From Humanitarian Engagement to Sustainable Impact

Khanjan Mehta
Humanitarian Engineering and Social Entrepreneurship Program
The Pennsylvania State University
How do we translate our technologies, our passion, our resources into sustainable impact?
Global Developmental Challenges
Certificate in HESE | Minor in Social Eship
Affordable Greenhouses

Grow better produce, all year round
Current Mashavu Social Franchisees

Eunice  Ann  Salome  Margaret  Lillian  Ann
$10 Pulse Oximeter
5c Test Strip: UTIs and Diabetes

- Neutral Red
- Iron (II) sulfate
- Potassium Chromate

Printed Strip

Positive Test Strip
Design with Communities
Commercialize for Markets
Impact: Scholarship

76 Publications  22 Review  40+ Prep
Four Thrust Areas

Focus on Execution

Practical Partnerships

Reframe Research

Change the Conversation
Thrust 1  Focus on Execution
10 Is it Affordable?
9 Is there a Business Model?
Is it Desirable?
7 Does it meet every need?
Is it Pretty?
5  Who will Manufacture it?
4  Will it hurt the Environment?
Is it Socially Acceptable?
2 Will it Reach the People?
Will it Scale?
Sustainable & Scalable Solution

- Technologically Appropriate
- Culturally Acceptable
- Environmentally Benign
- Economically Sustainable
Why Do Ventures Fail?

Typical Venture Lifecycle

120 Projects
500 FVC Actors
25 Experts

Design   Implementation   Maturity

Idea
Prototype (Pilot)
Launch

TIME

REVENUE

Reinvention
Obsolescence
Why Do Ventures Fail?

1. Failure to Meet a Need
2. Manufacturability
3. Designer Limitations
4. Usability
5. Complexity
6. Culture
7. Context

DESIGN
Why Do Ventures Fail?

IMPLEMENTATION

1. Access to Capital
2. Trust Management
3. Pricing
4. Gender Dynamics
5. Customer Education
6. Strategic Planning & Pivoting
7. Partners & Champions
8. Product Quality Control
9. Operational Organization
10. Competition Management
11. Team Dynamics & Incentives
12. Legal
Why Do Ventures Fail?

- Stakeholder Management
- Supply Chain
- Marketing
- Management
- Continued Innovation
- Standard Concept of Operations
- Legal
What are the problems for which we can design and deliver sustainable solutions?

“We are here for a community assessment. What are your problems?”
Design Ensembles and Systems

**Drying Bananas**

**Drying Fish**

**Drying Tomatoes**

- Pre-processing
  - Slice
  - Salt bath
  - Sulphur bath

- Post-processing
  - Verify Moisture
  - Package slices
  - Label

Solar Dryer

$ \rightarrow \text{Money}$
Design Ensembles and Systems

Product

Business Model

Concept of Operations

Centrifuge?
Labor Needs?
Typical Venture Lifecycle

- **Design**: Idea, Prototype (Pilot), Launch
- **Implementation**: Time
- **Maturity**
- **Obsolescence**: Reinvention
Design Execution Strategy
Design Execution Strategy
# Design Execution Strategy

## Implementation Strategy for Cyber Center-based Telemedicine Venture

<table>
<thead>
<tr>
<th>Tele-Station</th>
<th>Price/Visit</th>
<th>Managers</th>
<th>Observers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Pilot</td>
<td>Free</td>
<td>University</td>
<td>CHW Volunteers</td>
</tr>
<tr>
<td>Rural Local Pilot</td>
<td>Free</td>
<td>University</td>
<td>CHW Volunteers</td>
</tr>
<tr>
<td>Rotating Villages</td>
<td>5 (Villages)</td>
<td>10KSH</td>
<td>CHW Employees</td>
</tr>
<tr>
<td>Urban Transition</td>
<td>1 (Urban Cyber Center)</td>
<td>30-50KSH</td>
<td>CHW Employees</td>
</tr>
<tr>
<td>Steady State</td>
<td>2 (Urban + Rural)</td>
<td>30-50KSH</td>
<td>CHW Employees</td>
</tr>
</tbody>
</table>

- Establishing Market Presence (willingness to pay)
- Training Employees (self-sustaining service provision)

