

Socio-Technical Systems Technology Human Capabilities

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Definition: Socio-Technical System

- Socio-Technical System
- “an intellectual tool to help us recognize patterns in the way technology is used and produced” (Huff, “What is a Socio-Technical System?” from Computing Cases)
- Socio-Technical systems provide a tool to uncover the different environments in which business activity takes place and to articulate how these **constrain** and **enable** different business practices.

1. STS as an environment

- Socio-Technical systems provide a tool to uncover the different environments in which business activity takes place and to articulate how these **constrain** and **enable** different business practices.
 - **Instrumenting action**
 - enabling us to do new things
 - magnifying our ability to do old things
 - **Constraining or determining action**
 - we delegate actions and responsibility to technical artefacts
 - difficulty controlling complex systems

Complexity constrains as well as enables

- Tightly coupled systems
 - difficult to contain a failure by isolation; failures tend to cascade throughout the system
 - a tightly coupled work-study relation breaks down when university changes a Monday to a Tuesday
- Non-linear causality
 - actions “ripple” throughout the system producing changes/effects that are difficult to predict
 - no exams in the last week of classes prevents teachers and students from leaving early (=intended effects)
 - but it also leads to “stacking up” exams in the penultimate week

2. STS as **System**

- STSs are **Systems**
 - A whole of interrelated parts that are related to one another and interact with one another
- Requires systematic thinking:
 - actions feedback on the agent
 - the distinction between the agent (actor) and the objects targeted by agents (technical artifacts) begins to break down as artifacts
 - the environment or surroundings of action also feedback on the actor by constraining and enabling certain directions of action

Some examples

- Prohibiting exams during the last week of the semester
 - Goal: Prevent teachers and students from ending the semester early
 - Actual Unintended results:
 - Exams “stack up” in penultimate week of the semester
 - Certain pedagogical approaches are constrained while others are enabled
 - Reflective and summative activities discouraged
 - Comprehensive, content based exams are imposed
- Changing schedule to respond to holidays
 - Creating conflicts for students who have attempted to coordinate working and class schedules

3. STSs and their sub-environments

- A STS can be divided into different parts or components that function as sub-environments
 - hardware, software, physical surroundings, stakeholders, procedures, laws, and information systems.
 - constrain and enable activities individually and collectively
- Think about how the physical environment of the classroom embodies distinct pedagogical styles

How classrooms constrain and enable

	Teacher Centered	Student Centered
Technologically enhanced	Room 236. Teacher has data display projector, computer, smart board, wireless keyboard, and mouse	Different computer stations distributed throughout classroom. No clear teacher stage and student receiving areas. Maybe a central discussion zone but information stations where students go to solve specific problems
Technologically deprived	Traditional classroom. Chairs arranged in rows to maximize control and discipline. Clear separation of teacher and student zones	Chairs and tables arranged in circle to promote discussion. Distinction between teacher and student zones breaks down.

4. STS embody values

- **moral values** (justice, responsibility, respect, trust, and integrity)
- **non-moral values** (efficiency, satisfaction, productivity, effectiveness, and profitability).
- values can be **located** in one or more of the system components.
- Often these **values conflict** with one another causing the system to change.
- Example of conflict from university
 - Increasing tuition to cover cost increases creates distributive justice problems for students from poorer families

From Ethics of Teamwork, you learned...

- that values can be designed into a STS through...
- **Discovery**
- discover' the values that are relevant to, inspire, or inform a given design project
- **Translation**
- embodying or expressing...values in system design. Translation is further divided into operationalization, which involves defining or articulating values in concrete terms, and implementation which involves specifying corresponding design features
- **Verification**
- designers assess to what extent they have implemented target values in a given system.... [M]ay include internal testing among the design team, user testing in controlled environments, formal and informal interviews and surveys, the use of prototypes, traditional quality assurance measures such as automated and regression-oriented testing, and more
- Flanagan, Howe, and Nissenbaum, "Embodying Values in Technology" in Information Technology and Moral Philosophy, van den Hoven and Weckert.

5. STSs change, tracing out a trajectory

- **STSs change and this change traces out a path or trajectory.**
 - The **normative** challenge of STS analysis is to find the trajectory of STS change and work to make it as value positive and value realizing as possible.
 - Value positive trajectory?
 - Resolve value conflicts within system
 - Resolve value conflicts between different STSs
 - Value negative trajectory?

