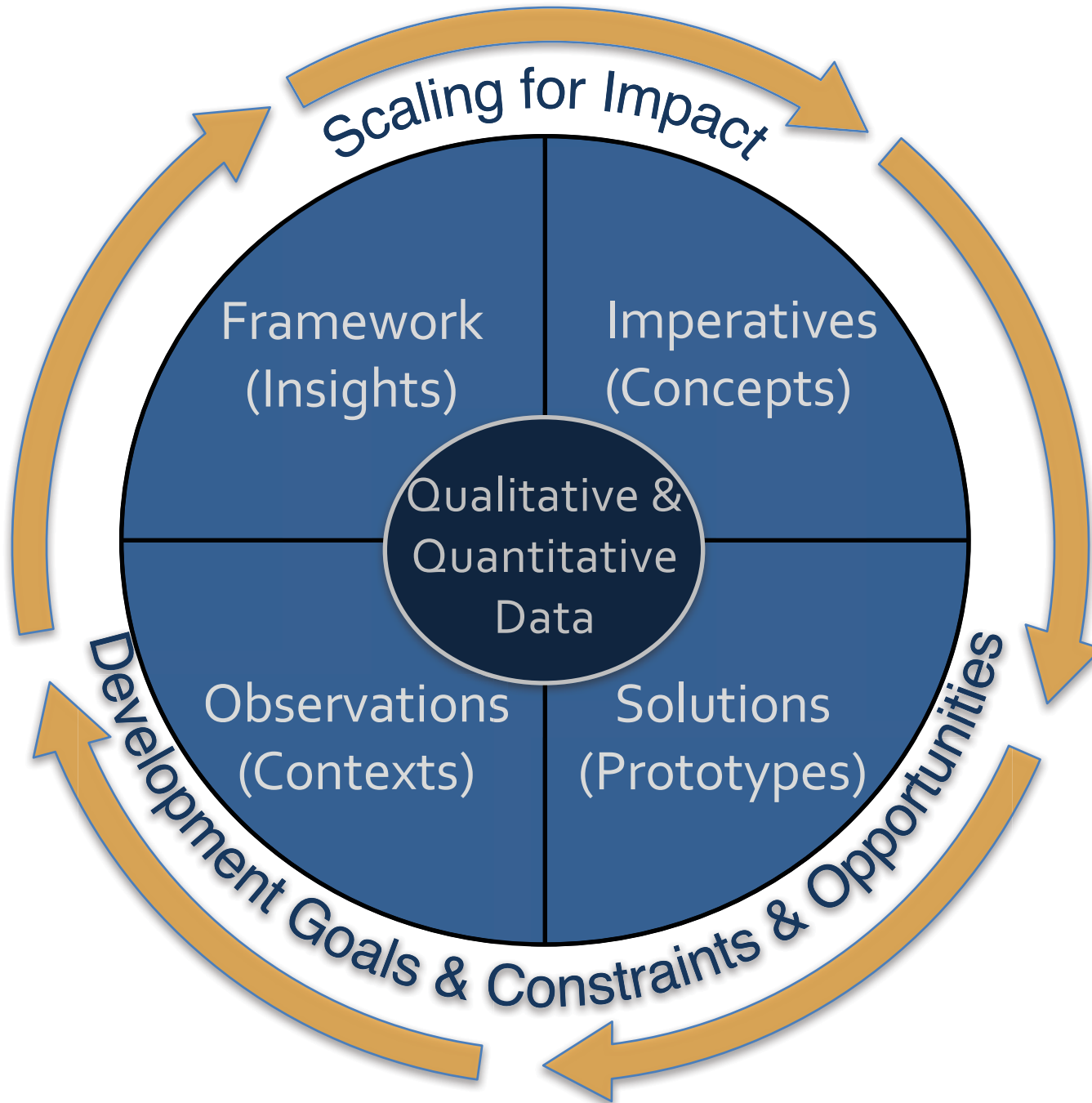
Development Engineering: Design for Social Impact

A new interdisciplinary **research** field that integrates:

