UNIVERSITY OF CAPE TOWN
Department of Computer Science

SOFTWARE ENGINEERING IN DEVELOPING COMMUNITIES

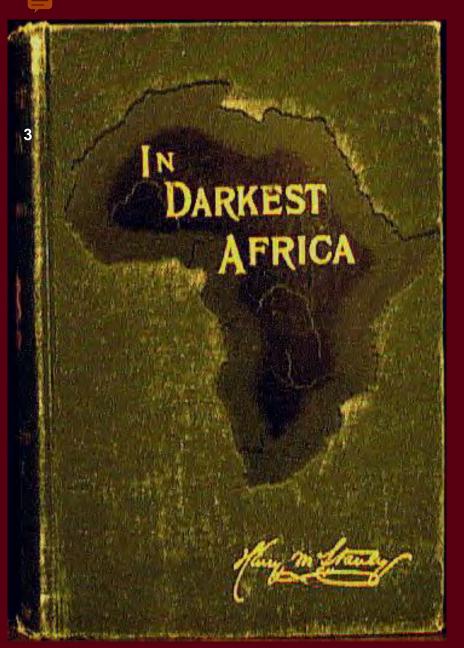26/7/11   Edwin Blake & Gary Marsden

Where are we?

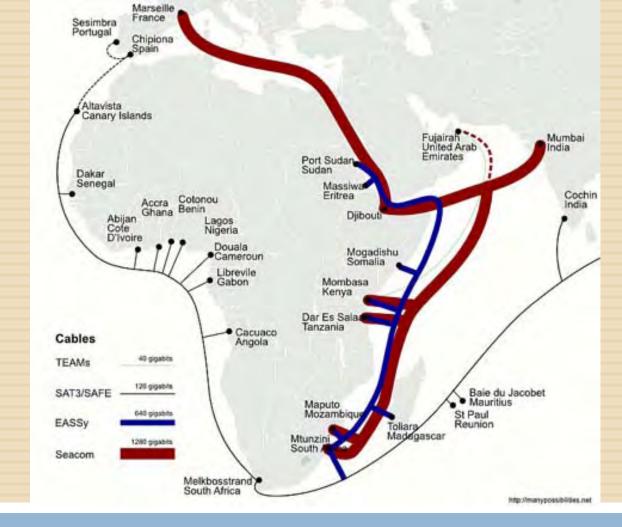Theme: Align the technical with the social and cultural context.

But first:

Where are we?

What is *our* context?

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Chinese Map of the African continent: 1389
from
Amalgamated Map of the Great Ming Empire

African Undersea Cables

Steve Song

http://www.flickr.com/photos/ssong/ / CC BY-SA 2.0

Develop! Progress! Transform! Leap-Frog!

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Progress

Progress

- The privilege of historic backwardness – and such a privilege exists – permits, or rather compels, the adoption of whatever is ready in advance of any specified date, skipping a whole series of intermediate stages.

- Leon Trotsky, 1932–3

More Progress

DEVELOPMENT
AS
FREEDOM

AMARTYA SEN

WINNER OF THE NOBEL PRIZE IN ECONOMICS

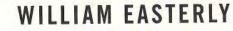"Fascinating. . . . The overall argument [is] eloquent and probing."
—The New York Times

"Tremendously important and provocative . . . an immensely stimulating book."
—NICHOLAS D. KRISTOF, The New York Review of Books

THE WHITE MAN'S
BURDEN

Why the West's Efforts to Aid the Rest Have
Done So Much Ill and So Little Good

WILLIAM EASTERLY

What to do (in ICT)?

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Requirements Engineering?

