

A CAPABILITY APPROACH BASED STAKEHOLDER ANALYSIS FOR THE BASE OF THE PYRAMID: A CASE STUDY OF THE FIREWOOD BASED COOK-STOVES

Khadilkar, Pramod Ratnakar; Mani, Monto
Indian Institute of Science, Bangalore, India

Abstract

People living under \$2 income per day, referred as Base of the Pyramid (BoP), face undesired situations like lack of nutrition, health, education etc. Design as a process of changing current undesired situation to a desired situation has failed. A crucial reason behind these failures is lack of normative basis to identify and understand the absent or unsatisfied stakeholder. Currently stakeholder analysis in the design is heuristic. This paper uses a normative framework of Capability Approach (CA) for the stakeholder analysis.

A brief discussion on stakeholder theory and analysis is used to identify gaps in the literature. The constructs of the CA are discussed for its suitability to the purpose. Along with methodological details, data generated from the stakeholder interviews, focus groups in a case study of dissemination of improved cook-stoves is used to interlink the theory with the practice. The scope of this work is in identifying and investigating the motives of the stakeholders in the involvement in the product. Though a lot of insights to discern and manage crucial stakeholders is inbuilt in the methodology, this work does not claim explicit coverage of these aspects.

Keywords: Decision making, Design methodology Human behaviour in design, Requirements, User centred design

Contact:

Pramod Ratnakar Khadilkar
Indian Institute of Science
Centre for Product Design and Manufacturing
India
pramod.khadilkar@gmail.com

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1 INTRODUCTION

People living below \$ 2 per day are referred as Base of the Pyramid (BoP). Lack of basic necessities, like food, water, healthcare and education, is prevalent in BoP. Attempts to provide these necessities through different mechanisms, like market, philanthropic activities, policy interventions and developmental aids have failed (Kandachar & Halme 2008; Ramani et al. 2012).

Design is a knowledge intensive, purposeful activity to change 'existing situation into preferred one' (Simon 1996). It is a process through which technologies, products and/or services are planned and brought to life. Design is the vision which dictates 'why' and 'how' a product changes a given situation. Looking at the deprivation and lack of opportunities of the people at BoP one can claim that design as a process, to a large extent, has failed or has not been effectively practiced to change the situation. This work is a part of ongoing research on a design methodology to improve the chances of product success in BoP. The focus of this research work is to aid design for product success. This paper emphasizes the importance of stakeholders in product success.

Absent or unsatisfied stakeholders have been identified for the failure of the products at BoP (Nieusma & Riley 2010; Ramani et al. 2012; Donaldson 2006; Best & Kumar 2008; Morelli 2002). Though identifying stakeholder's demands is a crucial step in the design process (Roozenburg & Eekels 1995), these failures raise questions on the effectiveness of existing methods or the methodologies. These failures challenge the normative basis underlying the identification, evaluation and selection of the stakeholders. Stakeholder theory and analysis is a well-researched, three decade old area from the management literature which has hardly been used in engineering and design. Few usages are for the evaluation of projects from developing countries like health, tele-centres etc. (Mishra & Mishra 2013; Sharp et al. 1999). Stakeholder theory and analysis is struggling with its operationalization as it fails to normatively analyse relevant stakeholder's motive behind product involvement. This paper uses the normative theory of Capability approach to address this shortcoming.

This paper is based on the three decade long experiences of the authors in disseminating the firewood based cook stove for the rural poor. Theoretical basis to decode the experiences from field with regard to stakeholder analysis is presented first and then case study is analysed to elaborate the theory.

2 IMPORTANCE OF STAKEHOLDER ANALYSIS FOR BOP

Stakeholders are individuals or groups which affect and get affected by the involvement in the product life cycle (Roozenburg & Eekels 1995). Direct user and buyer are considered as most crucial stakeholders and others as enablers who perform specific functions, like manufacturing, distribution, transportation etc., to support the product life cycle. Internal stakeholders like product planners, product developers etc. is another important category of stakeholders (Ulrich & Eppinger 2000). Currently stakeholder's expectations from the 'to be designed' product is identified as input for design of product. This is based on the assumption that the stakeholders are willing to get involved in the product life cycle due to their vocations or due to the evident benefit the product offers to them. Experiences from field does not support these assumptions (Donaldson 2006). Information and Communication Technology acceptance which is considered as more productive and labour saving has shown lot of exogenous factors not directly linked with the ICT product (Lee et al. 2006), similar observations are made in acceptance of farm equipment (Feder et al. 1985).

