Recommendations for Improved Development by Design*

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ABSTRACT

This paper challenges several of the accepted methods of practical engineering and product development for groups and situations in less industrialized economies. The underlying argument is that all activities related to product design, development, dissemination, and reporting must be of the highest possible quality and user-centric regardless of the economic environment. Five key points are addressed along with examples and recommendations for each.

Keywords

User, design, corporate approach, reporting, local networks

INTRODUCTION

Design has been elegantly and succinctly defined as the act of creatively meeting peoples' needs. Reports and statistics from multilateral organizations claim that only a small percentage of the world's population is able to meet even the most basic of needs. Can we conclude that engineers and designers are dismal at meeting the expectations of the profession – or simply that not enough technical and design expertise is directed at the problems of developing economies? Unfortunately (and in danger of being over-simplistic), both assertions probably have a degree of validity. Non-profit design, particularly technology design, for economic and social development in less industrialized economies (labeled here as "development by design") has taken many forms over the previous half-century, but lasting success stories are few although ideas and practitioners are many. The following five topics are among several areas in which the author sees the need for significant improvement in technology projects for users in developing economies.

1. USER, USER, USER

Engineers and designers are often taught during their formal education that the design process begins with a stated problem based on a market need. They are also taught that the process is cyclic with multiple feedback loops based on user input. To assist in generating ideas of sample design problems, American engineering students, for example, are commonly assigned a "bug list"; a list of instances or things that "bug", irritate, or are just plain frustrating to a person[1]. In practice, particularly in development, technology projects are expensive and resources are few. Existing solutions to similar situations look well matched with simple modification or appropriate adaptation. Likewise, feedback loops are minimized with short timelines and low budgets. Projects that start out as market pull quickly becomes technology push. The resulting design may be innovative, perhaps even useful to the target group, but rarely is the product sustainable or appropriate[2].

The feedback loops are vital, even more so when resources for research and development are limited and/or the design team is remotely located. Interaction with

"development by design" (dyd02), Bangalore © Copyright 2002 ThinkCycle

* The short version of this paper is: Five Challenges to Development by Design.

[1] An example of a "bug" from a list might be: "All these plastic shopping bags I accumulate when shopping are a nuisance". Bugs can then be turned into a variety of problem statements, which also encourages the examination what the need *really* is. In this example, is the problem of interest the disposal of bags, environmental impact, storage after usage, the transport of goods or something else entirely? It is interesting to note that AKILI, an NGO teaching business skills development to Kenyan informal sector artisans, found "bug lists" had only a limited success rate as a means of generating ideas with their clientele [Spyvey, personal communication].

[2] By *sustainable*, it is meant that the product will be picked up the user group without donor intervention (donation or subsidization). By *appropriate*, it is meant that the "benefits" of the technology are sufficient for the consumer to invest (their own money, time, and/or resources) in the technology.

potential users must occur continuously throughout the project, as well as after its completion. Rarely in development by design do we see comprehensive market research and user need-finding. A typical scenario for such a product is: the recognition of a problem by an inventive person (or team) who then, perhaps after some basic investigation of user groups, sets about designing and fabricating a product or products. More often than not, the designer, or design team, has nominal interaction with the intended users; market research is scanty, need-finding is minimal, and prototype testing is negligible.

As an example, consider a foot-operated micro-irrigation pump developed for small-scale farmers in East Africa. The international NGO behind the development of the pump has a strong track record of well-designed and widely-used technologies, particularly related to micro-irrigation that generated incomes for their users. The pump is attractive, extremely inexpensive, and delivers valuable water with low effort (the user shifts his/her body weight from foot to foot in a tipping motion). It is compact and easy to transport, set up, and maintain, but it doesn't sell like it should. Why? Eighty percent of the farmers in the regions targeted for this pump are women. Although the pump designers were well aware of this fact, user prototype testing was not comprehensive enough to predict that a good number of their farmers (in skirts) might prefer not to operate a machine that requires a stance with the piston cylinder below, and the handle support coming up from the frame between their feet[3].