ICT for Development

- Scope of ICT4D:
  - Offered as support in achieving goals such as empowerment, democracy and better lives, but:
    - Recognize that computing and communication technologies have a definite but circumscribed value
  - The underlying reason for this faith is that ICT is a Universal Enabling Technology, but:
    - it only becomes universal in the hands of a designer and appropriator.
- Mobile phones seem to be the platform of choice, but:
  - the expense
  - strictly individualized nature

How to do ICT Design and then ICT Development to Achieve ICT for Development?
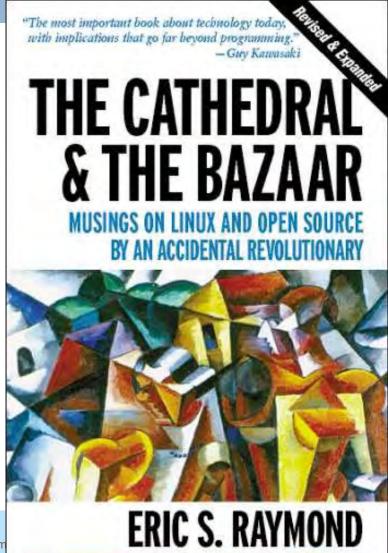
The Big Question

Cathedral and Bazaar

- Top-down and bottom up development
- Which of course refers us to the other sense of **development**

Department of Computer Science SE in Developing Com

Requirements Elicitation

- *Structured digital storytelling*

- *Cultural probes* (or technology probes)

- *Contextual inquiry*

- *Ethnographic techniques*

- Approach:

  - *start* gathering information in a bottom-up manner;

  - Information processed, analysed and abstracted

  - into sets of "goals" and "needs"

  - → leads to the requirements specification

Contextual Inquiry/Design

Design-oriented approach aimed at getting a grip on 'context'.

- Practical way to gather information relevant for design
- Alternate between watching and probing

Apprentice / Master relationship is fundamental for the investigation

- No explicit teaching, just watching the work, detecting what matters, seeing details.
- Requires humility, inquisitiveness, attention.

Ethnography ("write a culture")

From social and cultural anthropology.

- Rich descriptions based on long-term fieldwork in a community.
- for ICT the aim is to inform design.

Aim: understanding how people perceive and organise their world.

- Cultural and conceptual phenomena
- Behavioural patterns and material conditions.

Important principle: Immersion – researcher should spend a significant amount of time in the field.

- Participant observation is the basic method:
  - ethnographer participates in the community.
  - retains a position as analytical observer

The Issue

- Software engineering assumes that, on some level, the problem is identified
  - Requirements analysis
- Even iterative and agile SE methods, where the customer is integrated into the development cycles, still assume that the problem is well understood.
- In most ICT4D studies, we have no idea what the problems are before we start
- Agile and user centred approaches to software engineering are moves in the right direction …

Summary of the issue:

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□ **It does not work to tackle social and economic development top-down nor does top-down software development work.**
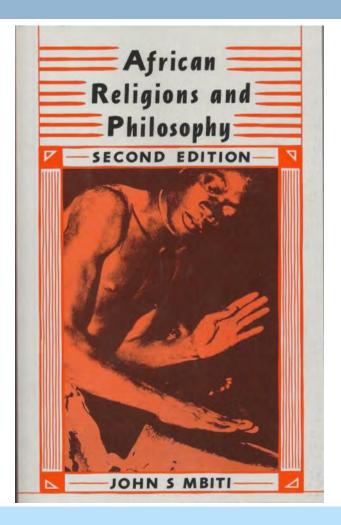
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First Ideas

Ubuntu

Action Research

Mbiti's "African Concept of Time"

☐ In traditional African thought, there is no concept of history moving 'forward' towards a future climax, or towards an end of the world.

☐ The notion of a messianic hope, or a final destruction of the world, has no place in traditional concept of history. So African peoples have no 'belief in progress', the idea that the development of human activities and achievements move from a low to a higher degree.

African Religions and Philosophy

SECOND EDITION

JOHN S MBITI

I am, because we are; and since we are, therefore I am

- "My humanity is caught up, is inextricably bound up in yours."
  Archbishop Desmond Tutu
- In Zulu one can say "umuntu ngumuntu ngabantu"
  - Sotho: "Motho ke motho ka batho (babang)"
  - "a person is a person through other persons"
  - "a person is a person because of other persons"
  - "I am what I am because of what we all are"

Shadow Side to Ubuntu?