Due to technology focus the design teams tends to forget that stakeholders are independent individuals with their own motives and unique behavioural traits. Even though, from designer's rationality, it may look like the product has immense ability to benefit the stakeholder; the benefit offered by product may not play a role of critical enabler in what the stakeholder wants to achieve. Reasons of non-involvement in product life cycle might not be obvious and might not be linked with the product characteristics and performance.

Understanding these reasons from stakeholder's perspective is ever more crucial in case of BoP. The stakeholders in developed or industrialized markets are bound by the organizational and legal norms. The certifications like ISO can ensure a uniformity of skills and processes. The economic and organizational goals of the stakeholders are well harmonized due to their awareness about policy and predictions about the overall growth. These aspects entail a degree of predictability to stakeholders from developed markets. On contrary to this, major part of the economy at BoP is informal. Due to underdeveloped market infrastructure, stakeholders from BoP are unorganized individuals with relatively less information on current trends and economic possibilities. Their decisions are based on

short term goals as the long term future is quite unpredictable due to constraints and lack of resources resulting into behaviours which may look irrational (Karnani 2009; Banerjee & Duflo 2011) to non-BoP stakeholder like designer or developer. The cultural and contextual differences between the designer and the stakeholders (Diehl 2009); and among the stakeholders (Whitney 2011) aggravate the difficulties in the stakeholder understanding.

3 STAKEHOLDER ANALYSIS: A BRIEF LITERATURE REVIEW

Freeman proposed the ‘Stakeholder approach’ in 1984. The basic premise of the approach is, *“People engaged in value creation and trade are responsible precisely to “those groups and individuals who can affect or be affected by their actions” – that is, stakeholders..... this means paying attention at least to customers, employees, suppliers, communities, and financiers”* (Freeman et al. 2010).

Explicit attention to the complexities involved in conceptions of value by each stakeholder and arriving at an optimal solution to maximize the stakeholder gain is the main contribution of the stakeholder theory and analysis. The literature discusses three broad perspectives on stakeholder approach like descriptive, normative and instrumental (Bailur 2007). Usage of stakeholder theory has been criticized at two levels, one at practical application level and second at theory level. The challenges at application level (Sharp et al. 1999; Bailur 2007) are, a) vagueness of definition of what constitutes a stakeholder b) Lack of concrete suggestions to form a strategy to identify, involve and manage the stakeholders. Identifying and involving stakeholders is the scope of this paper. Managing the stakeholders is not covered explicitly in this work. Outcome of the design is the main reason of the involvement of the stakeholder and thus, though not explicitly, design is responsible for stakeholder management. Existing literature using the stakeholder analysis does not deal with these shortcomings and use heuristic methods to identify stakeholders. Most of the current work give attention on methods of categorizing the stakeholders based on their function or importance which does not help in facing the mentioned challenges (Sharp et al. 1999; Bailur 2007)

Stakeholder analysis has crucial theoretical limitations (Bailur 2007), 1) Need of *‘honesty, transparency, and flexibility on the part of stakeholders when consulted’* 2) Lack of criteria for differentiating between primary/secondary, important/influential stakeholders 3) Subjectivity of analyser towards the differentiating the stakeholder. In design, stakeholders and their importance will change with respect to the design problem, the design context/environment and the designer. A fixed rule to differentiate between the stakeholders will not work in these situations. The behavioural or ethical dimensions of the stakeholders, including the stakeholder analyser, need some grounding theory which can define what should be the basis to evaluate the value or well-being of the stakeholders. The grounding normative framework could have the ability to avoid the biases or subjectivity of all stakeholders including the analyser (in our case designer). The shortcoming in existing design literature is absence of such normative framework to evaluate the value of each stakeholder. Capability approach (CA) is one such framework which can be used for this purpose.

4 USING CAPABILITY APPROACH FOR STAKEHOLDER ANALYSIS

Amartya Sen proposed the theory of Capability Approach (CA) where the ultimate purpose of life, well-being, is conceptualized in terms of normative entities of capabilities. Capabilities are the effective options available to an individual to be and to do for leading a valuable life (Sen 1999). Capabilities are normative entities to evaluate well-being due to its constructs. Interpreting the expectations of stakeholders from design through constructs of capabilities can cover for the theoretical limitations stated earlier. The distinctive features for relevance to stakeholder analysis have not been attempted earlier.

