Who Buys Latrines, Where and Why?

This field note aims to explain the concept of household demand for sanitation in developing countries, what stimulates demand among new adopters, and how this knowledge can be used to develop marketing strategies to accelerate sanitation uptake. It draws these insights from an in-depth study of household latrine adoption behavior in rural Benin.
Project Background.

As part of a 2-year-long Sanitation Marketing Pilot Project funded by the WSP and USAID, IDE and its partner organizations undertook a 14-week design project to develop marketable latrine designs for rural Cambodians. The overall project aims to have 10,000+ latrines purchased and installed by 2011. The design effort was led by Jeff Chapin, a consultant from the US-based design consulting firm IDEO, and assisted by a core team of Khmer assembled from IDE and its partner organizations: AUN Hengly (Rainwater Cambodia), CHHOEUN Chhoeurn (MRD), KEN Savath (IDE), ROS Kimsan (IDE) and Sopheak (LienAid).
Latrine state-of-the-art.

In Cambodia, the existing latrine infrastructure essentially falls into three categories: open defecation in rice fields (i.e., no latrine), dry pits (encouraged by CLTS) and really nice, really expensive concrete latrines ($200-$600). Respectively, they each reflect a major problem for rural sanitation: lack of sanitary waste disposal, unstable construction and cost-to-adopt.
Project Goal.

To address these issues of rural sanitation, we aimed to design a suite of upgradeable latrines that would enable and encourage all rural Cambodians, regardless of income, to address their sanitation needs and desires. The latrine designs should enable subsequent investments to build upon initial investments in order to make efficient use of a villager’s money and to encourage early investment in a latrine. Furthermore, the latrine designs should enable investment in a sustainable latrine--one that will not collapse, will not degrade year-on-year, will not fill up prematurely and will not be abandoned.
Final Report.

Process Review.
User Research Review.
Prototype Reviews.
  1st Round.
  2nd Round.
  3rd Round.
  4th Round.
Design Direction Explained.
Next Steps.
Process Review.

User Research Review.
Prototype Reviews.
  1st Round.
  2nd Round.
  3rd Round.
  4th Round.
Design Direction Explained.
Next Steps.
Project Process.

The design effort followed a user-centered design methodology that began with in-field contextual observations and interviews with the key stakeholders involved in latrine manufacturing, installation and use. The learnings from the observations were distilled and synthesized into a framework that illustrated the potential opportunities for the design offering and showed where the design offering fit into the greater sanitation marketing effort.

From there, multiple rounds of brainstorming, prototyping and user testing were undertaken to develop the latrine designs. From the multiple iterations, a design direction emerged that addressed user needs as well as marketing thoughts around how to position the benefits and costs of latrine ownership. Though work still remains to be done, a vision for the design offer is in place.
Where we are.

Field Note

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User Research Review.

Process Review.
User Research Review.
Prototype Reviews.
  1st Round.
  2nd Round.
  3rd Round.
  4th Round.
Design Direction Explained.
Next Steps.
User Research Process.

In the first phase of the project, we spent two weeks in the field talking with villagers, ring producers, retailers and masons to understand behaviors, needs and desires regarding latrines. All interviews and observations were performed in context--at the villager’s home, at the retailer’s store and at the ring producer’s lot. A detailed explanation of the findings can be found in the User Research Report held by IDE Cambodia. A brief summary of the findings follows.
Study Regions.
Regional Hydrology.

Relatively high water table--0.5m to 7m from surface.
Household wells common--water access not a major issue.
Minor, intermittent flooding of households in wet season.
People We Met.

masons  ring producers  retailers  villagers
The experience of building, maintaining and owning a latrine consists of many ups and downs. Some experiences push a villager to build, maintain and use the latrine. Others deter the villager from doing so. Only if the experiences place the villager above a certain threshold will the latrine be built and used.
The Water and Sanitation Program is an international partnership for improving water and sanitation sector policies, practices, and capacities to serve poor people. September 2004 Field Note

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Sanitation and Hygiene Series

Phase 01 Preparation
- will cost money
- don’t know what to build
- have to save money
- have to form a new habit
- my daughter will be safer
- won’t have to go as far to shit
- won’t be sick as much
- daughter shits at night

Phase 02 Initiation
- chicken gets into latrine
- starts to smell
- shit in the rain and stayed dry
- takes a bath in latrine
- shows latrine to guests
- daughter shits at night
- shows latrine to guests
- uses waste as fertilizer
- fields smell nicer
- not sick as much

Phase 03 Maintenance
- overflows in wet season
- have to rebuild pit
- pits collapses
- tiles crack
- termites eat the shelter
- latrine fills up
- village is ODF
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The Adherence Loop* illustrates opportunities to enable everyone to believe in the need for latrines, to know how to build, use and maintain latrines and to be able to act on that knowledge. Breaking the loop will lead to failure to use latrines properly or at all.

