Designing innovations : Frugal-Concrete/Abstract

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11th Feb 2019 class

Levels of abstraction

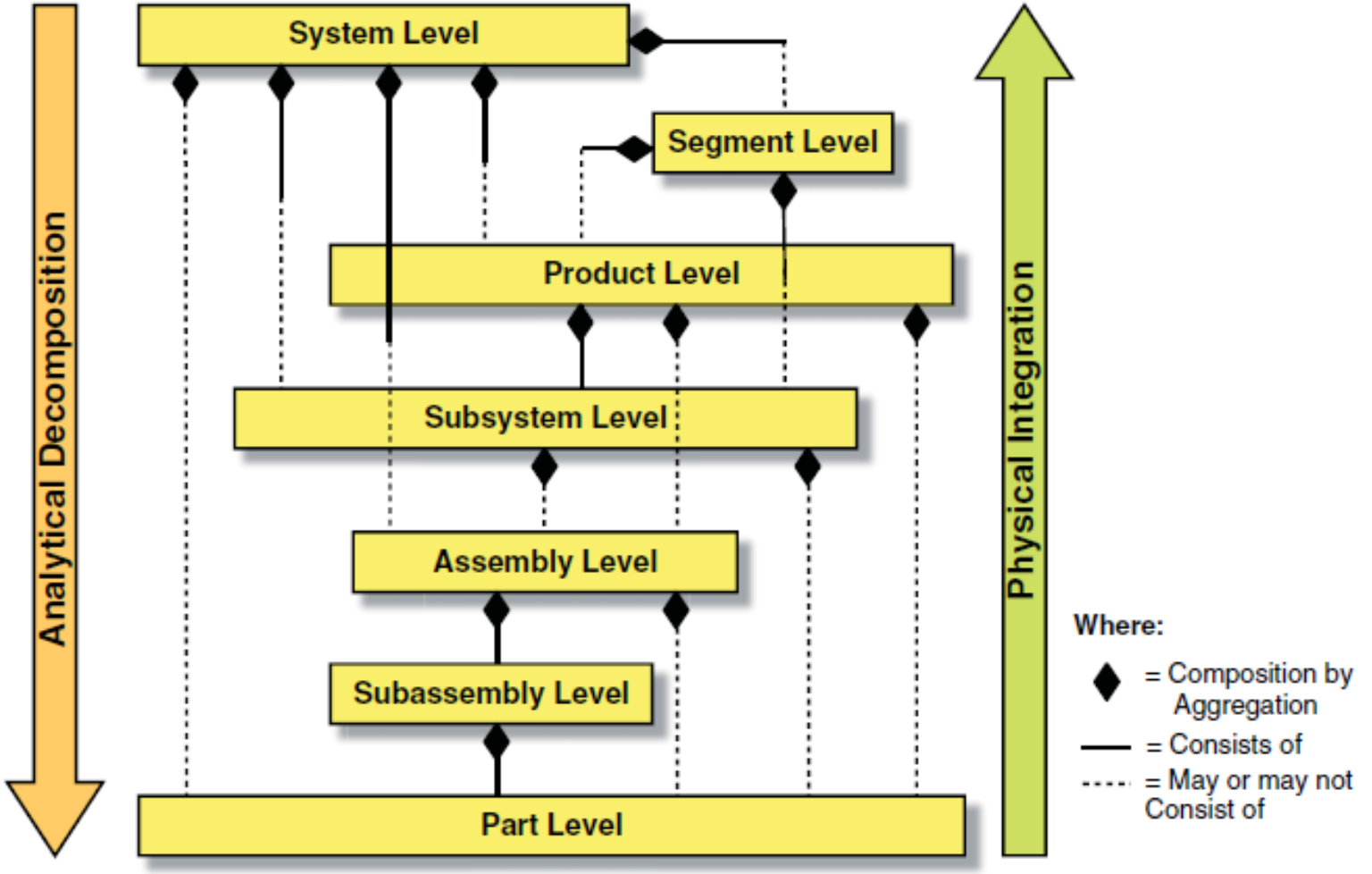
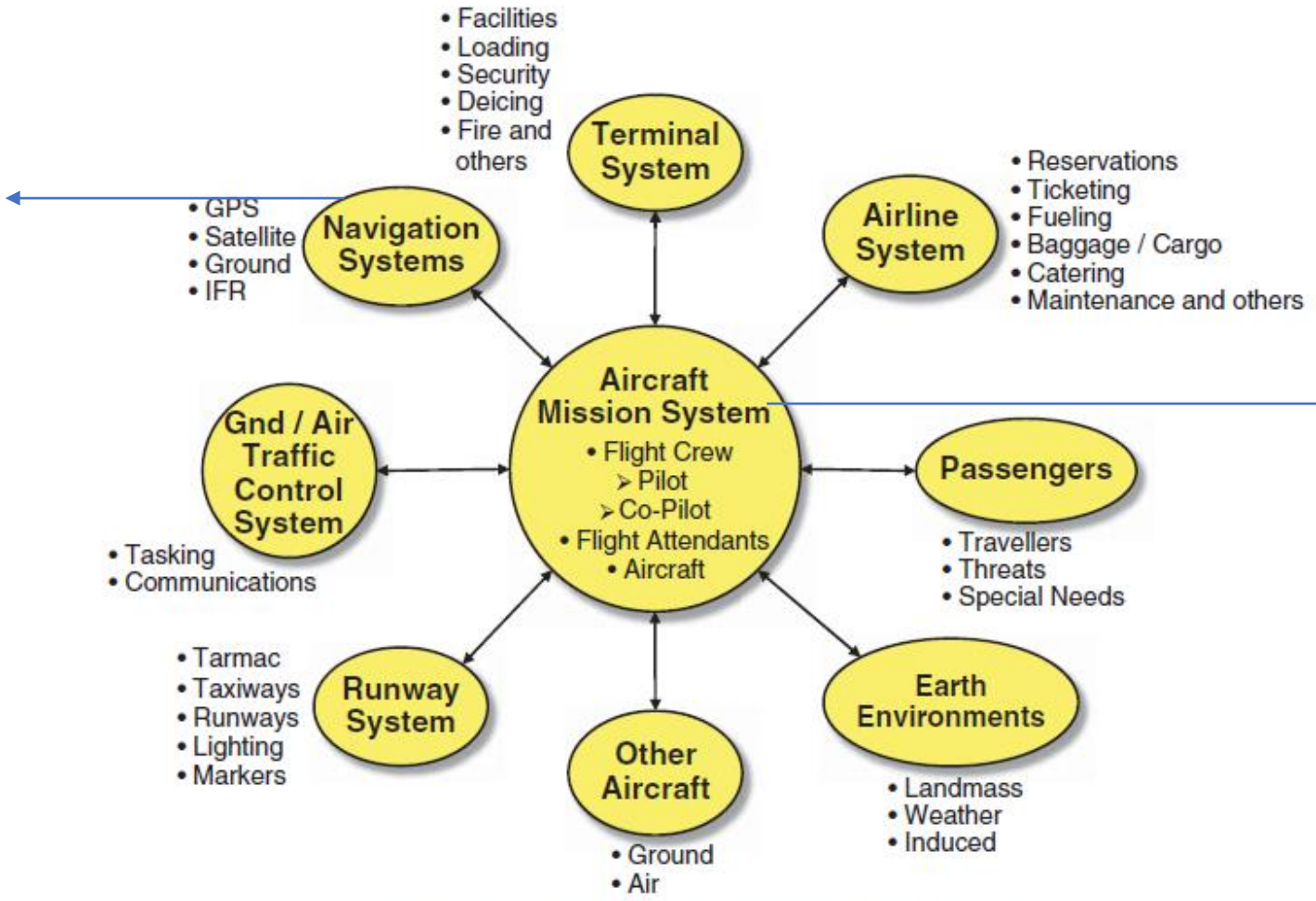