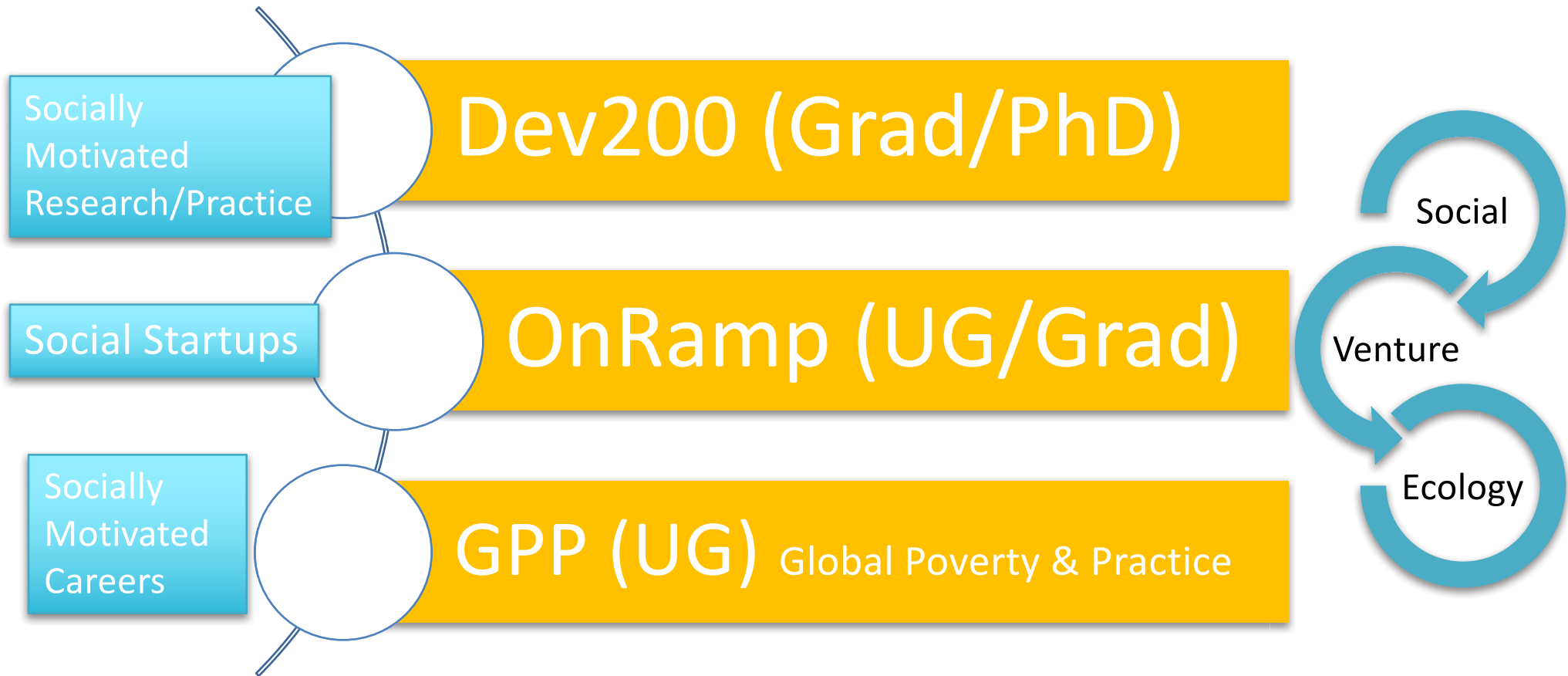
- Engineering, physical sciences, energy & resource development
- Economics, business & social sciences

to develop, implement, evaluate & scale technologies to benefit people living in poverty in developing regions and low-income areas of the U.S.

Design for Social Impact



Theory, Methods & Practice Ecology



REVERSE INNOVATION

Create high-performance, high-value products and services that appeal to consumers in poor and rich countries alike.