*© IDEO
CLTS strengths

CLTS is remarkably effective at getting people to believe that they need a latrine, and it puts into place a good system for reminding villagers to build latrines. CLTS does not, however, help villagers develop a good mental model of sanitation or adequately teach them how to build a sustainable latrine. As a result, there is often unsanitary handling of pit contents and negative reinforcement (pit collapse, bugs, smell. . .)
IDE can build upon the successes of CLTS by better educating villagers about latrine construction and by providing low-cost latrine designs that, when built, reinforce the benefits of proper sanitation and lead to sustained use of a latrine.
Design Principles.

Coming out of the user research, we established eight design principles that would guide our work moving forward:

1. Let everyone go wet.
2. Allow self-build at entry level.
3. Work from the bottom up.
5. Divide the pit, slab & shelter (mentally).
6. Set the stage for the mason.
7. Show few options but enable many.
8. Support the shopping.
Prototype Reviews.

Process Review.
User Research Review.
Prototype Reviews.
  1st Round.
  2nd Round.
  3rd Round.
  4th Round.
Design Direction Explained.
Next Steps.
Prototype Reviews.

In the course of this design project, we took four trips to the field after the initial user research in order to review prototypes with stakeholders--villagers, masons, ring producers and retailers. In all cases, a number of 2D and 3D prototypes were shown. This section will briefly review the prototype evolution and the learnings from the process. More detailed information can be found in the Field Visit Reports held internally at IDE Cambodia.
1st Round.

The first round of prototyping was primarily inspired by lingering questions coming out of the initial user research. Most importantly, ‘What is the viability of an upgradeable latrine path?’ As such, we introduced a number of upgradeable latrine paths to a group of villagers gathered at the village chief’s house. The visit was with just that single group in the Kandal province. We wanted to understand the following:

- Comprehension and appetite for upgradeability
- Knowledge of basic latrine components, costs and construction methods.
- Preferences around basic latrine architectures.
- Desired latrine building start points and upgrade paths.
- Comprehension of visually-presented information.
1st Prototypes

The first set of prototypes consisted of two components: a set of three large posters which illustrated six different upgrade paths and a set of 1/5th-scale prototypes with which each of the upgrade paths could be constructed.

Each upgrade path was designed from fairly standard and readily-available latrine construction components. Each path had a different starting point and, collectively, they covered the basic types of latrines available on the market today (dry pit, wet pit, offset pit, direct pit, concrete shelter, bamboo shelter, etc.). One poster showed a single path broken into three steps and into six steps to try to assess how many upgrade steps were ideal and how well the villagers could fill in the gaps in the upgrade paths. A transparency with a natural shelter printed on it was overlaid on the early steps to illustrate that a self-built, locally-gathered natural shelter would be used in the early stages before enough money was saved to build a concrete shelter.
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Field Note

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1st Prototypes

### SIMPLE POUR-FLUSH TO IDEAL POUR-FLUSH

- 75,000 - 115,000 r.
- +65,000 - 85,000 r.
- +60,000 - 250,000 r.
- +300,000 - 600,000 r.

### DRY PIT TO IDEAL POUR-FLUSH

- 55,000 - 70,000 r.
- +85,000 - 125,000 r.
- +60,000 - 250,000 r.
- +300,000 - 600,000 r.

### OFFSET POUR-FLUSH TO IDEAL POUR-FLUSH

- 85,000 - 130,000 r.
- +50,000 - 70,000 r.
- +60,000 - 250,000 r.
- +300,000 - 600,000 r.