Figure 8.7 System Analytical Decomposition into Levels of Abstraction versus Physical

context diagram – defines what is NOT in a system

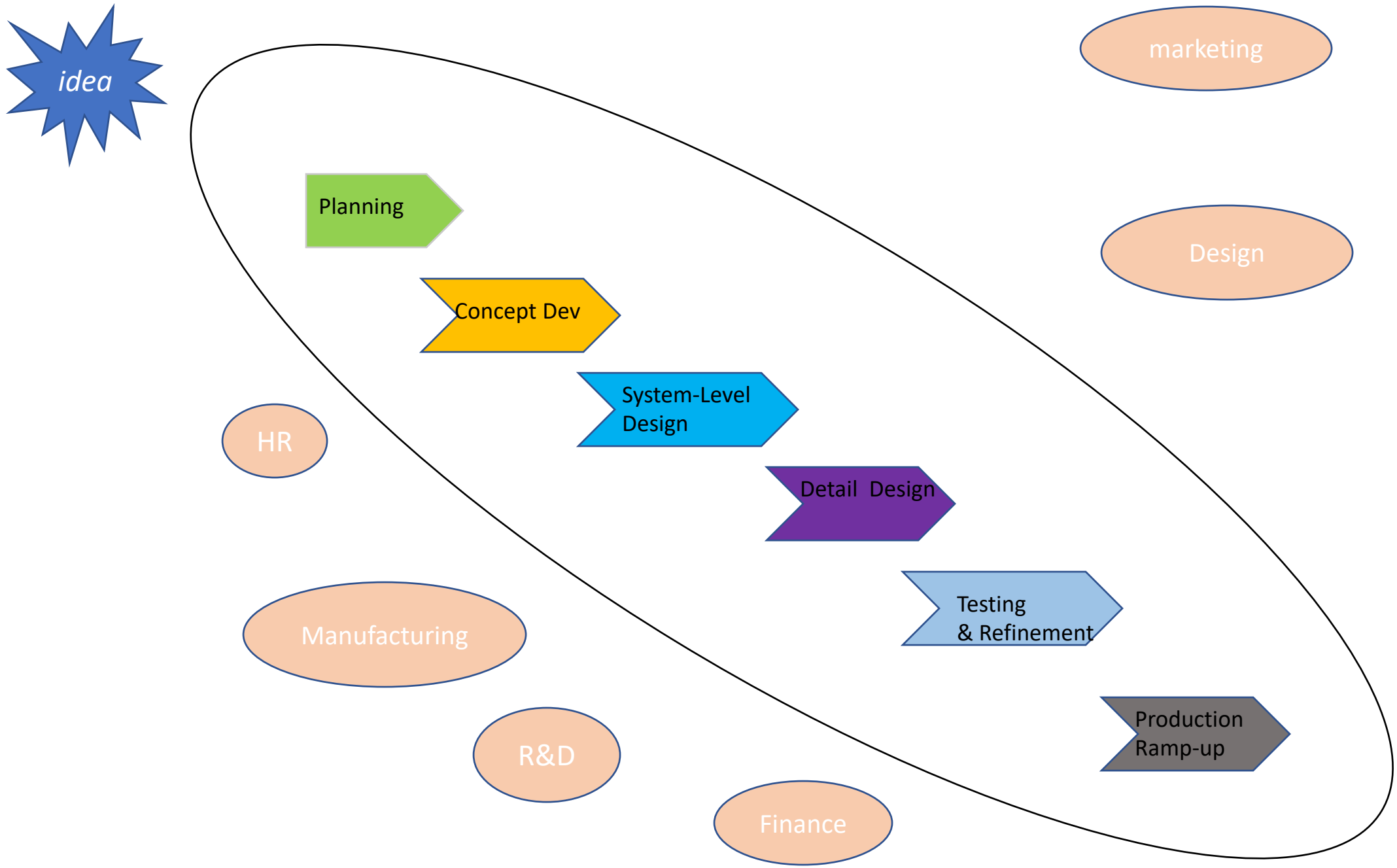
External system



System of Interest

Figure 8.1 Context Diagram for an Aircraft Mission System

Source: Systems Engineering by Wasson


idea
marketing
Planning
Design
Concept Dev
System-Level
Design
HR
Detail Design
Testing
& Refinement
Manufacturing
Production
Ramp-up
R&D
Finance

