Frugal Engineering

by

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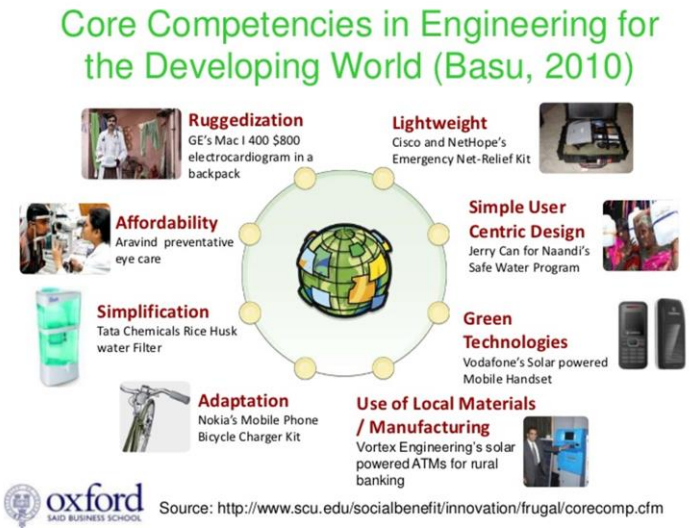

Frugal innovation is also referred as **'affordable excellence'** because of its **Unique Value Proposition (UVP)**
which are as follows **(a)** through **(d)** - R.Tiwari and C. Herstatt

(a) **Reduced cost of ownership:** It is just not the price point at purchase, which anyway is crucial as a factor for success with frugal innovations; it is more than that; it rather is in significantly reduced **'overall or total cost of ownership (TCO)'** that is achieved by the low costs of input usage, maintenance and repair throughout its service life from acquisition till disposal.

- For example, in **automobile industry**, it is **not just the low price** of a vehicle but also the **consideration for high fuel mileage** as well as low **maintenance/ repair costs** that affect a purchasing decision in the **price-sensitive segments of small cars.**
- The same is true for a **fan or fridge**, where **power consumption** and **maintenance cost** is important, **besides the price-point**.

Unique Value Proposition (UVP) in Frugal Innovation....Contd.

(b) **Robustness:** Frugal innovations are often targeted at customers in the mass market or consumers at the **bottom (or base) of the pyramid (BoP)** in the economy.

- This may be for people in rural and semi-urban areas in developing economies or even the **BoP consumers in industrialised economy**.
- For the **latter case, a term 'Reverse Innovation'** in the event of frugally engineered product is commonplace.
- **The products need to withstand various infrastructural shortcomings like voltage fluctuations, abrupt power-cuts, dusty environment, and extreme temperatures.**
- Planned obsolescence that seeks to intentionally limit the lifespan of a product without simultaneously reducing the associated costs for the customer as in practiced now is not compatible with frugal innovation approach.

Unique Value Proposition (UVP) in Frugal Innovation....Contd.

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- (c) **User friendliness:** Many (potential) **buyers** of frugal products **have no prior, first-hand experience** of using similar products. Companies cannot presume a significant level of familiarity on the consumer side in dealing with their products. Frugal products, therefore, need to be **easy-to-use and fault-resistant.**

- (d) **Economies of Scale:** Finally, the need for significant cost reduction, and the **thin profit margins** almost necessarily associated with frugal products **necessitate access to voluminous business** to reduce unit costs of development and production.

We, therefore, **to embody the Value Proposition**, would need to **explore** the **views concerning frugality and design; Design Thinking.**

(as in following slide)

Principles in Frugal Design

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The following design principles are found, that were used singly or in combination for design frugal innovations:

- Minimal use of resources
- Integrating low income consumer in the design process
- Frugal mindset
- Selection and Combination of basic and advanced technologies
- Design focused on cost
- Elimination of over engineered/ unnecessary functions and Product/ system Simplification
- Innovation on a system perspective.

Minimal use of resources (financial, material or institutional):

- Minimal quantity of raw materials
- Reuse of components and
- Simpler designs without supererogatory (over engineered) features.

- (Lessening the use of raw materials reduces adverse impact on the environment and effects a drastic reduction of cost)

Integrating low income consumer in the design process:

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- Understanding and involvement of bottom of this segment
- Designers adopt a more problem-based approach than a solution-based one
- Use of crowdsourcing for a frugal design process through novel and low-cost ways, and
- Exploring methods and means to reduce costs and complexity in the product/systems.
- Analyzing the local needs particularly for the low-income consumers

Frugal mindset:

- Where resource limitations are beheld not as encumbrance to R&D and innovation rather as opportunity
- Innovations developed affordability (frugal) engineering are good-enough in providing the needed (core) functionality for the target market.
- Combining and identifying newer ways of using existing (old) technologies and embedding them in modular designs

Selection and Combination of basic (existing) and advanced technologies:

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- On account of resource constraints, innovations developed under a frugal perspective often embraces basic/ existing and established technologies, which are not quite advanced in comparison to the sophisticated counterparts, who adopts the traditional approach and techniques of innovation. However, modern technologies, such as, IoT or AI based have also supported in several frugal innovations and subsumed and embodied as well. Approaches include; combining existing technologies and embedding them in modular designs and also identify newer ways of using existing and established technologies.
- Innovations developed having frugal characteristics are good-enough to provide the needed functionalities for the target market.