### OFFSET (BAMBOO) POUR-FLUSH TO IDEAL POUR-FLUSH

- 40,000 - 70,000 r.
- +50,000 - 70,000 r.
- +100,000 - 300,000 r.
- +300,000 - 600,000 r.
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### STEPS TO IDEAL

1. **75,000 - 115,000 r.**
2. **+65,000 - 85,000 r.**
3. **+60,000 - 100,000 r.**
4. **+60,000 - 200,000 r.**
5. **+120,000 - 250,000 r.**
6. **+150,000 - 300,000 r.**
7. **+300,000 - 600,000 r.**
1st Prototypes: Primary Learnings

1. One big reason non-owners refer to a nice latrine as “concrete” (as such referring to the building type of ideal latrines) rather than by some more latrine-descriptive name (e.g. pour-flush offset pit) is that they have very little understanding of what’s going on below ground. Neither how the whole system is working or how it gets put together.

2. Non-owners had little confidence in their ability to build a latrine.

3. People could spend $100 now, but don’t want to. Are waiting to save more. Don’t want a $30 latrine.

4. Villagers understood the step-by-step approach but had almost no interest in it.

5. IDE effort must follow some type of CLTS behavior change marketing effort (either done by IDE or other CLTS practitioners.)
6. There’s appeal in familiar products with a new twist. Especially if they can visually see and understand the twist (e.g., pervious ring).

7. Strongly prefer offset pits to direct pits.
   a. emptying easier
   b. ‘costs less than a direct pit’

8. No interest at all in dry pit.

9. Prefer one big pit (5 rings) vs. 2 smaller pits (3 rings ea.).
   a. Space constraints make a single pit better
   b. Cost constraints. . . need two lids if you build two pits.
1st Prototypes: Secondary Learnings

1. Non-owners are familiar with all the components of a latrine (rings, pan, slab, shelter, PVC pipe), but don’t know how to install or how to design.

2. Non-owners would rely on the mason for knowledge of how to build latrine.

3. Think that building over time will cost them more than all at once
   a. Would waste materials.
   b. If self-build first steps and use mason for later steps, mason would say that things were don’t wrong in the first place and charge extra for having to redo them.
   c. Would spend more on labor than materials

4. Latrine owners ‘knew’ that one ring filled in one year.

5. Latrine owners ‘knew’ that it was best to at least built with one ring above ground level.

6. Think that the bottom of the pit is where most of the water drains. (owner)

7. ‘More deep is more good in the dry season’ (owner)

8. ‘Deep pits fill slower than shallow pits’ (owner)

9. No interest in a bamboo-lined pit (or other natural material)
1st Prototypes: Secondary Learnings

a. Temporary solution.
b. Would allow soil in.
c. Would collapse.
d. Would rot or be eaten by insects.

10. Pervious ring (ring with large porosity) was very intriguing to villagers.
   a. Was the first prototype they picked up at the beginning of meeting.
b. They knew it wasn’t available locally.
c. They thought it would cost 5,000-10,000r more than a standard ring.
d. They thought it would allow better drainage.
   e. Yet, they were concerned that it would allow soil into the pit, leading to early pit filling.

11. Most people expected a medium quality wet latrine to cost $200-300. Quality seemingly related to footprint and presence (or lack thereof) of bathing space.

12. And lastly, our little bit of hope. . . one guy said that he could do the 1st stage. . . 3 rings, a ceramic pan and a water bucket for flushing/washing!!! It’s not all bad. . .
1st Round: Summary thoughts

The 1st Round of field visits was a bit depressing. As you can glean from the learnings, the fairly wealthy, non-CLTS village we visited wanted almost nothing to do with low-cost latrines or upgrading. They understood it and they all seemed to have money on hand to build a low-cost latrine, but no one was convinced. They were all waiting for the few hundred dollars that it would take for a concrete latrine or for another NGO to show up and give them part or all of a latrine. We did, however, take away some learnings about the pit type and layout (wet and offset very much preferred). And we realized that CLTS-type behavior change efforts would be an absolute requirement for our marketing campaign. Perhaps most importantly for design, we learned that villagers without a latrine have no idea what the underground parts of a latrine look like or do. They’ve only ever seen what is above ground: the concrete building. Were we to have any success in helping people self-construct low-cost latrines, we were going to have to greatly simplify and effectively communicate the underground, functional parts of the latrine.
2nd Round.