- Importance to freedom: this feature manifests at two levels
 - *Freedom to choose what one wants to be and do* (Robeyns 2005): Stakeholders are different in multiple aspects. These aspects are internal like gender, physical/mental abilities, behavioural aspects and values as well as external like Geographic location, culture, upbringing etc. A designed intervention/commodity should match/concur with the desires and resources one controls. Treating their needs as capabilities ensures that stakeholder’s vision about the desired outcomes is understood from their own perspective. This graduates the stakeholders at BoP as thinking rational individuals from inert recipients (Sen 1999).

- *Freedom to choose among available options* (Robeyns 2005): By definition capabilities are feasible options to choose from. Having multiple feasible options is sometimes essential due to the ‘diversity’ of human beings and available resources (both external and internal to individual). Design thus should understand that multiple stakeholders will be interested in different feasible design concepts. Design concepts should thus not be frozen from the technical feasibility as technically inferior concepts might be something which is desired to fulfil the capabilities of the stakeholders. This aspect cautions designers to simulate and evaluate the product in broader ‘capability’ space, in which direct and indirect effects of product on capabilities of relevant stakeholders could be consciously found (Khadilkar & Mani 2013).

This construct can overcome the limitation about the subjectivity of the analyser towards the stakeholder analysis. Capabilities are the attributes of the individual or a group of individual and not of the analyser. Identifying capabilities need an effort from analyser/designer to use participatory approaches, to understand the internal and external resources available to an individual.

- *Distinction between means and ends* (Robeyns 2005): Stakeholders would be interested in a given design only to fulfil certain ‘ends’, i.e. the purpose of human well-being. A feasible option of using improved firewood stove is instrumental for reducing the firewood consumption. Reduced firewood consumption is instrumental to reduce the efforts and time spent in collecting the firewood, to provide extra time and energy to user’s disposal. Saved time can be then spent on intrinsically valuable, like knitting or chitchatting with neighbour or to take rest. Improved firewood stove is important for the fulfilment of intrinsic capability, for e.g. of being a knitter, but the former does not ensure later. Though the primary responsibility of designer is related to product, i.e. to fulfilling instrumental capability, tracing the intrinsic capabilities linked with the product increases the understanding of the needs and value judgments of the users. This broadened scope allows the designer to avoid the theoretical limitation in understanding the real purposes of involvement of stakeholder.
- *Distinction between means and capabilities* (Robeyns 2005): Means or instruments are not capabilities, for a mean to translate into capabilities a set of resources including product are required. Having a fuel efficient stove is not equivalent to capability of using that stove as availability of firewood, skill, social conditioning towards acceptance of innovation etc. are required (Refer Figure 2). Different resources require different stakeholders who are responsible for converting a mean into a capability for the user. By tracing the resources for a capability, related stakeholders could be identified. Though an inherent criterion to decide hierarchical importance of stakeholders is absent this provides insights on relational importance of stakeholders on success of the design. This construct thus overcomes the theoretical limitation of organizing the stakeholders based on their relative importance.
- *Importance to ethical individualism* (Robeyns 2005): Ethical individualism postulates that ‘individuals, and only individuals, are the ultimate units of moral concern’ (Robeyns 2005). In many cases design interventions are tested for a unit bigger than individual, for e.g., a family or a community. Tragedy of commons is known notion in social well-being studies. Powerful people control the resources leaving the powerless disadvantaged. This distinctive feature suggests that evaluation of the well-being should be based on the most disadvantaged individual as a unit of measurement. This construct thus helps in aggregating the stakeholders, whose well-being through the product or design should be fulfilled, thus guiding the designer for the second theoretical limitation.