## Implementation Strategy for Subsistence Farmers’ Low-Cost Greenhouses Venture

<table>
<thead>
<tr>
<th>Procurement</th>
<th>Design</th>
<th>Builders</th>
<th>Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Design</td>
<td>Local Market</td>
<td>Fully Custom</td>
<td>University Local School</td>
</tr>
<tr>
<td>Train/Recruit</td>
<td>Local Market</td>
<td>Try Standard</td>
<td>University</td>
</tr>
<tr>
<td>Launch</td>
<td>Urban On Request</td>
<td>Standard Company</td>
<td></td>
</tr>
<tr>
<td>Public Outreach</td>
<td>Urban Wholesale</td>
<td>Mass Standard Company</td>
<td></td>
</tr>
<tr>
<td>Steady State</td>
<td>Contract Suppliers</td>
<td>Mass Custom Company</td>
<td></td>
</tr>
</tbody>
</table>

- Establishing Market Presence (acceptance of risk)
- Building manufacturing capability (price-point reduction)
Thrust 2  Practical Partnerships
Venture Teams

Ultra-multidisciplinary Teams

55% Women

Freshmen → PhD
Venture Team Pipelines

Design for Developing Communities

50 Students

HESE 1
HESE 2
HESE 3
HESE 4

800 Students

BIOE 401
ED 100
ME 440
ED 509
ENGL 496
ED 301
ENGL 202C
EE 403
Partner Networks

Academia
Nonprofits
Government

Industry
Startups

Community
corporat to produ flowers and sell farmers. smallhol African Republic.

1.2 "HESE" as used in this License Agreement shall include The Pennsylvania State University College of Engineering, the trustees, directors, officers, employees, students, fellows, and affiliates of The Pennsylvania State University.

mbers [5]. and lower countries [6]. East experience rain. The
Funding 2.0

Securing Water for Food: A Grand Challenge for Development

World Hope International
“I am a Professor. First I write fiction and then I write non-fiction.”
Why Research and Publication?

IMPACT
Benefits of Research & Publication

Rigorous Evidence-Based Solutions

CORRECT Questions ➔ Right Product

Trust and Credibility

Continuity; Shoulders of Giants

Higher Engagement; Due Diligence

Comm Education ➔ Develop Market

Collectively Change the Conversation
Purpose of Research?

Gap in the Literature

Strengthen Ventures
Democratize Knowledge
Inspire and Inform Innovators
Mainstream HESE
Diverse Manuscript Frameworks

- Hypothesis-Driven
- Non Hypothesis-Driven
- Literature Reviews
- Typology / Taxonomy
- Theoretical Models
- Challenges and Opportunities
- Lessons Learned / Best Practices
Diverse Manuscript Frameworks

Design Tenets

Educational Tools

Essay or Opinion Piece

Case Studies

MAKE STUFF UP*

*Real, Rigorous, Ethical
The Number of Scholarly Documents on the Public Web


Abstract The number of scholarly documents available on the web is estimated using capture/recapture methods by studying the coverage of two major academic search engines: Google Scholar and Microsoft Academic Search. Our estimates show that at least 114 ...
“Please stop teaching me how to fish.”
Curricular Innovation

www.youtube.com/hesepsu
Smallholder Farmer

“Smallholder farmer, head of the household & mother of six”

A Day in the Life

Blessing, the head of her household and mother of six, lives in a rural village and earns money through smallholder farming. Every morning, she gathers water, then returns home to help oldest daughter cook a small meal, do the wash, and care for the families chickens and goats. She then sends her younger children to school. When she is not working the small plot of land where she grows pineapples, she is at her home where other women gather, gossip, and socialize. She sells her pineapple locally, and though she would like to expand doesn’t have the know-how or credit needed to do so.

Blessing, N.
Female, 35
Married, 6 children

Personality

Traits/Attitudes
Hard working, family oriented, happy, welcoming, loves to laugh, gossip, and dance. She identifies strongly with her community, but

Goals
Expand her farming operation (in size or diversity of crops) to generate additional income and improve her families nutrition.