User need-finding and market research before design must be comprehensive: Who is/are the target group(s)? What are their characteristics? What are their requirements? How diverse are these requirements? What would be the potential value of a "solution" to the user? How are the users addressing the need now?… and so on[4]. After a day of riding prototypes around a township and talking to traders and businesspeople, designers of a cargo bicycle added some unexpected "cargo" to their growing list: children traveling to and from school! Throughout the process, feedback is required to insure design adherence to user needs with goals and directions adjusted accordingly. Designers and project team members must go into the field and ask questions of the users: Which one is easier to operate?[5] Why? Why is this one preferable? How would *you* use something like this? How much would you be willing to pay for it? Test markets or pilot projects must be implemented and these results again fed back into the design process before a product can be marketed to its target group.

2. *GREAT* DESIGN IS PARAMOUNT

There are ideologies attached to engineering and product design in or for development situations; for example, the Appropriate Technology movement required, among other specifications, that "appropriate" products have decentralized production [3]. The act of design aimed at development often provides real motivation for the designer who feels his/her work is constructive and needed. But the noble image of this type of design discourages open dialogue and constructive criticism within the field and by "outsiders". Practical design that truly meets peoples' needs must start without biased ideological and emotive restrictions that hinder a design process based on the consumer. Following this, all design and resulting technologies must be evaluated rigorously – and honestly. Design awards are given to products directed at "marginalized" groups that haven't been rigorously tested with real users, let alone proven in test markets. Technology that is unsuited to the user and/or environment, or that is simply poorly engineered can only be detrimental to users with no financial safety net to take risks[6]. Ironically, many such technologies are classified as "socially responsible".

Designers must be creative. Solutions that work for one product may be inappropriate or impossible to implement for the next. Designers must understand the conditions in which a product will be fabricated and the quality maintained. Stock materials may be difficult to procure or be inconsistent from batch to batch. A length of round steel tube, for example, may have a varying wall thickness, irregular welded inner seams, and be more oval than round. Standard parts may not be available or may be in short/unpredictable supply. Fabrication matters too to the user: in locations where nothing is disposable and tools may be inaccessible, allen screws make maintenance very difficult indeed!

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[3] For a industrialized economy example, see [1]

[4] These are not and should not be quick-answer questions. For example, a designer should never conclude, "They aren't" for the last question. The need is being addressed, perhaps "unsuccessfully", but likely in unobvious ways. For example, "benchmarks" for the treatment of a pandemic health condition may be as various as indigenous medicinal treatments, religious rituals, and/or Marmite [2]!

[5] While user-testing can be done a variety of ways, prodding criticism out of users not accustomed to having their opinion asked has been found to work well when the user is given two differing samples to compare.

[6] Critics of Appropriate Technology (AT) point to the prioritizing of ideals over dedication to the user in explaining the decline of the movement's popularity with practitioners [4].

There are various debates as to who is qualified to design in nonprofit and private sectors of less industrialized economies: students lack engineering experience, expatriates lack crucial local knowledge, locals are unable to discern their biases, and non-engineers lack technical know-how. Talking about who should be designing is unconstructive. What simply matters is high quality design that results in a product sustainably meeting user needs. High quality design includes all facets of design: functional, technical, ergonomic, sociological, etc. that must be recognized and suitably addressed. Stressing open-source design can bring together the needed expertise to address these facets and to apply modern design methodologies[7].

Appropriate technologies and "design for the real world" have arguably always been open-source with the how-to publications and the discouraging of patents [6, 7], but historically many well known technologies, such as the ram press, are still linked to the original designer (almost always singular). By stressing open-source as compared to the technologies themselves, *ThinkCycle*[8] does a tremendous service to users by replacing designer ownership with community ownership, promoting collaboration, and encouraging product evolutions in numerous directions. There is a caveat, however. Remote design (where designers are remotely located to targeted users and environments) can only work when grounded by local designers who access their users.