5 METHODOLOGY FOR STAKEHOLDER ANALYSIS

Each design stage involves mix of uncertainty and clarity. At initial fuzzy end (shown in orange colour in Figure 1), design is a black box and the involved stakeholders are generic, like, family/spouse, community, society as influences on that user. During the later phases of design (represented as Green colour in Figure 1), when design becomes more concrete, the stakeholders are more specific for a design concept. Explicit understanding of need, and later product, (refer section 5.2.1) helps in tracing the ends of means (upward arrow in Figure 1), and translating means into capabilities (downward arrow in Figure 1) (refer section 4). Stakeholders either provide, or consume, resources; identifying

resources can lead to list of stakeholders. Translating means into capabilities identify resources, and thus stakeholders (refer Figure 2). Tracing ends of involvement in product can identify the motives of stakeholders (refer Figure 3). Ensuring the fulfilment of identified motives and essential resources for specific stakeholders through design can lead to aggregating and managing stakeholders (represented with dotted lines in Figure 1 due to lack of explicit attention in this work). Stakeholder analysis is thus progressive and is relevant to each design stage. Going forward, a case study is used, simultaneously, to simulate the complex theoretical aspects of the CA based stakeholder analysis.

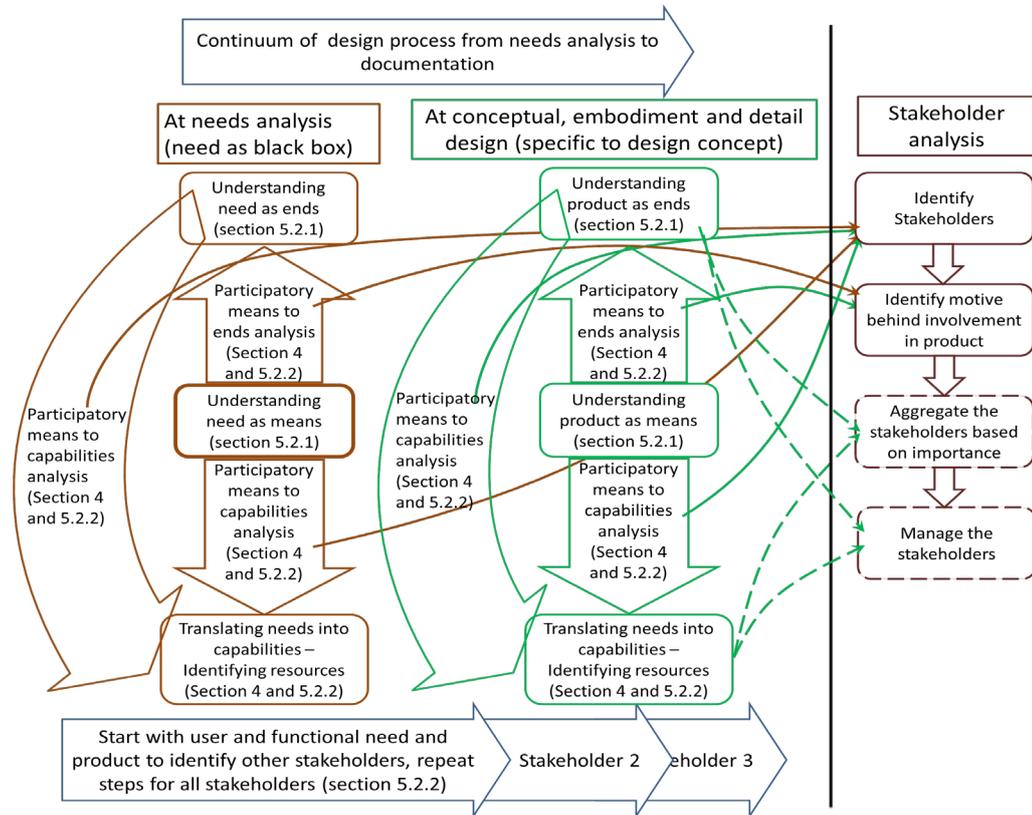


Figure 1. Approach/theory behind the CA based stakeholder Analysis

5.1 Introduction to the case study: Firewood based cook-stove

Centre for Sustainable Technologies (CST) is Indian Institute of Science's (IISc) focusing on 'promoting Sustainable Technologies tailored to suit local conditions of resource availability and habitation' (Anon 2008). astra stove (astra is 'Application of Science and Technology for Rural Areas' currently CST) is a firewood based stove, scientifically designed and disseminated by CST. This technology is in use for three decades and provides 40 percent efficiency. The technology of astra stove offers following advantages: a) Improves the health of women by reducing the direct exposure to harmful emissions from the firewood. Attached chimney and the geometry create air draft to vent out smoke. b) Improved efficiency reduces the firewood consumption reducing effort spent in collection. c) Reduced cooking time provides breather to women in their morning chores