Romanticised notions of "other": African orientalism

Mazrui: "strange combination of cultural condescension, paternalistic possessiveness and ulterior selectivity"

Summary so far:

- Ideas of community are expressed by Ubuntu

Use Action Research … if you're clueless

Action research applies an engineering paradigm for dealing with complex design situations in order to achieve democratic social reconstruction.

- Designers do not initially understand local issues and culture

while at the same time

- Local communities cannot appreciate the potential of ICT to address their development needs.

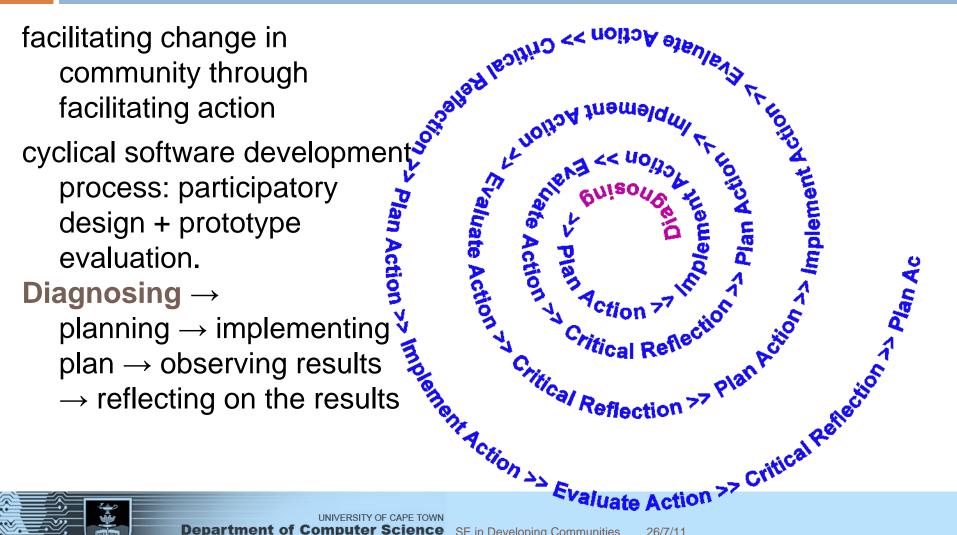# Use Action Research … for development

- The cyclical approach to action and reflective learning has been around for a long time. It was advocated in its various forms in the post World War II development of the UK, USA and Japan.

- More as a mindset, an attitude.

- More emphasis on the Action (or Engineering) aspect than is often done while retaining the key importance of learning and reflecting.

Phases of Action Research: Diagram

DIAGNOSING
Identifying or Defining a Problem

SPECIFYING LEARNING
Identifying general findings

CLIENT SYSTEM INFRASTRUCTURE
Specification and agreement that constitutes the research environment

ACTION PLANNING
Considering alternative courses of action

EVALUATING
Studying the outcomes of an action

ACTION TAKING
Implementing a course of action

Computer   ities   26/7/11

Action Research Cycle

facilitating change in
community through
facilitating action

cyclical software development
process: participatory
design + prototype
evaluation.

Diagnosing →
planning → implementing
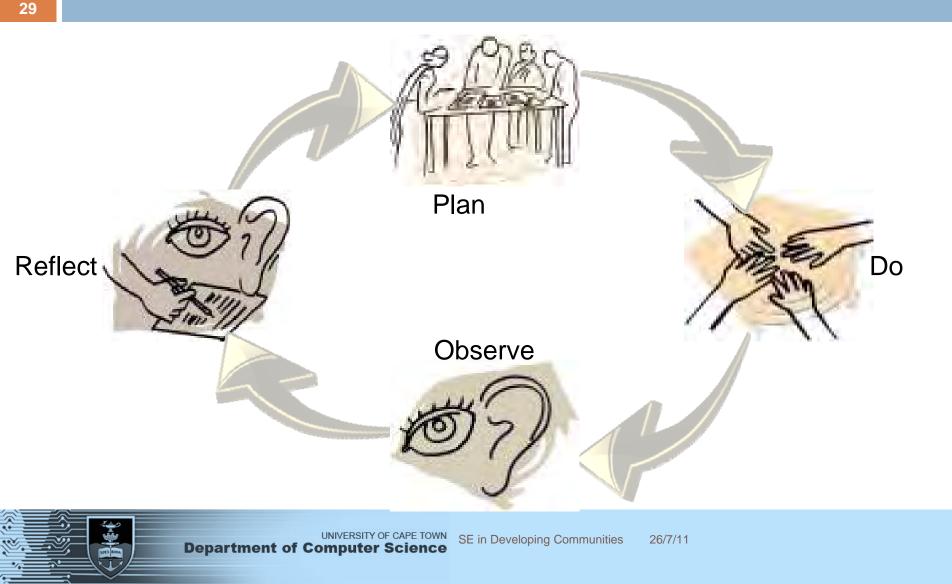plan → observing results
→ reflecting on the results