Design under Chain Linked Model vs. under Systems Engineering

	Chain-Linked Model (CLM)	Systems Engineering (SE)
Design	Activity occurring in firms as part of an innovation system and process (central chain)	Activity under study
Input	Main feedback (raw data) between customers' needs and entrepreneurs' expectations	Stakeholders' needs, wishes, desires, expectations, etc., but also the real use of existing products
Outcome	A concrete artefact exhibiting innovative characteristics	Abstract (systemic) models enabling the development of solutions (that can be innovative) satisfying stakeholders' requirements along the system's entire life cycle
Selective criterion	The innovative outcome is adopted (or not) by customers	The system must be well-conceived and it can be embodied in various context-dependent solutions
Process	The central chain is based on iterations between design occurrences depending on the product maturity: invention, detailed design, and re-design	Design involves both organisational and technical processes, which are based on iterations between system design and solution development.
Knowledge	Pool whose content is not detailed	*Ex ante* knowledge increasingly encoded in software
Research	Activity pulled by firms' demand, whose content is not detailed in the model	Engineering sciences play a key role, with a focus on software enabling Model-Based System Engineering (MBSE)
Sources	Kline and Rosenberg, 1986	ISO/CEI/IEEE 15288:2015

So, where does grassroot/frugal inventions and innovations fit?

Hierarchical and Linear Model of Innovation (HLMI) vs. Alternative model of innovation (AMI)

Frugalist Diptych

First panel: Frugalism in poor countries		Second panel: Frugalism in rich countries	
P1	*"Find opportunities in a constrained context and transform constraints into opportunities"*	P7	*"Engage and iterate"*, *i.e.* involve end users in innovation process as soon as possible
P2	*"Do more with less"*	P8	*"Flex the assets"*, *i.e.* and improve innovation process agility
P3	*"Think and act with agility"*	P9	*"Create sustainable solutions"*
P4	*"Aim for simplicity"*	P10	*"Shape customers' behavior"* to give frugality hedonistic value
P5	*"Involve marginal populations"*	P11	*"Co-create value with prosumers"*
P6	*"Follow oneself insight and heart"*	P12	*"Make innovative friends"*, *i.e.* extend the boundaries of innovative communities
Source: Radjou *et al.*, 2013, p. 45.		Source: Radjou and Prabhu, 2015, p. 33-35.	

Engineering solutions – the grassroots way.

- https://www.youtube.com/watch?v=jJ-tTrZPvag

PROBLEM ADDRESSED

Not all the farmers can afford bullock, a small tractor or a power tiller. Also due to relatively
low land holding capacity many farmers do not need these farm equipments. Bicycle Weeder is a multi-purpose farm implement developed using inexpensive bicycle components.

Name : Gopal Malhari Bhise
District & State : Jalgaon, Maharashtra


MITTI COOL


MITTI COOL
SOUL OF THE SOIL

Q: are frugal/social/grassroot innovators – cognitive engineers/designers?

Remya Jose, she was 14 years old when she designed it.

https://www.youtube.com/watch?v=MGK5TpTLNZY

https://www.youtube.com/watch?v=2v1rSA4FqlM

Shalini Kumari, 19, a resident of Patna, received the award.
Made the first prototype at age 12

https://www.youtube.com/watch?v=z3oBPywM8H4

In Japan, the social enterprise Nippon Basic has developed the Cycloclean– a bicycle that purifies water. Designers use pedal pressure to force water through a carbon filter, pumping up to six litres a minute

Hippo Water Roller is a barrel-shaped container. Its innovative design allows for 90 litres of water to be placed inside a rolling wheel.