astra stove is traditionally constructed using bricks and mortar. In absence of masonry skills to achieve intricate geometries, finish and dimensional accuracy; the performance of the stove is affected severely. Unavailability of skilled labour was the starting point for design of new innovative stove construction. A new technology called 'Rammed Earth' is employed to construct the stove structural walls. This method uses a proportional mortar of sand, soil and cement which is rammed inside a mould. Main challenge was to achieve the intricate geometry without complicating the method of construction for unskilled users. This new construction method results into better strength and life of the stove. Due to saving in labour charges on skilled labour and saving in material and transportation cost of bricks cost of stove is reduced in new construction method (by 15 to 20 percent). Time saving in training (reduced from close to 10 days to 2 days) and actual construction (reduced from 3 to 5 hours to 2 to 3 hours based on experience) resulted into increased efficiency of dissemination.

An instance of dissemination of the stove in northern part of India (Uttar Pradesh) has been used as a case study in this work. This project was initiated through a social responsibility division of a leading multinational company from India (referred as stakeholder, 'project executor' in this work). CST provided complete technology support and has guided the project executor in dissemination. 'Project executor' was autonomously responsible for planning and executing the dissemination. The information used in the case study is based on the direct experiences in the field, user group and semi-structured interviews conducted by the authors during the time span of 25 days.

5.2 Step by step methodology

5.2.1 Understanding of product concept/s

Understanding the design scope is important to understand what kind of resources is desired. Thus understanding the overall scope, specific to a need and design concept, is important. Following steps help designer in consciously thinking about the whole product life cycle. This kind of checklist is missing in current design methods and methodologies. This list originated from the technology acceptance literature. In the case of stove, as design is frozen, the stakeholder analysis is during the stage of manufacturing, distribution and service. Following analysis should be repeated for each product concept to arrive at the initial list of the involved stakeholders.

- Inherent properties of product (Rogers 1983) – These aspects should be understood for a design as a black box and then for concrete design concepts for all the stakeholders. The stakeholder's judge the product based on certain inherent properties of product. This list help designer to explicate the inherent properties.
 - *'Relative advantage- is the degree to which an innovation is perceived as better than the idea it supersedes ... relative advantage may be measured in economic terms, but social-prestige factors, convenience, and satisfaction are also often important'* (Rogers 1983). For astra stove, the baseline was traditional stove and its relative advantages are listed in section 5.1.
 - *'Compatibility - is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters'* (Rogers 1983). The looks, method of usage, cooking vessels, fuel and construction method was compatible with the existing stoves. Only incompatible part was the method of roasting of rotis (Indian Bread). This was an important aspect for users.
 - *'Complexity - is the degree to which an innovation is perceived as difficult to understand and use'* (Rogers 1983). There is no perceived complexity by the other stakeholders. For direct users pre-planned cooking sequence to utilize the multiple burners was relatively complex.
 - *'Trialability - is the degree to which an innovation may be experimented with on a limited basis'* (Rogers 1983). Being large in size and heavy the stove was not portable and thus was not demonstrated in use, other than in videos. The new construction method added to the non-trailability. In old method of construction knowing dimensions was good enough for building stove for trial, the new method demanded construction of mould before constructing any stove. Due to lack of trialability only few higher management officials from project executor had seen the product as the funds and time allowed them to visit CST before commencement of the project. The decision to implement stove was thus based on feedback without actual trial, leaving a lack of faith in ground staff. This lack of faith was reflected in the communication with community during communication. Ground staff of the project executor said, "if, this product works (emphasis added) then it would be beneficial to all of you (society)", "if, these stoves work well (emphasis added) we could construct them in large numbers" (During personal communication and focus group interactions).
 - *'Observability - is the degree to which the results of an innovation are visible to others'* (Rogers 1983). Stove is located inside the kitchen. People don't mind showing it when cooking is not happening, though showing the product during cooking is uncomfortable. Due to prevalent gender and caste norms; male and other caste stakeholders (as buyers of product) were not welcomed or were hesitant to the kitchen dominated by females affecting the observability.
- Drivers of the project (Philanthropy, aid or Market?) – Drivers influence the stakeholders professionalism, commitment and accountability (Heeks 2003). Government projects involve persistent revenues; and due to higher possibility of corruption and lack of necessity to comply