Ethnographic Action Research

1. Ethnography: long term embedding in a culture to gain deep understanding.

2. Participatory Techniques: researchers and participants work together to understand the problem.

3. Action Research: combining action with developing further understanding (see earlier)

Ethnography

- Understanding a (local) culture through
  - Participant observation
  - Immersion
- Make sense of grand ideas within a context
- Take: "Impact of Internet on Empowerment"
  - Positivists would measure some access statistics
  - Ethnographer would go to a specific place and look at 'internet', 'impact' and 'empowerment' and what they mean for that place

Plan

Reflect

Do

Observe

Carrying out Action and Research   I

- Usually the research starts broadly building up a picture of community and ecology
  - Themes/stories
  - Building relationships
  - Enlisting participants
  - Social mapping
- Narrowing - targeted research
  - Answering specific questions for specific groups

Carrying out Action and Research   II

Organize the actions into small units which can be completed in short time

Take field notes on every action

- Actions includes: fieldwork entrance letters, fixing computers items, meetings and workshops
  - Anything that consumes our time in the field is part of the action

Use some known data analysis techniques

- Align our field notes empirical material in those techniques

Think and make sense of the actions and results

- Some time is needed away from the field

Field notes

Expect to spend 1 hour of working day writing field notes

Field notes should be written up as soon as possible after leaving the field site, immediately if possible

- Plan to leave a block of time for writing just after leaving the research context

Be self-aware

- Reflect on what you are doing as you are doing it

Data Collection Methods   I

Semi-structured interviews

- ◻ Participant observations
- ◻ Analysis of documents
- ◻ Use of checklists: data registers, analysis tools, and health workers
- ◻ Software prototyping process
- ◻ Group discussions and Training workshops
- ◻ Video/still pictures
- ◻ Analysis of press media reports

Data Collection Methods   II

- Audio recording is no substitute for field notes
- 6 hours transcription for 1 hour audio
- Use 'coding' to speed things up
- Cluster recurring issues under common themes
- Disseminate findings to feed into 'action' and 'planning'

Data Analysis and Presentation

Interviews, Observations, Questionnaires, and site documents work together to support the research claims.

Empirical materials are presented in

- Descriptive statistics (quantitative data)
  - Model and measurement instrument for evaluating user satisfaction (7-point scale)
- Qualitative excerpts of encoded user reactions
- Software evaluation via criteria such as reliability and usability
- Screen shots of programs

Secondary Sources of Data

- Documents from the field
- Photos and videos

Ethnographic Action Research: Resources

- *Ethnographic Action Research: A User's Handbook*. Jo Tacchi, Don Slater, & Gregory Hearn (2003). UNESCO, New Delhi, India. eprints.qut.edu.au/4399/

Summary so far:

- Ideas of community are expressed by Ubuntu

- (Ethnographic) Action research allows democratic development

Practice — a Pragmatist View

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Have come to believe that creating knowledge is inextricably intertwined with effective action.

Knowledge that does not lead to effective action is not really knowledge

A failure to create effective systems is equivalent to a failure of understanding.