Students Design Water Barrel That Filters as it Rolls

hipporoller.org

M-Pesa

- Launched in 2007 in Uganda

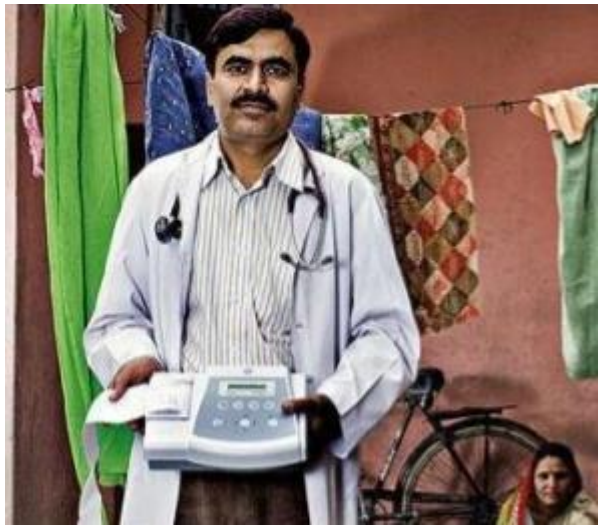
(first patent for mobile payment system was filed in 2000)

- In India, teamed up with ICICI bank for roll out (launched in 2013), Vodaphone is running the last mile.

Cardiopad is a touch screen medical tablet that enables heart examinations such as the electrocardiogram (ECG)

Dr. S.R. Daga, formerly a paediatrician in Mumbai has developed a low-cost incubator from polystyrene boxes for preventing hypothermia among babies.
At $200 each, the reusable sleeping bag-style warmer can maintain infants' body temperature by using phase-change wax that stays around 37 degrees Celsius for up to 6 hours.

Source: http://www.thealternative.in/lifestyle/25-great-frugal-innovations-from-around-the-world/



GE healthcare: MAC line of ECG system is designed for developing market conditions. It is highly portable and can be easily carried to patient's room and it can also be operated on battery.

FLAP bag: TImbuk2, the messenger bag company has designed a bag, featuring photo-voltaic panels for capturing solar energy, an internal USB charger for electrical gadgets and a flashlight for night-time vision.

Is this engineering or totally jugaard?

Discussion points

- Can frugal innovations/inventions fit into a systems architecture?
- If yes, how; if no, state the reasons.

Under SE, design is driven by "*stakeholders*"" "*needs, desires, wishes, expectations*" (ISO/CEI/IEEE 15288:2015, p. 52); this category is wider than that of customers

The *International Council on Systems Engineering* (INCOSE) (2015) states that "*Systems Engineering is an engineering discipline whose responsibility is creating and executing an interdisciplinary process to ensure that the customer and stakeholder's needs are satisfied in a high quality, trustworthy, cost efficient and schedule compliant manner throughout a system's entire life cycle*."

ISO/CEI/IEEE 15288:2015 standard defines SE in similar terms, as an "*interdisciplinary approach governing the total technical and managerial effort required to transform a set of stakeholder needs, expectations, and constraints into a solution and to support that solution throughout its life*."

Inclusivity is the principal root of Frugalism,

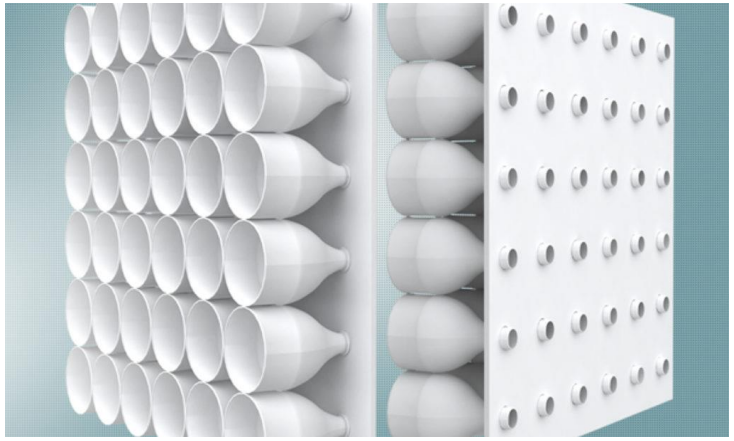
Required to design frugal innovation.