Sensors & Smartphones



Food, Energy, Water Systems



[Visualize an End to Cervical Cancer](#)



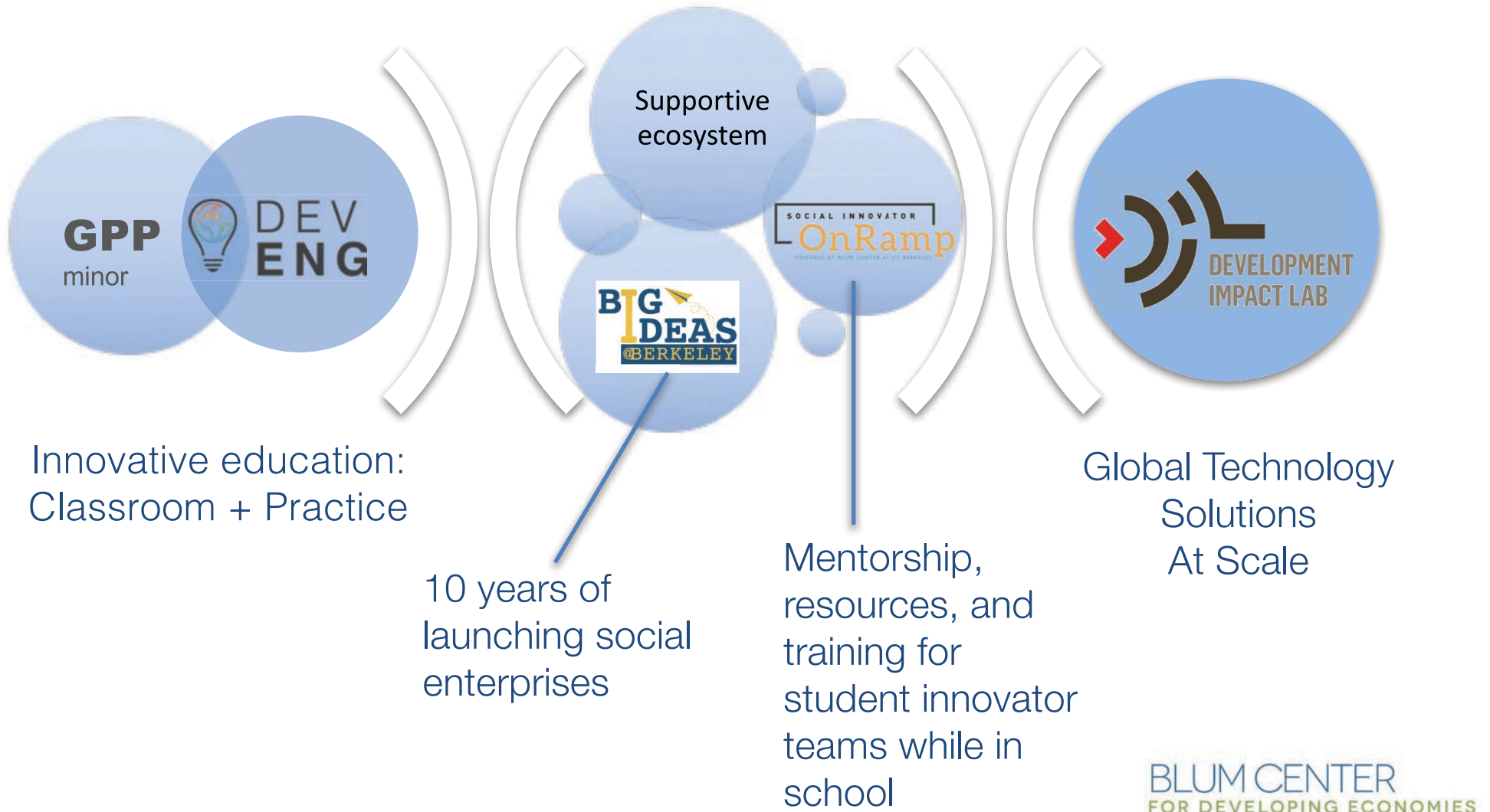
[CARES: Community Assessment of Renewable Energy & Sustainability](#)