with deliverables, chances of additional gains are quite high. Due to this stakeholders are highly interested in government aided projects, even though majority of products fail (Heeks 2003). Philanthropy is perceived differently due to moral burdens associated with doing social good and perceived parsimony. Market has relatively straightforward transactions but at the same time is far more competitive. In the case-study it was a social responsibility program of the company. The accountability towards results was low. The project was initiated and driven by top management and thus the ground execution staff were not highly motivated and alienated. Project executors were running highly successful projects in animal husbandry and land reclamation. These projects demanded less mental and physical stress as compared to new astra stove project.

- **Manufacturing:** Understanding whether product is manufactured in industrial factory set-up or by artisans or by informal workers is important. Many low end technologies are manufactured in decentralized ways involving local workers and even at the site. Each involves different stakeholders with different reasons for associating with product. In case of astra stove, it is manufactured at the user's house. Product has overlaps in manufacturing and dissemination stage due to this mode of manufacturing. Each stove construction needs preferably two labourers. Raw material like Sand, cement, chimney pipe etc. is procured in prior and is transported to the site of construction. This was done by project executor's field officer. Owner has to dig soil from nearby fields. Mould had to be transported to the site.
- **Marketing:** Mode of marketing is important from strategic point, for e.g. through self-help groups or through rural marketing networks. Publicity could be achieved through village 'santhe' (a local fair) or through door to door marketing or through FM radio etc. For this decision early involvement of management and marketing teams would be required. In case of astra stove, marketing was not at all discussed, everything was impromptu. There was overall lack of planning. Community meeting and user group meeting were arranged to introduce the product. People with local influence were brought to introduce the product to users.
- **Dissemination:**
 - Public good, private good distinction – Public good involve far different stakeholders and different challenges. Behaviours of stakeholders in achieving social well-being as compared to personal well-being will be quite different (Bhat 2013). In public goods community, local governing agency is very important in the dissemination and usage phase. The stove was a private good.
 - Product, service or combination? – Product is defined here as a tangible product (like a screw driver) or just a service (like online ticket booking) or combination. Combination is the presence allied services for normal functioning of the tangible product, for e.g. recent water purifiers in India need replacement of use and throw 'chlorine battery' without which the product cannot achieve desired functionality. In absence of the service to provide the chlorine batteries purifiers are of no use. With the advent of smart technologies and ICT, stand-alone products are rare. In case of astra stove, lack of maintenance has been the important reason for the failure of most of the stove projects in the past (Hanna et al. 2012). Assured support during the life span of stove was important aspect in this project. This aspect was highlighted by Authors, but was not paid enough attention in the planning and marketing by project executor.

5.2.2 Generating stakeholder list

After detailed understanding of the product, identifying the stakeholders is simpler. For identification of stakeholders the constructs of CA are used. First set of stakeholders could be identified using the construct of distinction between means and capabilities for the direct user's technical requirements from product like, need to save firewood or need to save time for a woman from specific context. This will result into list of generic stakeholders (showed in oval shape in Figure 2). Distinction between means and capabilities has to be repeated for each identified stakeholder. Few stakeholders are easy to identify but the construct of CA helps in structured exploration of involved stakeholders. CA construct of distinction between means and ends guides the designer to trace the reasons behind 'why' each stakeholder is interested in a given product (Refer Figure 3). Out of 3 labourers selected by the product executor, which on casual reasoning looked quite perfect match for the job but means to end tracing presented different reasons behind the involvement in the project affecting the sustenance of their involvement.