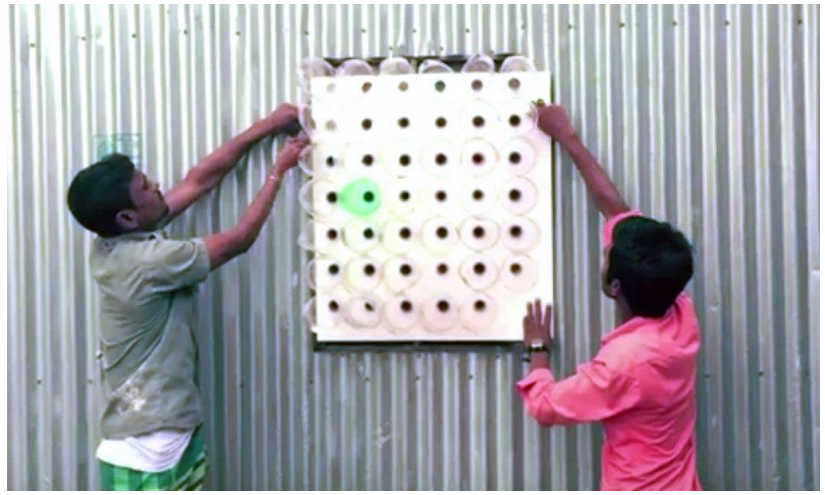
Inclusivity occurrences	Product (object knowledge)	Process (procedural knowledge)
Political inclusivity	Claim that innovation outcomes must make a better world for everybody (innovation must be progressive)	Claim that innovation process must involve everybody (innovation must be democratic)
Ethical inclusivity	Consider inclusivity as the main criterion for innovative choice	Innovate with awareness of the socially excluded
Market inclusivity	Target excluded clients	Consider clients as prosumers
Entrepreneurial inclusivity	View frugal innovations as opportunities to develop frugal entre- or intra-preneurial projects	Practice frugal entre- or intra-preneurship
Managerial inclusivity	Enable systems or solutions leveraging frugal innovation process	Implement frugal, then agile and collaborative innovation process
Technical inclusivity	Improve the value of the product (affordability, functionality, usability, agreement, reliability, etc.) (users' inclusivity), and develop solutions that are modular, hackable, material efficient (cradle to cradle, downsizing, upcycling, etc.)	Improve the iterations between system and solutions design by using new methods (design thinking…), tools (virtual reality, 3D printing…), and workplaces (Fab Labs, Hacker Spaces, etc.)

Frugalist Engineering Framework (Product Domain)

Frugal Systems Engineering (FSE)		Frugalist principle	Existing tools	SE Diagrams
Design a frugal system	Stakeholder needs and requirements definition process	Map usually excluded stakeholders (political inclusivity) and vernacular constraints and enablers	Ethnography methods, immersive design, empirical inquiry, empathic design, life cycle analysis, etc.	Context, use case diagrams
	System requirements definition process	Elicit inclusivity	Value analysis, target costing, cost as independent variable, etc.	Requirements diagrams
	Functional architecture definition process	Develop parsimonious structures	Functional analysis, functional reliability methods, intra-domain DSMs, etc.	Block definition diagrams, internal block diagrams, activity diagram, state machines
Map conceptual design to embodiment design	Function-Organ mapping	Perform surjective mapping	Inter-domains DSMs	Traceability matrices
Develop frugal solutions, *i.e.* apply DFF	Physical architecture	Look for economies of scope (modularity), enable DIY, etc.	Modularity-focused methods...	Out of scope
	Component design	Look for economies of scale or organ downsizing, etc.	Standardisation, dimensioning methods with good enough criteria, database of vernacular solutions...	
	Form design	Apply functionalist maxim...	Form design patterns...	
	HMI	Put "*usability*" (Adler et Winograd, 1992), affordance, and agreeability into practice...	Ergonomics patterns...	