3. THINK DEVELOPMENTALLY, ACT CORPORTATELY

Great design based on user needs doesn't guarantee "sustainability" of the product or project. That is, after the organization (usually a non-governmental organization or NGO) has ended its involvement, the product continues to be used and/or sold indefinitely. For this to happen, technology development projects must take the "corporate approach"[9]: the development, distribution, and sale of the product must follow the private sector technology model as much as possible. First, the product must be market-driven and locally competitive without donors and NGOs donating or selling the product below retail cost. Intervention skews the market by falsely driving prices (and possibility the design process as "cost" becomes less of an issue). The retail cost must also insure that the manufacturers, distributors, and retailers[10] all make a profit to motivate quality and continuity[11].

Designers and donors must think like businesspeople: significant impact on a population occurs only when it is self-driven. People want something when it brings them value, and in such situations, small amounts of capital can be raised. A survey of South Africa's lowest income groups found that on average four percent of a family's annual income is spent on tobacco. This is not necessarily a surprising statistic in itself, but more meaningful when compared to other expenditures: money spent on tobacco was four times that which was spent on education and medical expenses combined [10].

The corporate approach includes dissemination. Advertising and promotion are key to reaching the intended market. For example, consider an oilseed press developed for rural areas where sunflowers are prevalent. Poor transport and communication infrastructures make word-of-mouth dissemination impossible. Furthermore, even if an enterprising farmer learns of an incredible new product to turn his seeds into liquid gold – how and where would he find it? Not surprising, newspaper and indigenous radio adverts, local demonstrations, signs and visibility at expositions and events all (and individually) boost sales and build brand name awareness. A Tanzanian NGO with limited marketing funds to reach rural buyers was able to successfully advertise their product by placing a highly visible and colorful sign at the bus terminus of a major regional market town. Impacts can also be limited when publicity ends too soon (before product maturation). For products that are major investments to the purchasers, like the oilseed press, product demonstrations are often also required. Similar to a young professional purchasing his first car (or bicycle), several "test-drives" and pre-purchase visits to the retailer should be expected. Fund allocation for promotion is as important as it is for design.

Can markets be manipulated into adopting a product [11]? If the product does not bring value to the user, certainly not. Value in one society does not guarantee the same reception in another, nor does one society's acceptance of a solution to a need or problem make it a universal

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[7] Development by design is nearly absent in scholarly engineering design literature, as is seemingly cutting-edge design methodologies from development by design. Methodologies and techniques such as Quality Function Deployment (QFD), customer chain analysis, the DfX's (such as Design for Assembly), work flow analysis, etc. all have a needed place in development by design, assuming designers are able to consider differences in market economies and goals, and adjust the tools accordingly [5].

[8] www.thinkcycle.com, Also see [8]

[9] Micro- and small enterprise development specialist Alan Gibson is credited for labeling the "corporate approach".

[10] Depending on the situation, the manufacturer, distributor, and retailer may be the same enterprise.

[11] Xtracycle Access Foundation calls this "Zero-subsidy design standards" [9].

solution. This is intuitive, practical and not new to most, yet old mindsets persist: despite astronomical advertising budgets, low condom usage in many societies is considered an issue of the user population, not the technology.

4. MORE KUDOS FOR NEGATIVE RESULTS THAN GOOD IDEAS

Publishing in development by design, appropriate technology, socially responsible technology and so on, is largely limited to "how-to" manuals and descriptions of technologies, philosophies, and methods[12]. The best-known collection of publications in the field, the Appropriate Technology Sourcebook, is a catalog of recipes and anecdotal reference. Would a Rope and Washer Pump that is (apparently) useful in Nicaragua, be appropriate to a highlands area in Borneo (assuming the materials are locally available)? Perhaps, but certainly not as is described in the referenced article. The specific design is at best a technical concept. Publications must include more.