BLUM CENTER METHODOLOGY

Train
a new generation
of global innovators

Transform ideas
into inventions and action

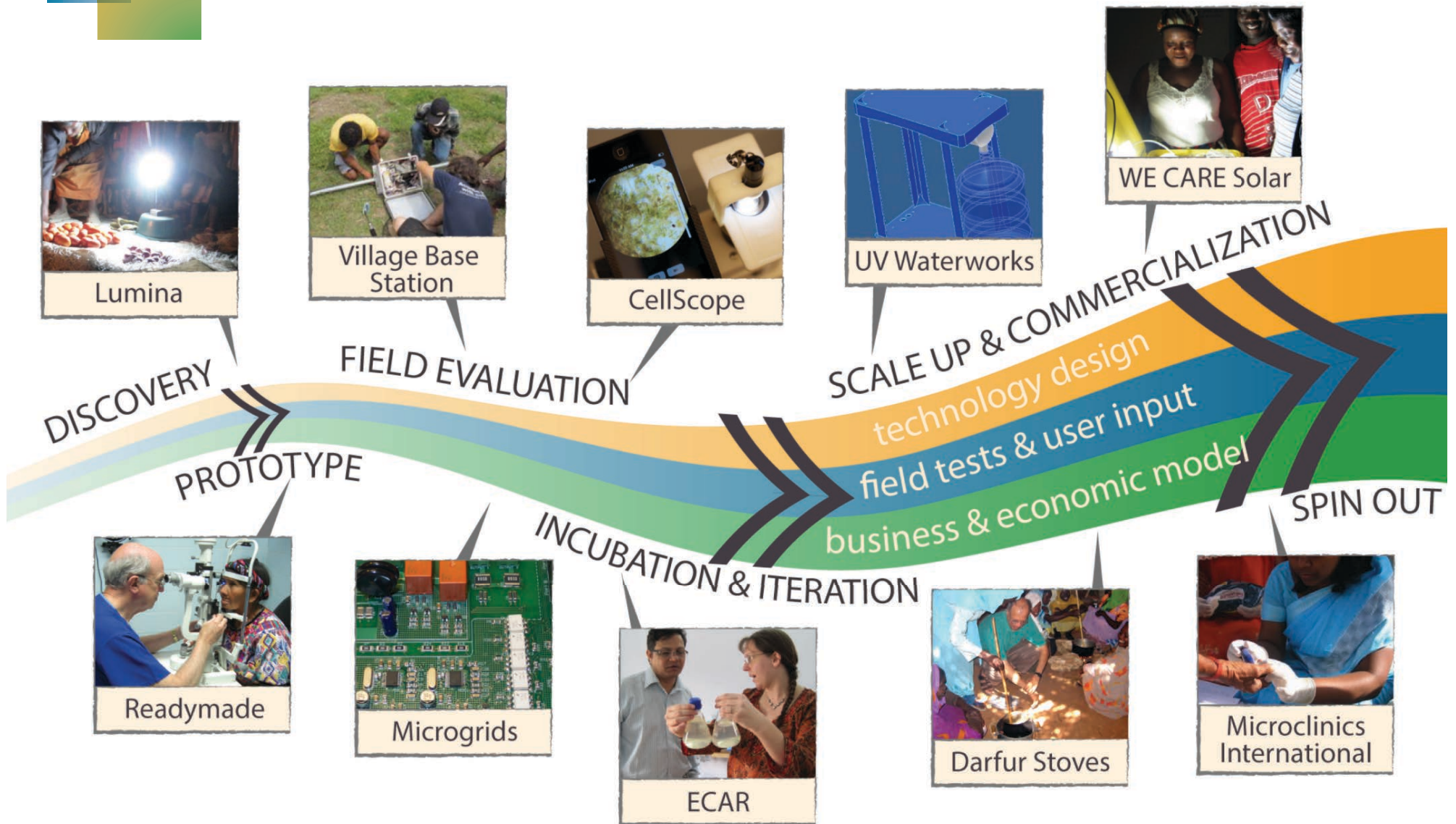
Drive
discovery & innovation





APPROACH

THE INNOVATION PIPELINE



2016-2017 Timeline & Categories

Metrics: from 5 projects in 2007... to over 135+ projects in 2017

Big Ideas @ Berkeley is a campus-wide annual competition that provides **funding, support and encouragement** to interdisciplinary student teams.