The 2nd round of prototyping was essentially a continuation of the 1st round in order to get more and better data in response to our first set of questions. The 1st visit was in a fairly wealthy village that had not undergone CLTS, and the conversation was somewhat dominated by the village chief, who already had a nice concrete latrine. We left the 1st visit a bit depressed about the whole project. It seemed everyone except one guy just wanted a nice concrete latrine or nothing.

For the 2nd round, we traveled for three days to Svey Rieng and primarily visited CLTS villages as well as retailers and ring producers. Since the IDE marketing effort will include a CLTS-style behavior change aspect, it was thought that CLTS villagers would be a better approximation of the mindset of our future customers.
2nd Prototypes

The prototypes used in the 2nd round of user testing were very similar to those used in the first round, though some critical changes were made. First, we didn’t use the 1/5th scale models. We had found that the poster prototypes better communicated the upgrade paths because they could show all steps at once. Second, we took all the information on the posters and shifted onto A4 paper. This was done for two reasons: to make the visuals easier to transport and to experiment with an alternate mode of explaining upgrading.

Rather than showing a linear path, we used transparencies to overlay each successive step in the upgrading process. Villagers could use the tools to pick and choose the elements that they wanted and understand the cost trade-offs. It was a more flexible and vibrant method of explaining the concept.
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Sanitation and Hygiene Series

2nd Prototypes
2st Prototypes: Primary Learnings

1. Poorer CLTS villagers receptive to low-cost models, including bamboo pit lining and natural shelters. They understood and like the idea of upgrading. They understand and feel capable (after some motivating discussion) to build low cost models themselves.

2. Poorer non-CLTS villagers disinterested in low-cost options, want to wait for ideal latrine. They think low-cost means low-cost to them but still meets ideal latrine requirements as NGO will provide subsidy.


4. 100% preferred the offset pit vs. direct pit design even though it is a little bit more expensive.

5. Concrete ring is important to both CLTS and non-CLTS villagers interviewed. Opportunity to reduce ring thickness and reinforcement to reduce cost.
6. Very poor CLTS villagers expressed interest in the bamboo pit option. They felt it was affordable and something they could build themselves. Some understood it was a temporary option as it would rot and be eaten by termites in 6 – 12 months.

7. Poorer CLTS villagers were more open to natural shelters compared to non-CLTS villagers. Mid-high income villagers wanted to build all at once and do in full concrete due to social status in village (not stated but implied).

8. Most villagers copy what others have done—little creative & independent thought, particularly in non-CLTS villages.

9. Tested idea of mixing and matching based on budget – using actual prices helped villagers understand what they could build to meet their budget and personal design standards. Found to be effective in CLTS villages as this helped people feel confident in their choice, allows for personal touch, and they feel empowered to build themselves.
2st Prototypes: Secondary Learnings

1. Transportation (from market to village) creates logistic issues and increased costs. Perhaps an opportunity for low-cost concrete ring production done at the village level.

2. Some villagers (men and widows) expressed a lack of skill to build their own natural shelter, requiring the hiring of labor. Opportunity for latrine specific skilled (inexpensive) labour and technical support at local level.

3. Bamboo and leaf shelters were seen undesirable by some villagers as they feel they would have to rebuild because of termites.

4. Do not seem to know proper composting techniques to create safe fertilizer from human waste (empty pit as soon as full into fields).

5. Initial testing of layering visual information found to be more effective at communicating upgrade concept then step-by-step images. Also allows for greater idea modification to fit needs of villagers.

6. In non-CLTS villages lack of urgent need (expressed as laziness) was a big reason why people don’t build a latrine. In the 50% converted CLTS village people did not want to expend energy on a dry pit.
2nd Round: Summary thoughts

The 2nd Round of field visits was very satisfying. The CLTS villagers understood and liked the ideas around low-cost latrines and upgrading. Our new method for explaining the concepts (the A4 transparencies) really engaged the villagers in building mental models of what their latrine could look like and how they could build it. Most of the learnings from the first visit regarding pit layouts (wet, offset, single) were reinforced. The visits inspired some new thinking on our behalf, particularly in regards to potential to lighten the concrete rings or construct them on-site as well as ways to tackle the transportation of the rings if they were still made centrally by the ring producer. The concept of a bamboo-lined pit had some life put back into it as a very low-cost, albeit temporary alternative for the poorest villagers. Perhaps most disappointing was the disinterest in double pits. From a sanitation perspective, using alternating pits is most ideal. We left the concept on the table, but needed to make it more enticing. Lastly, we were very intrigued by the copying behavior amongst villagers. If one person built a specific type of latrine, most others did as well. This was something that we could use.
3rd Round.