Motivations
Religion (Christian), her husband, children, new baby, community membership, and future purchases
Overview of Global Biomedical Device Design Tool:

International donors from developed countries fund nearly 80% of health care equipment in developing countries. Almost 70% of the donated equipment is not in use because of lack of maintenance or spare parts, or because local personnel do not know how to use it, representing a tragic waste of potentially valuable resources. This disconnect arises because equipment from developed countries is designed in a context that is substantially different than that of developing countries with respect to resources, infrastructure, social and behavioral norms, and the healthcare environment. Further, even if the target population for design is the developing country, the typical biomedical engineer in the U.S. is unlikely to be familiar with the unique challenges of designing devices for such resource-constrained environments.

This tool will aid in design space exploration and ensure that every decision made in the design process can be defended by a well-informed rationale. Such a tool should provide an engineer in a developed country the means to incorporate needs of the target user in a developing country from the concept generation phase through to the manufacturing phase.

Learning objectives:

(i) students will learn design strategies and research organizational skills used in modern research laboratories and industrial settings,

(ii) students will learn finite element analysis and computational modeling skills in order to apply engineering concepts to biological and healthcare problems that entail multiple physical principles and complicated geometries.

The technology landscape in a developing world hospital can be bleak. This photo taken from Mt. Meru Hospital in Arusha, Tanzania, illustrates a typical operating room in a donation-dependent hospital. Notice that there are no overhead operating room lights, only a small floor lamp. The large windows are required because the power frequently fails, rendering even the floor lamp useless.

Kochia, a sleepy community on the shores of Lake Victoria in Western Kenya, caught in the turmoil among traditional ways of life, excitement brought on by development projects and the throes of relentless globalization. Celebrities are spreading HIV and funerals are killing people. Cows are drowning in wells dug by white people. Girls are dropping out of school and children are being rented to orphanages. Crusades and miracle services are blurred lines between religion and crime. Along with the rapidly declining fish population in the lake, the time to ‘teach people how to fish’ has passed. It is time for timely and decisive action. Obongo, Okello, Sister Phoebe and friends unite...
Okello’s Foray into Social Business

Traditions → Social Innovation

Meaning of Community
Mr. Jackson’s Secret to Success

The Orphanage Business
Donor Education
The Headmaster’s Harambee MBA

Gender Equity; Secondary Education

Motivating and Incentivizing
The Fisherman’s Sweet Fate
The Fisherman’s Sweet Fate

Resource-Driven Entrepreneurship

Lean & Inclusive Business Models
Mzungu Memories: A Conversation over Busaa
Mzungu Memories: A Conversation over Busaa
Mzungu Memories:
A Conversation over Busaa
Learning Objectives

Systems Thinking
Self Determination
Building Relationships
Lean Business Models
Social Innovation
How Things Work
Get Stuff Done
“No, Please don’t change the world.”
Thrust 4  Changing The Conversation
Motivations for Engagement

Men
1. Making a difference
2. Participating in an exciting project
3. Applying theory to address a problem

Women
1. Global professional
2. Making a difference
3. Applying theory to address a problem

Both Genders: Sustainable Difference
Motivations for Engagement

Changing the World → Recruiting

Entrepreneurial Ecosystems → Engaging

HESE ≠ Soft skills
1. Professional, Independent and Innovative
2. Most went to Grad school
3. Balance of Fieldwork and Paperwork
4. Meaningful Extra-curricular Activities
5. STEM Education → Developing a Mindset
6. Circuitous Path to Current Position
7. Salary range: 30,000 → 300,000

8. Step up; Get Stuff Done; Take the Plunge!
The Big Design Questions | The fundamental one: Should outsiders get involved at all?

Owner: Rob Goodier  Created: July 3, 2014  Comments (6)
Filed under: General

Is engineering for global development a new wave of cultural imperialism? Or is it an exercise in co-creation?

The Big Design Questions series has taken on some of the deep controversies and unasked questions over the last two months. The view that has emerged is one of tradeoffs that are inherent in any design. Now, Khanjan Mehta, a contributing editor at E4C and head of the Humanitarian Engineering and Social Entrepreneurship (HESE) program at Penn State, leads this series to a big-picture overview of the hard decisions that we make, including the biggest one: Should outsiders get involved at all?
“I know trimming the bush takes time. But what’s time to a goat?”
Execution; Partnerships; Research; Conversation
ECOSYSTEMS that foster Multi-Million Smile Enterprises