Technology, technical artifacts,
social objects, natural objects

Distinctions

- **Artifacts**: objects that are not found in nature but are made, designed, and created by humans
- **Social Artifacts**: “play a role in ruling the behavior of humans, their natural cooperation and the relationships between humans and social institutions” Vermaas 11
 - laws, government, state, marriage, driving license, traffic laws, currency (money), organizations (corporations), contracts (including social contracts)
- **Artistic artifacts**: works of art created for enjoyment and beauty
- **Technical artifacts**: “material objects that have been deliberately produced by humans in order to fulfill some kind of practical function.” Vermaas, 5
 - technical function
 - physical composition
 - instructions for use (use or user guide)
- **Technology**: the knowledge and skill that goes into the making of technical artifacts
 - Applied science
 - Craft and skill (handed down from generation to generation)
 - Engineering?

Hypothesis 1

- **Society determines technology**
 - SCOT argues that technologies pass through three stages: interpretive flexibility, closing of interpretive flexibility, and the emergence of the technical “black box.”
 - From Penny Farthing bicycle to modern design (based on Lawson bicycle)
 - Typewriter and the QWERTY keyboard
- Pinch and Bijker (Social Construction of Technology)

Hypothesis 2

- Technology determines society
- Winner and Perrow
 - Complexity (manifest and latent)
 - tightly coupled systems—difficult to control because it is impossible to isolate failures
 - non-linear causality—effects of acts ripple throughout system; non-linearity makes it difficult to predict the consequences of actions
 - Reverse Adaptation
 - Because complex technologies redefine needs (and values), we are forced to adapt ourselves (and our needs) to them.
 - Technological Imperative
 - Technologies transform and redefine human needs. Machine needs become imperative and trump human needs.

Neutrality Thesis

- “from a moral point of view a **technical artifact is a neutral instrument** that can only be put to good or bad use...used for morally good or bad ends, when it falls into the hands of human beings.” (Vermaas 16)
 - Guns don’t kill people; people kill people.
 - At stake—Who is responsible for harms produced by the use or abuse of technology: the user or the designer?

Again, designers can design value into a technology

- **Discovery**
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The ontology of a technical artifact

- **Technical artifacts are relational**, that is, they must be understood in relation to different contexts
 - **Social context**: technical artifact must be unpacked in terms of the use guide
 - But users can always develop procedures that **circumvent** (work around) the guide
 - **STS**: including laws (social artifacts), procedures, other technical artifacts, social context, information and information systems, economies

Techno-Socio Sensitivity

Responsibility Skill	Description	Module	Activities
Techno-socio sensitivity	“critical awareness of the way technology affects society and the way social forces in turn affect the evolution of technology”	Socio-technical Systems	Identifying sub-environments
Socio-Technical Systems in Professional Decision Making (m14025 from Connexions)			How each constrains activity
Responsible Choice for Appropriate Technology (m43922)			How each enables or instruments activity
			Value vulnerabilities and conflicts
	CE Harris, (2008), “The good engineer: Giving virtue its due in engineering ethics,” Science and Engineering Ethics, 14(2): 153-164.	1. Different environments constrain and enable activity. 2. System of distinguishable but interrelated and interacting parts. 3. Embody / express moral and non-moral values. 4. Normative objective = tracing out a value positive path or trajectory of change.	Plot out system trajectories or paths of change

Responsible Technological Choice

AT Case	Pivot to PR	Frameworks
One Laptop Per Child	Laptops to Teachers	<ol style="list-style-type: none"> 1. Restore / Preserve interpretive flexibility 2. Labor Intensive 3. Simple 4. De-centralized
Removing gender bias from airplane cockpit design	Removing social injustice from gas pipeline design	
Uchangi Dam (eng as honest broker)	Engineers as Honest Brokers in PR Energy Debates	
Amish (exercise of technological choice)	Vieques—Are windmills an appropriate or intermediate technology for Vieques?	Values in technology “fit” those embedded in STS
Aprovecho Case (NGO designs and tests wood-burning cooking stoves)	<ul style="list-style-type: none"> •Are wood-burning stoves an appropriate technology? •Is there a need for these stoves in PR? •Would PR be a good regional center for testing stoves? 	Technology serves as “conversion factor” in the conversion of capabilities into functionings
Waste for Life (Press that makes building materials out of waste products)	Using STS analysis to explain difference between Lesotho success and Buenos Aires failure	

Mindsets or Mental Models

Paternalism and other unquestioned assumptions

What is a mindset or mental model?