METRICS: UNDERGRADUATE MINOR: “GLOBAL POVERTY AND PRACTICE”

A model for how the 21st century university can train students to tackle the urgent problems of the new world.

- Largest Undergrad Minor on campus with students from 70 majors
- Entrepreneurship for Poverty Alleviation
 - Water & Development
 - Women, Poverty & Globalization
 - Human Trafficking
 - Evaluating Global Action
 - Poverty & Technology
 - Field Reporting in the Digital Age
 - Law & Development
- Experiential learning in 54 countries:
 - a) Self-identified work experience
 - b) Bookended by pre-departure training and post-reflection



“Global Poverty: Challenges and Hopes in the New Millennium.” More than 1000 students hope to enroll each semester - but only 300 students can be accommodated in the classroom, the largest on campus.

METRICS: WHO PARTICIPATE?

Participating in Undergraduate “Global Poverty & Practice”

Minor:

871 Students from 52 different majors on campus:

74% of students in the minor are female

89% female Leads on GPP projects

30% are 1st generation college students

22% are underrepresented minorities

80% are 1st or 2nd generation immigrants

Participating in Graduate “Development Engineering”

Minor:

24 affiliated faculty from 14 departments.

30 PhD students (50% female, 20% URM, education, engineering, public health, sociology, energy resources, college of natural resources).

>100 students have taken our required courses.

METRICS: WHO ARE THE SOCIAL ENTREPRENEURS?

Participating in Big Ideas Competition:

Since 2012 (when we added the support ecosystem): 50% of participants are now female, compared with only 39% pre-2012

Last year, of the male participants, more 62% had already entered an innovation contest before Big Ideas, while only 38% of women had entered a contest before Big Ideas— we are seeing the ecosystem we've built attract and support women!

Interviews suggest that women students are motivated by their **empathy for and connection with** project beneficiaries.



More men are needed to join into the conversation on gender equality.

“I learned to understand a woman’s perspective on issues - it’s not a binary thing- it’s a process and spectrum...okay I’m going to try to learn as much as I can. I think that is the role of a man in this space. There are things biologically that I won’t understand, **but I need to empathize the best I can.**”