First and foremost, the outcomes or "impacts" (in development-ese) of projects and programs must be reported, not just those with positive outcomes, but more importantly, the "failures". Who was the target group? What range of water sources was appropriate? How many pumps were made? How many were in use a month after set-up? A year? Were there any negative outcomes from the project? Any secondary impacts? Any surprises? Articles about good ideas and new innovations that might be beneficial to different populations must include, or at least be followed up with, widely disseminated implementation and impact reports.

Second, like any good design documentation, the lessons (not failures!) learned "along the way" should be documented. What did the rejected prototypes look like? Why were they rejected? With more and more regions becoming connected by the internet and the web, the potential for learning from others' tinker-ings, lessons, and successes could have an invaluable impact on projects all over the world, particularly those that do not have the resources to hire the experts or to research previous work in-depth. Comprehensive reporting is not simply a matter of changing process, but rather a matter of changing the development culture. With current funding structures, donor agencies truncate project timelines and limit risk-taking and candid reporting.

Third, impact reporting must be longitudinal and meaningful. Outcomes change with time. For example, a domestic solar cooker that may have been enthusiastically used the first month after set up and installation may have been cannibalized for parts a year later. Factors and outcomes may also reflect changes with fluctuations in or with an economy, political stability, or even rainfall.

Meaningful reporting gives a "zero-time" comparison and is often quantitative. Zero-time comparisons are those that compare the average user's situation before introduction of the technology to her situations (at different points in time) following the purchase and usage of the technology[13]. The "before technology" scenario is determined from the user's situation at the temporal point of purchase (zero-time). For example, if a user is able to

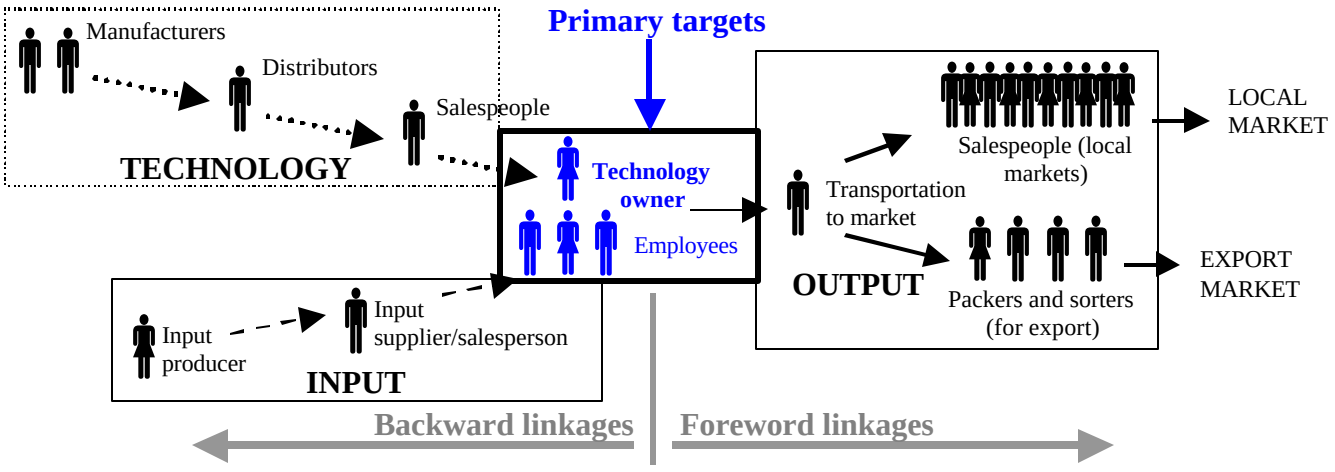

Figure 1. Potential for job creation with introduction of technology. For the technology example of the solar cooker, inputs are the raw peanuts, outputs are the roasted peanuts.

[12] For a cross-section of such papers in various publications, see references: [12-16].

[13] John Kihia of ApproTEC Kenya is credited with zero-time data collection used as a basis for "before technology" impact analysis.

sell enough roasted peanuts to pay for a child's school fee after using the cooker to expand her business, this gives an indication of income generated. But how does this compare to income she made from peanut sales before using the cooker (roasting peanuts by a different method or selling only raw peanuts)? Furthermore, is this a special case or are many cooker users able to expand their businesses and improve quality/add value through usage?