- A framework that structures, orders, and filters experience
- Mind sets (or mental models) are for the most part good
- But because they filter, they leave things out
 - Werhane: “resulting mindsets or mental models are incomplete, and sometimes distorted, narrow, and single-framed, and often turn into biased ways of perceiving, organizing and learning.” (*Alleviating Poverty*, 46)
- Because something does not make it through our mind sets, we think it unimportant

Paternalism

- Divides the world into developed and underdeveloped
- Developed is superior to the underdeveloped
- Responsibility of developed is to impose its technology, social forms, economic systems, and political views on the undeveloped
- Werhane: “encapsulates the poor as passive recipients rather than active determinants of their own futures.” (Alleviating Poverty, 45)

Generalization Bias

- Closely related to bias of common sense and bias of conceptualism
- We ignore particulars (information special to a region) and reduce the remote and distant to the familiar and local
- Examples:
 - Children are not mature enough to have/use banks
 - Women in impoverished circumstances cannot pay back micro loans
 - Individuals in impoverished nations, who are at the bottom of the economic pyramid, are there because they lack crucial skills or are handicapped

Unquestioned Assumptions

	Assumption	Mental Model
OLPC (XO Laptops)	Children learn through inquiry-based and self-directed learning.	Research Bias: Theory prevents concrete observation
Waste for Life (Hot Press)	A technology is neutral and can be integrated into different STSs with similar results.	Neutrality Thesis
Aprovecho (Wood Stoves)	A stove appropriate for underdeveloped countries can be developed “in the lab.”	Paternalism (Reverse or Inverse Peace Corps helped matters)
Amish	The Amish have abandoned technology for a primitive lifestyle.	STS Chauvinism
Airplane Cockpits	Women are physically and emotionally incapable of flying airplanes.	Gender Bias (Gender differences form basis of value hierarchy)
Podcasts to Zimbabwe	Podcasts are value neutral tools that can be integrated into a STS with no “surprises.”	Neutrality Thesis

Capabilities Approach of Sen and Nussbaum

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ADEM

Capabilities Approach

- “help answer the question, “What is this person able to do or be?”
- “Substantial freedoms, causally interrelated opportunities to choose and act.”
- “They are not just abilities residing inside a person but also freedoms or opportunities created by a combination of personal abilities and the political, social, and economic environment.”
- Paradigm Shift
 - Replace view that these communities are deficient (have needs...) with view that communities are repositories of capabilities and resources that can be engaged.

- Martha Nussbaum. *Creating Capabilities: The Human Development Approach*. Belknap Press of Harvard University Press, 2011, 20, 33-34.

Conversion Factors

- Importance of realizing capabilities
 - Making real the human potentials of individuals is an essential part of happiness and wellbeing
 - In language of Capabilities Approach, this is turning capabilities into “functionings”
- Means that realize capabilities are called conversion factors: private, social, environmental

More on conversion factors

- Personal
 - Metabolism, physical condition, sex, reading skills, gender, race, caste
 - Social
 - Public policies, social norms, practices that unfairly discriminate, societal hierarchies, power relations related to class or gender, race, caste.
 - Environmental
 - Physical or built environment, climate, pollution, proneness to earthquakes, presence or absence of seas or oceans
- Robeyns, Ingrid, "The Capability Approach", *The Stanford Encyclopedia of Philosophy (Summer 2011 Edition)*, Edward N. Zalta (ed.), URL = <<http://plato.stanford.edu/archives/sum2011/entries/capability-approach/>>.