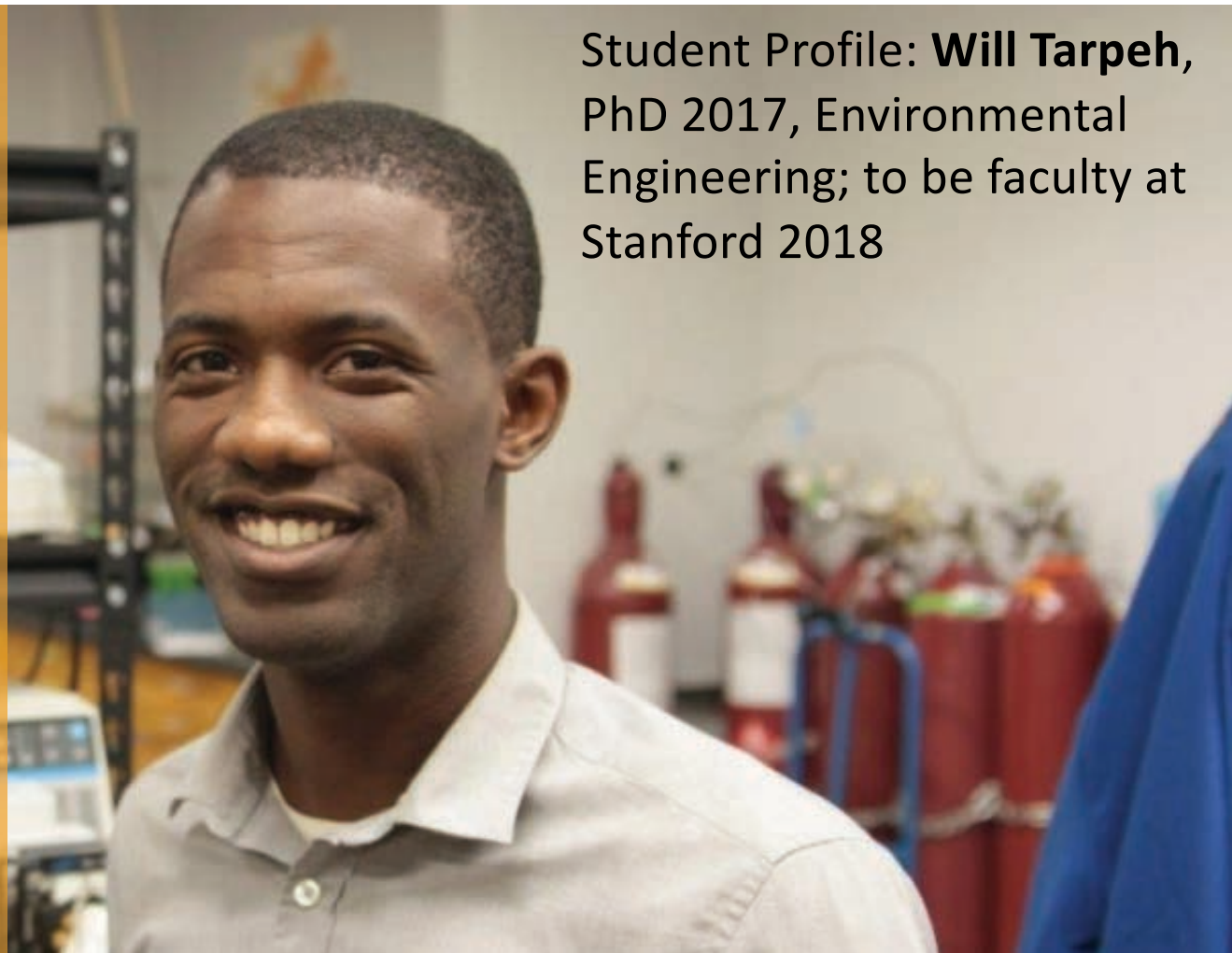
Student Profiles: Julia Kramer

- PhD 2019, Mechanical Engineering
- Research on cervical cancer detection & training in Ghana & world-wide.
- 275,000 women die each year from cervical cancer with 80% of these in the developing world.
- Collaboration with Kathleen Sienko Univ of Michigan.



1st place 2014 Big Ideas winner, global health (“Visualize an end to Cervical Cancer”) . Crowd funding.

Project: Electrosan
redesigning sanitation systems that improve public health and the environment by converting human waste into income-producing by-products (fertilizer, sanitizers). The process applies electrochemical cells to recover nitrogen from human urine and to disinfect feces, bringing affordable sanitation to poverty-stricken communities.



Student Profile: **Will Tarpeh**,
PhD 2017, Environmental
Engineering; to be faculty at
Stanford 2018

“One of the boxes I needed to check when choosing a grad program was combining lab work and fieldwork...

The other was combining engineering with development.”

DevEng “is really meaningful because it recognizes the interstitial space that otherwise just isn’t recognized.”

DESIGNEXCHANGE

Where designers and researchers share methods and best practices.

JOIN

Learn

Browse methods and case studies to improve your design skills. Learn what to do and what not to do to successfully complete your next design task.

Invite

Invite your friends to join theDesignExchange community!

Methods

Learn about the methods you could use on your next design.

Cultural Probes

Gain insight into and inspirational responses about the daily life and habits of communities



Case Studies

Read about how real design problems were solved.

Adapting Usability Testing for Oral, Rural Users

Read about a study conducted in Ghanaian villages that evaluated an audio computer designed for people living in oral cultures



<https://www.thedesignexchange.org/>

WE INSTITUTIONALIZE CHANGE



Now ACCEPTING SUBMISSIONS

DEVELOPMENT ENGINEERING

THE JOURNAL OF ENGINEERING IN ECONOMIC DEVELOPMENT



AIMS & SCOPE

Development Engineering (Dev Eng) is an open access, interdisciplinary journal applying engineering and economic research to the problems of poverty.