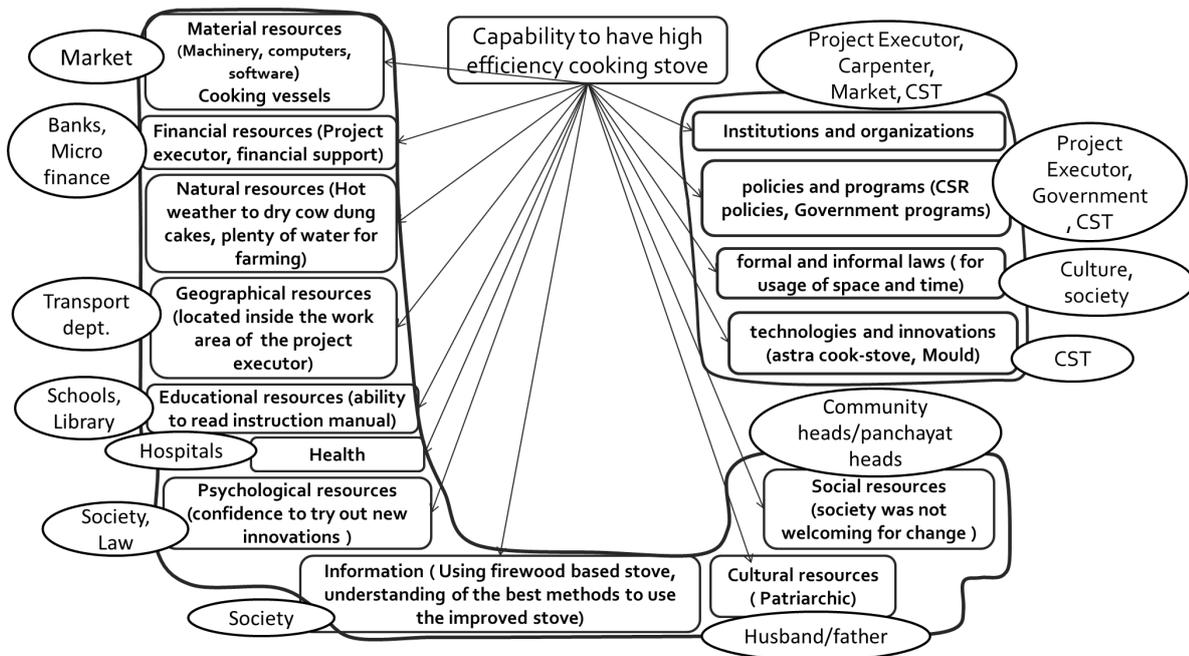


Figure 2. Choice framework based understanding of the resources for the direct user adopted from Kleine (2010)

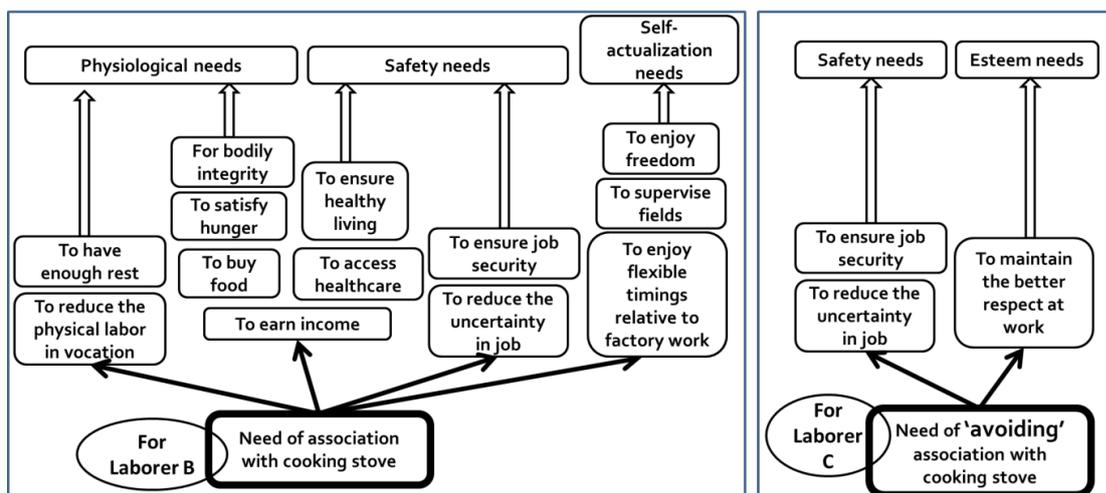


Figure 3. Understanding the distinction between means and ends for the stakeholder 'stove constructor - labourer B and C

Details about the background of two labourers B and C

- Labourer B – worked as a casual labourer in the project executor’s factory, which had inconsistent demand and heavy physical exertion. He looked at this opportunity to as an allied skill to his existing masonry skills which could be pursued independently. He felt the stove construction is less labour intensive.
- Labourer C – contractual but regular labourer with project executor and was in-charge of one small section. Smart and believes that stove building does not involve any great skill (This aspect is interesting when ‘Deskilling’ was the main purpose behind mould design).