Create the background conditions where people are
“empowered” to exercise their basic capabilities

Life	Sense, Imagination, Thought	Affiliation
Bodily Health	Emotion	Other Species
Bodily Integrity	Practical Reason	
Play		Control over one's environment

Application

Duchity Haiti

Concept	Description	Question posed from concept relative to development	Information from survey and visits relative to concept	Information challenges: focus for more info-gathering activities
Capabilities Approach	<p>“[S]ubstantial freedoms, a set of (causally) interrelated opportunities to choose and act. [These] are not just abilities residing inside a person but also freedoms or opportunities created by a combination of personal abilities and the political, social, and economic environment.” (Nussbaum)</p>	<p>What are the pertinent capabilities affected by electricity availability and use? Can electricity play the role of a conversion factor here?</p> <ul style="list-style-type: none"> • Practical Reasoning: means of realizing life plans and aspirations • Affiliations: (economic and social) • Control over environment: (unemployment and environmental degradation) 	<p>Survey data also indicates that predominant occupations are business/merchant and farming. It also establishes a strong interest in the availability of electricity for carrying out business/market and agricultural activities. It indicates a low level of interesting in using electricity to run entertainment devices like TVs, computers, and radios</p>	<p>More data required both on how electricity would be used and how electricity stands in relation to other energy generation alternatives. One interesting problem. Could computers based on the OLPC model play a greater, and positive role in education. Electricity, thus, could serve as a conversion factor in realizing educational capabilities such as emotion and sensation, imagination, and thought.</p>

Duchity



220 km, 6-12 hours

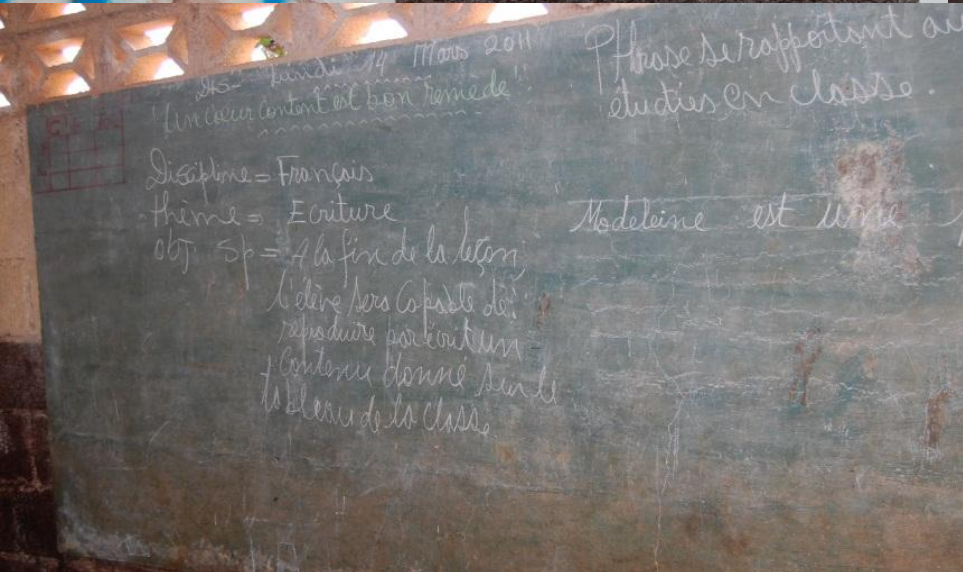
Scenes From Duchity



Glacé River: Hydro Power



Education in Duchity



Hardware / Software	Physical Surroundings	People, Groups, & Roles	Procedures	Laws	Cultural Matters
Diesel Generator Electricity Wiring (inside and outside) Individual Generators	Mountains (stripped and unstripped of vegetation) School: (natural lighting, benches, and blackboards)	Orphanage YouthHaiti Global Initiatives (Rotary Club, UNICEF, etc.) NSF UPRM (land grant university)	Measuring water flow Using/Repairing generator Measuring water fall Making Charcoal (inspecting new school)	Eng Codes (Parish will not fund rebuilding school in Pleasance) Regulating the generation of electricity (public, private, utility)	French Colonialism Language: French and Creole
Computers? Cell Phones? Transportation technology	Earthquake and Tsunami Zones Highways (paved, unpaved)	Universities Primary and Secondary Schools Governments (international context)	Pedagogical Approaches (parochial non-parochial) Student Assessment	Environment al standards and enforcement Land use	

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Jeopardy and Technological Choice

- Responsible choice for appropriate technology
 - <http://cnx.org/content/m43922/1.8/>
- Jeopardy STS IM
- Jeopardy Socio Technical Systems (with categories on capabilities and markets)
- Technology Choice Cases (OLPC, Amish, Uchangi Dam, Airplane Cockpits)
- Tech Choice Cases (Aprovecho, Waste for Life, Human Capabilities)