Design focused on cost:

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- Principle of design to cost or cost innovation while meeting all the (core) functional requirements, incorporating rather basic minimum features.
- Turning a high-cost product into low-cost goods (e.g., low cost airlines).
- Cost reductions through process innovations: Usually by (i) local sourcing, (ii) standardized components, (iii) cost-effective raw material sourcing and (iv) low labour costs (in emerging economies) as well as efficiency and scaling-up.
- Conducting continuous and through feasibility check for a given product concept or design and the process to achieve design to cost are: (i) Components with supererogatory or complex designs are to be examined for elimination or modification (e.g. using single wiper instead of two wipers in Tata Nano Car) (ii) and/ or reducing the number and size of components (e.g. reducing the diameter of tyre and reduction the number of fasteners) and (iii) Substitution of materials (e.g. use of engineering plastics).

Design focused on cost Contd. :

- Use of a design for manufacturing approach: That is, examining and determining the number of useful in the design.
- Involving suppliers in cost-reduction exercise and get their insights on integrating some functions in the designed parts.
- Adopting frugal innovation cost cutting approach into initial design process for innovation

Elimination of over engineered/ unnecessary functions and Product/ system Simplification:

- Functions or elements may be done away with in the product if the buyer does not see value, due to those, as essential or basic. (For example: many mobile phones include functions beyond the basic value expectations for a large customer segment).
- The cardiogram device (Mac 400) developed by GE removed components, not unnecessary but increases complexity and so the product can be used even by not specialists. It is at a lower price, making it is affordable for small hospitals and clinics, usually in remote areas.
- By restricting functionalities to the core, lesser resources (material, human, logistics, etc.) are required in manufacturing the product.
- Simplification of use is another key design principle of frugal innovation (compared to existing products sold on developed markets) as it aims at creating simpler solutions.

Innovation on a system perspective:

- While enterprises are capable in designing new products with a frugal perspective, it also requires to understand that there is a need to rethink the systems.
- In other words, the approach should put emphasis on ‘product-service system’ perspective rather focusing only on the product, when conceiving a new frugal innovation.

Criteria for Frugal Innovation (Weyrauch and Herstatt)

with example of GE's Healthcare's Vscan - the hand held ultrasound device:

- **Substantial Cost Reduction:** Has the innovation significantly lowered cost (at least by one-third) from a customer perspective (purchase price and/ or total cost of ownership)? Vscan: Cost reduction by 85%: GE's Healthcare's Vscan was launched in China for USD 15,000, in 2008. At that time its cost was 15% of that of a low-end traditional ultrasound unit.
- **Concentration on Core Functionalities:** Does the innovation concentrate on core functionalities that are in fact required for its specific purpose and the local conditions? Vscan: Focus on essential functions fit local needs: Small size and battery powered to enable to travel to patients in rural areas (for whom transportation to hospital is quite difficult) and also very easy to use by doctors who are not specialists.
- **Optimised Performance Level:** Can it be assumed that there was a serious examination of which performance level is in fact needed for the specific purpose and the local conditions? Vscan: Performance Level fits the intended purpose: Performance fits requirements of the clinics in rural areas in emerging markets that call for simple solutions. Performance fits the requirements of quick diagnoses in developed markets.

Frugality and Design Thinking: Views and fruitful associatio

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- In an article related to Design Thinking (DT) for developing frugal products, the authors **(Martin Soles et al.)** introduce a holistic framework for frugal innovation and to analyze the process of deriving the vehicle concept to meet local requirements in rural areas of Sub-Saharan Africa.
- In a recent edition of **WDCD** (What Design Can Do) at **Amsterdam**, a workshop on **Frugal Design Thinking** was held showing how the method can be applied to the field of mobility.
- **Innoitus**, the global **consulting organisation** affirms that **Frugal Design Thinking** is a systematic approach to problem solving, they follow as practice, and it is through contact, observation and empathy with users, design solutions to fit their needs.
- According to a **World Bank Report** (2019), that entails reference to lower priced products, also indicates that many jobs now and in future, will require skills—a combination of technological know-how, problem-solving, critical thinking, collaboration and empathy. **All these are required in Design thinking (DT),** particularly the last one as the **DT process begins with the step 'Empathize'** – understanding the need.

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Familiarization with **Design Thinking** and **Engineering Design Process**
will help create
Unique Value Proposition for Frugal Products