MyIndiaPictures.com

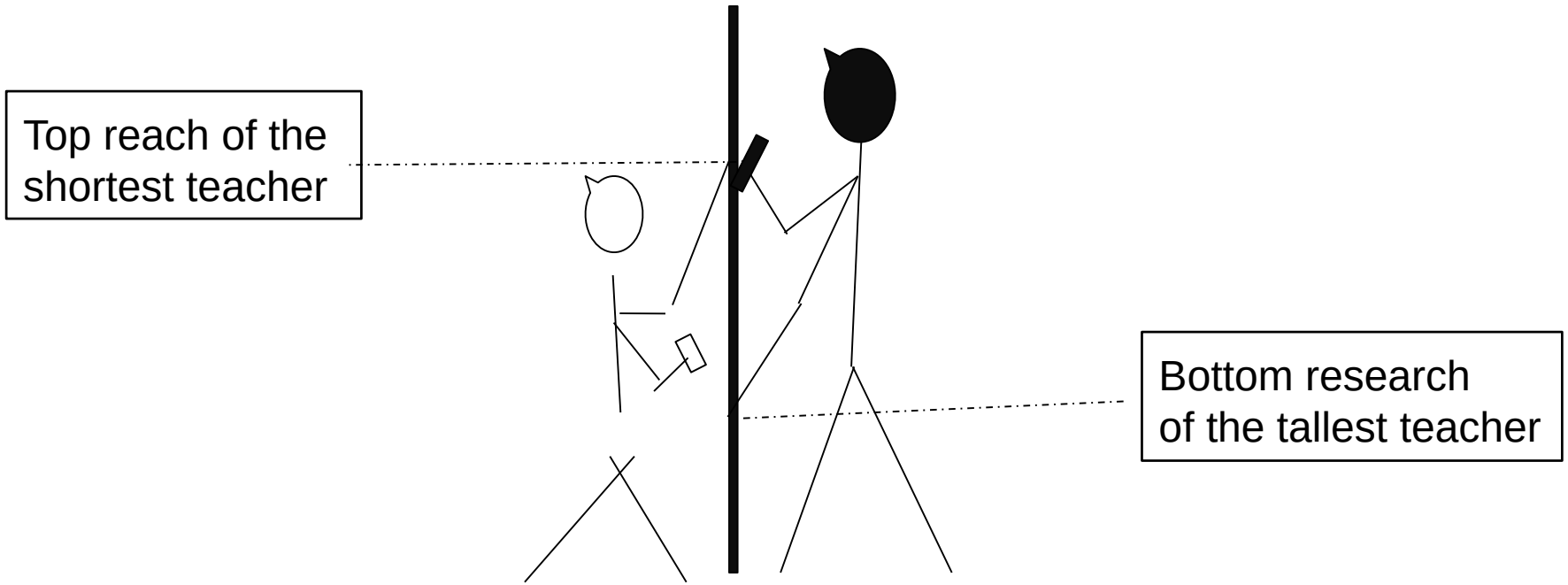





Coolbuddy.com

All things small & big!

Analysis of Need



Best Top & Bottom height of class-room chalk board

Frugalism is focused on astute concrete solutions or craftsmen’s resourcefulness, while Abstract Design Paradigm emphasises abstract categories and engineers’ modelling activity

Hence.. The way forward for National versus international innovation framework for new product innovations…

- The question is not: What is the trade-off between performance and cost? But rather: How can designers obtain the highest level of inclusivity with the lowest life cycle cost possible?
- Most confuse frugal innovation with low cost design, frugal engineering and hacking, Low Tech or good-enough solutions and routine engineering.
- Frugalism encourages a "*de-westernisation*" (Boillot, Dembinski, 2013) of innovation thinking and practice, and it would be interesting for Frugalists to integrate Abstract Design Paradigm in their frames of reference.

Source: Frugal innovation or frugal renovation: how can western designers adopt frugal engineering?
Jean-Pierre Micaëlli, Joëlle Forest, Eric Bonjour et Dominique Loise ,Dans Journal of Innovation Economics & Management **2016.**

To end on a musical note….

- https://www.youtube.com/watch?v=JxiCBgjRWG4