Published studies must present novel research motivated by a specific global development problem. The journal serves as a bridge between engineers, economists, and other scientists involved in research on human, social, and economic development.

SPECIFIC TOPICS INCLUDE:

- Engineering research in response to unique constraints imposed by poverty.
- Assessment of pro-poor technology solutions, including field performance, consumer adoption, and end-user impacts.
- Novel technologies or tools for measuring behavioral, economic, and social outcomes in low-resource settings.
- Lessons from the field, especially null results from field trials and technical failure analyses.
- Rigorous analysis of existing development "solutions" through an engineering or economic lens.

EDITORS IN CHIEF:

Ashok Gadgil Civil and Environmental Engineering Lawrence Berkeley National Laboratory, Berkeley, California, USA	Paul Gertler Economics University of California, Haas School of Business, Berkeley, California, USA
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example topics:

- Engineering research in response to unique constraints imposed by poverty.
- Novel technologies or tools for measuring behavioral, economic and social outcomes in low-resource settings.
- Technology markets and the role of innovation in economic development.
- Assessment of technology solutions, including field performance, consumer adoption and end-user impacts.

21st Century Skills

#TechCon2016 #NextGen



21st Century Skills: Ability to Ideate & Reframe Problems & Solutions

- Mobile phones/ Smartphones
- Community Groups and NGOs
- Complex household structures
- Groups facing discrimination

- Isolation
- Seasons
- Donors, government & diaspora
- Liquidity constraints
- Social norms
- Pollution
- Role of Gender

UN Sustainable Development Goal 5:

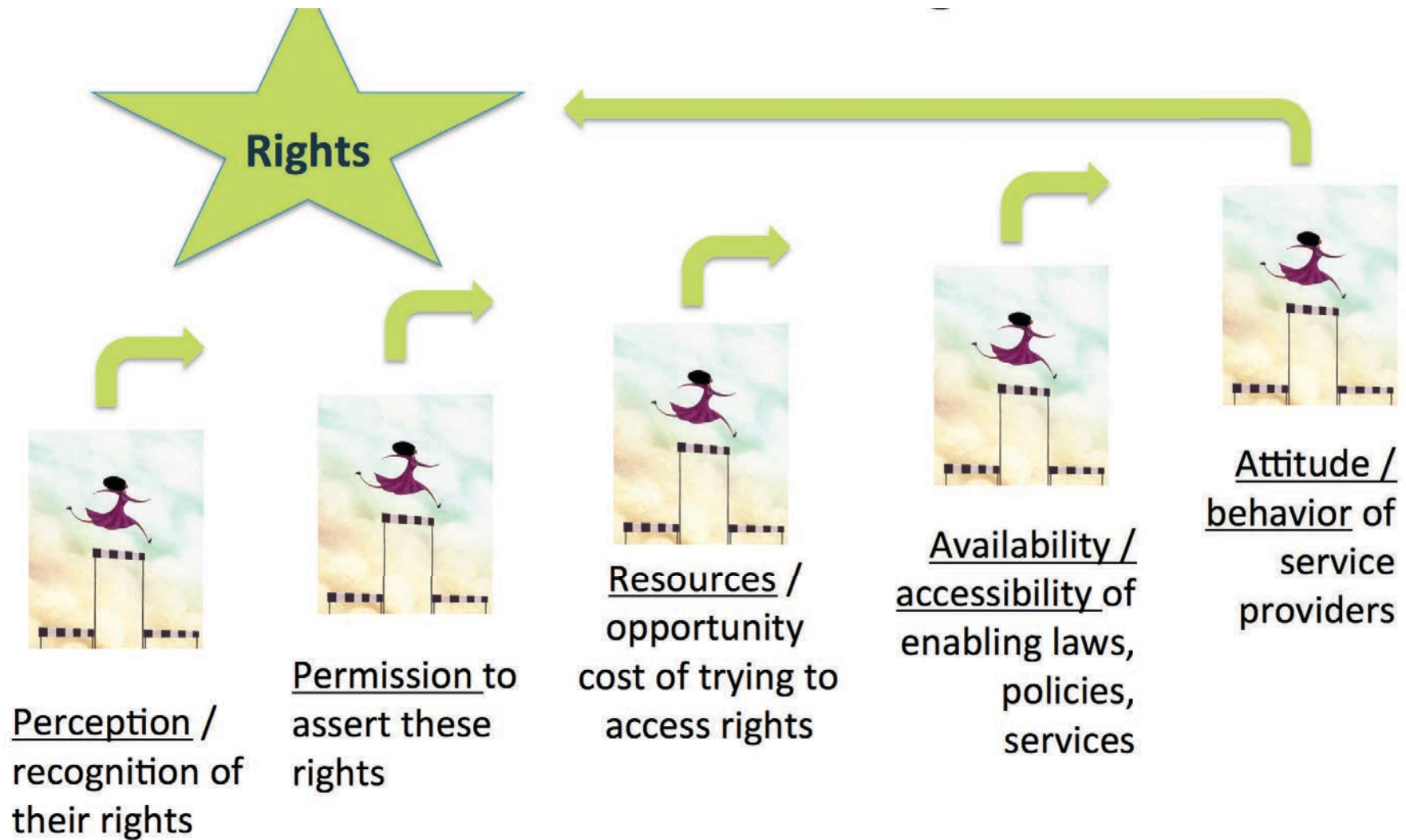
Achieve gender equality and empower all women and girls