Figure 4 shows the means to end tracing of ‘Need of association with cooking stove’ which is based on the personal interaction with the three particular stakeholders. Labourer A and B were clearly interested in association with the stove project for varied reasons. They had queries about the remuneration, details about the duration of contract etc. which project executors did not respond with clarity. Labourer B was interested in stove project for stability of job, low physical exertion and for flexibility of time. Flexibility of time was interesting to him as he could work in his fields whenever is necessary and still finish stove construction by working early or late during the day. Labourer C

refused to get associated with the project as he had a consistent job. He joined in for few days of training and then quietly resumed his regular job and distanced himself from stove project.

Different stakeholders showed quite varied reasons for association with the project (see Figure 4) which displays the insights ‘distinction between means and ends’ can provide. (Figure 4 does not cover the higher level capabilities)

One of the crucial stakeholders in this study, the project executor is discussed here as a sample. Project executor team was running few highly successful programs related to land reclamation, animal husbandry and supply of solar powered lanterns. These programs were stable and belonged to their domain of expertise. The ground staff was not motivated towards implementation of this new technology as the efforts required by them, both at mental and physical levels, were high. The perceived benefit for them was not evident in short term, resulting into lack of motivation in planning and execution. This resulted into shortcomings like not identifying the best candidates as early adopters of technology resulting into non-adoption in pilot itself. The lack of motivation and faith failed to generate confidence about product within the community. Though the effort by project executor was tremendous it did not result into the desired effects.

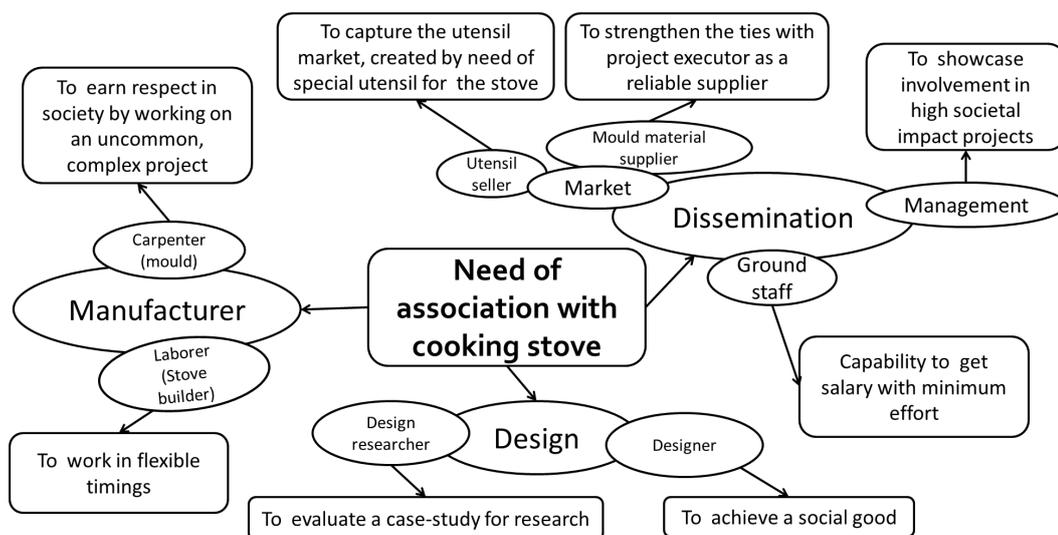


Figure 4. Matrix of stakeholder's motives for association with the astra stove

6 CONCLUSIONS

CA based stakeholder analysis is a conceptual guide to optimize the stakeholder involvement in complex, unknown and unpredictable BoP contexts. Listing direct stakeholders is straightforward, but method of identifying indirect stakeholders and their motives behind involvement (or non-involvement) is complex. Theory based structured approach to tackle this complexity is the important outcome of this work. Constructs of tracing means till ends and differentiating between means and capabilities provide practical tools to generate insights into the involvement of stakeholder in product. Emphasis on freedom of the stakeholders helps in avoiding designer's biases in interpreting the stakeholder motives. Analysing stakeholders through capabilities can overcome the practical and theoretical limitations of useful stakeholder theory and analysis. The perceived usefulness in this maiden attempt has encouraged us for rigorous validation in future.

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