Deaf Telephony: Case-study Context

- Project set out to assist South African Deaf people to communicate with each other, with hearing people and with public services.
- Team has been working for ten years with a Deaf community that has been disadvantaged due to both poverty and deafness.
- Deaf users in this community started out knowing essentially nothing about computers.
- Their preferred language is South African Sign Language (SASL) and this use of SASL is a proud sign of their identity as a people. Many are also illiterate or semi-literate.
- Deaf people encounter many problems with communication.
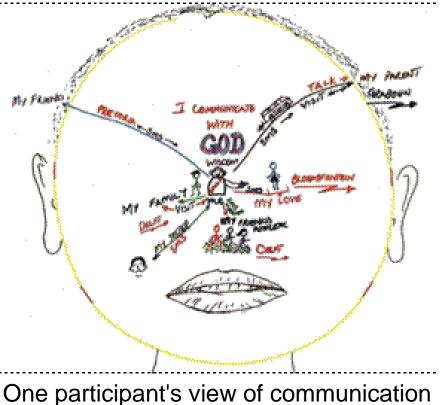- Currently communications technology does not support sign language.

Deaf Telephony : Method

- The (eventual) method shares aspects of community-based co-design and action research.

- This methodology is a way of exploring a design space in a way that alleviates the restrictions of the designer's own viewpoint and bias.

- In a cyclical fashion the designers develop according to their skills and learning and according to the users' expressed requirements and their learning.

- The researchers and the users end up being the design team.

Outcome: Community-Based Co-Design

- The story of this wide-ranging design has been one of continual fertile (and on occasion frustrating) co-design with this community.

- The team's long-term involvement has meant they have transformed aspects of the community and that they have themselves been changed in what they view as important, and in how they approach design.

Extended case-study:
www.id-book.com/casestudy_11-1.php

One participant's view of communication

Summary

- Ideas of community are expressed by Ubuntu

- (Ethnographic) Action research allows democratic development

- **Ubuntu means the researchers and users form one community: mutually learning and mutually designing**

Final Thoughts

Ethics: Ubuntu Action

- Ethics can only be born out of honesty about *ourselves* and the community in which we operate.
- A long-term intimate involvement with a community raises important ethical issues which are fundamentally concerns of reciprocity.
- Explaining your role to the community
  - Explaining what research is
- Avoiding halo effects
  - Use local researchers
- Informed consent
  - Often through proxy ("human-access point")

Realize: I

- The community might be very ambivalent to change since it upsets cherished notions and comfortable dysfunction.

Realize: II

- The community reluctance to accept the "beneficial" solutions proposed by the ICT developer might force the developers to give up their cherished notions of progress.

- It is the democratic right of a society to filter new products through their cultural and social requirements.

- The right or wrong of the new application depends on the situated creation of meaning by the community

Community Based Socially Aware } Software Engineering

- Ubuntu provides the grounds for our community based approach to ICT.

- An approach in which researchers and target users become equal members of the same community that is intent on developing knowledge through effective action.

- Each party admits their own legitimate interests in the joint enterprise

⇒ some kind of *Ethnographic Critical Action Research*

⇒ *Action Engineering?*

Designed for Use *vs* Appropriated for Use

- SMS was an afterthought on the GSM standard
- Nokia's Jan Chipchase: "however we design this stuff — carefully design this stuff — the street will take it and will figure out ways to innovate, as long as it meets base needs"

Action Research >>> Agile Software Engineering

- The cyclical nature of action research, where questioning and reflection are tied to intervention, neatly solves the need of users to learn about ICT while the engineers learn about the community within which they are working.

- Need a methodology that not only iterates on the solution, but the problem as well

Putting ourselves in the design loop?

- Is Action Research really ⋙ Agile or Iterative Software Engineering?

- Can we move :
  - *from* designed *for* *(4?)* systems
  - *towards* co-creating designed with systems?

- Can we envision a flexibility in ourselves to redesign ourselves as much as we design artefacts outside?
  - Are our own methods and beliefs as much up for grabs as the cherished values of the community that we are trying to transform with our technology?

Open ended design?

- Is it not probable, once we accept the community as co-designers that we might not even have the last word in design?
  - Can we facilitate the process by aiming to produce tools rather than finished products?
  - Are the uses of our systems of necessity situated outside the perspectives which we are able to entertain?