- End all forms of **discrimination**
- Eliminate all forms of **violence**
- Eliminate all **harmful practices**, such as child, early and forced marriage and female genital mutilation.
- Recognize and value unpaid care and domestic **work**
- Ensure women's full and effective participation and equal opportunities for **leadership** at all levels of decision making in political, economic and public life.
- Ensure universal access to **sexual and reproductive health**
- Undertake reforms to give women equal rights to **economic resources**, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources
- Enhance the use of enabling **technology**, in particular information and communications technology, to promote the empowerment of women.
- Adopt and strengthen sound **policies** and enforceable legislation for the promotion of gender equality

Economic (dis)empowerment

- Only 47% of women globally have an account at a financial institution
- Women earn less than men globally (60-75%)
- Women more likely to work in informal employment
- Women bear responsibility for unpaid care work
- Women are responsible for water & fuel collection (1-4 hrs a day)
- Women work longer hours in developing countries (paid + unpaid)
- Women are not equally represented in trade unions
- Women make up 43% of agricultural labor, but own less than 20% of the land
 - Limited access to seeds, fertilizers, credit, technical assistance
- And... gender equality is a \$12 trillion economic opportunity (McKinsey Global Institute)

Power structures impede women's access to their rights



Adapted by Chowdry Sangeeta, Global Fund for Women from: Meera Chatterjee, 1988, Women's Access to Health, Allied Publishers, Chennai

DevEng Ideation & Reframing Cards

The Role of Gender

Motivation:

Gender roles affect almost every facet of life, and in turn affect almost every product and service



Illustration:

Individual pay-per-use for public toilets appears perfectly fair at first glance. However, it often requires women to pay more than men (due to menstruation, pregnancy, and taboos against women exposing themselves in public). A possible solution is family membership.

What stage are you in?

Just beginning (pre-prototype):

Ideation Questions:

- 1) Make a projection: What would happen if women and men used the same product?
- 2) Are there any roles or customs your product could take advantage of to empower women *in ways the community understands and accepts*?
- 3) Can you design a solution just for women? Just for men?

Intermediate (post-prototype):

Reframing Questions:

- 1) How do existing gender roles affect what your product needs to do? How it will be used? Barriers it will face?
- 2) Will your product or service interact with existing gender roles in harmful ways?
- 3) Can your product advance desirable norms?

Engineering Ethics: What Does Your Professor Say?

“What we design? For whom do we design? How we manufacture? What resources we use? What will be the impact on society and the environment? These are all ethical and social justice questions that are important in product design. ”

Alice Agogino, Professor
Mechanical Engineering
Minner Fellow



deveng.berkeley.edu



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