To be useful to other projects and programs in evaluating feasibility and outcomes, goals and indicators must be quantitative and measurable. This is already required in many funding proposals by donor agencies. Examples of indicators might be: jobs created, income generated, or return on investment (ROI)[14]. Definition of each is important as interpretation may vary. For example, whereas a job may be a waged activity taking eight hours a day, five days a week, in one culture, it may be five hours a day, three days a week unwaged, in another. Consider also Figure 1, which shows the impact of a solar cooker on more individuals than the purchasing entrepreneur through forward and backward linkages [17]. In such cases the complexity in measuring job creation may be impossible given project funds. Ambiguities and complexities still must be addressed and reported.

5. *LOCAL* NETWORKS MUST BE ESTABLISHED

Unfortunately, the breadth of work, projects, and conferences (like dyd!) is relatively unknown to most practitioners and researchers engaged fully or partly in development by design, particularly in the less industrialized countries. Publications are scattered over numerous mediums, organizations, and disciplines. As a result, many are reinventing similar products instead of benefiting from previous work[15]. Websites like *ThinkCycle* and discussion groups like *Design in Development*[16] are exciting moves to bring people, knowledge, ideas, and experiences from a range of fields and professions together. However, more networking and partnership is needed still on two levels: cross-organizationally and locally.

Development by design spills over into countless domains: engineering, business, economics, the arts, sociology, development, and health, to name only a few! Different opinions, experiences, perspectives, and access to information encourages cross-pollination and even adds healthy tension which drives improved project and technology designs. However, resource restrictions and lack of awareness may limit development-by-designers from seeking out other less obvious experts. Not all prolific academics, researchers, and practitioners are online, and many more lack the resources to participate in international (or even regional) conferences. Local networks must be pulled together to give depth to the field and encourage collaboration.

Small networks already exist and can easily be unified with a (dedicated) point person using the snowball technique[17]. However, a directory of local people and a listing of expertise and interests is only a starting point. The real power of networks is in ongoing interaction. A local society can be established enabling potential collaborations, diverse and relevant input for curriculum building at universities, a weekly or monthly seminar series, informed peer feedback on local issues or proposals-in-progress, and a community able to voice opinions and lobby governments and organizations. By further linking local lists online (through websites such as *ThinkCycle*), greater and broader networks can be built. For example, such an online network might make possible community-compiled annotated bibliographies on subjects related to development by design. All scales of connectivity are truly needed in the building of a field.

CONCLUSION

Engineering design and product development *can* be used as a means to drive economic growth and social change. This is evident from products such as the *jiko* charcoal cooking stove, micro-irrigation treadle pumps, block press, cargo bicycles, and so on, that have had tremendous beneficial impacts on various groups. But for every successful product, there are containers full of those that have had a limited field life – even (or especially) after donation. For a product to be successful in a less industrialized economy, it must, at the very least, meet the same basic requirements for any product in any economy: the design must be of the highest quality and the design process must be driven by consumer needs. Donors,

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[14] There are two ROIs: the return to the average consumer for the effort and finances invested, and the value to the donor who invested in the project. ApproTEC in Nairobi, Kenya, refers to the latter indicator as "bang for buck" when it is possible to compare the income generated by technologies users to donor funds allocated.

[15] For a good example of this, see [18].

[16] "Design for/in Development" group at Yahoo Groups: groups.yahoo.com/group/designindevelopment

[17] The Snowball Technique is an interview method used to identify additional people of interest: "Please name three people you know involved in this area…" Each of these three people is also queried, and so on until the interviewer is given names of people he or she has already interviewed.

NGOs, and academics involved in this field must evolve their culture(s) to include promotion and evaluation in project budgets. They must also require the reporting of results - not just ideas, and encourage the establishment and strengthening of local networks, and reconsider accepted practice.

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