The 3rd round of prototyping marked our first effort into bringing full-scale prototypes to the field. It also marked the first time we introduced villagers to tangible examples of latrine products that are not currently available in the market. We had begun to form the concept of a latrine ‘core’--a simplified functional unit of a latrine--and wanted to explore some ideas in that realm. We also looked to understand villager perceptions around pour-flush pan designs and pan materials. We wanted to know what was important and what wasn’t, so that we could find areas for potential pan cost reduction. In a similar vein, we introduced a thin concrete ring to villagers to gauge their potential acceptance of such an idea. The thin ring was our first full-scale effort to reduce materiality and, thus, the cost of the rings. We met with two groups of villagers (mixed men and women and latrine owners and non-owners) in non-CLTS villages in the Kandal province.
3rd Prototypes

The prototypes used in the 3rd round were full scale models of a thin concrete ring, a pan stand and numerous ceramic and concrete pans. We introduced a 2.5cm wall thickness 0.8m diameter concrete ring as well as a precast concrete stand that would support a pourflush pan. The pan stand was specifically intended to be used with an offset pit, and the thought was that the stand would replace the need for the slab & ring typically used for this purpose. Low-cost users could just use the pan and pan stand combo without a bigger slab. Wealthier users could use the same stand but build a brick slab around it.

We also brought the three ceramic pans most commonly found on the Cambodian market (Thai, Vietnamese and Chinese models, each at different price points) as well as two locally-produced concrete pans. One of the concrete pans was left with the standard red pigment surface. The second was painted white and coated in 2-part epoxy to make it cleaner looking and give it a smoother surface. We had also intended to bring a plastic pour-flush pan but did not get it from the supplier in time. . . perhaps a sign of things to come were we to ever include that pan in our offering.
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3rd Prototypes: Primary Learnings

1. Villagers didn’t notice that the ring was thinner than normal until we pointed it out to them. . . not highly aware of the specific details of latrine-related products.

2. Once aware, villagers were okay with thickness of thin ring. . . ‘if it breaks, it will only do so in transport. . . once in ground, okay.’

3. When asked if they’d rather have the underground or above ground parts of a latrine given to them, the villagers all agree on the underground: ‘It’s complex and expensive. . . we’d do the shelter by ourselves.’

4. ‘Most difficult part of latrine construction is making the chamber’ . . . for that the villagers need a mason . . . other stuff many could do by self.

5. Discussion moved in direction of making pan stand enclosed to act as pre-cast pan chamber. . .
6. Pan stand perceived as cheaper than a ring and slab as way to elevate pan.

7. Villagers have had bad experiences with locally-made concrete pans:
   a. The goosenecks break off at the junction after two to five years
   b. ‘Feces is salty. . . it ruins the concrete at the neck’
   c. Harder to clean than porcelain—have to clean each time used rather than periodically
   d. Concrete absorbs water, stays wet; porcelain stays dry

8. Very strong preference for purchase and use of ceramic pan even with cost differential.

9. Non-owners are familiar with all the components of a latrine (rings, pan, slab, shelter, PVC pipe), but don’t know how to install or how to design.
3rd Prototypes: Secondary Learnings

1. When comparing the plain concrete pan to the epoxy-coated concrete pan, the villagers expressed preference for the plain pan. . . because of it’s original construction, it had a smoother hole. They only cared about the smoothness of the hole, not the rest of the surfaces, which were actually smoother in the epoxy version.

2. Some villagers believe that locally-made concrete pans use less water to flush (though we can’t really discern the reason) for this belief.

3. Ceramic pans are mentioned to be easier for children to use.

4. Villagers aren’t able to sort the ceramic pans in correct price order.

5. Pan preference given on factors of
   a. Aesthetics
   b. Size of the hole
   c. Sound of the porcelain when rapped with hand (higher pitch is better)
   d. Thickness of porcelain

6. Would not want an earthen floor because it gets wet and the pan would then get dirty.
3rd Prototypes: Secondary Learnings

7. Villagers not sure of proper pan height... would rely on mason.
8. ‘Thin ring is fine, as long as it’s cheap.’
9. Villagers prefer 1m diameter ring to 0.8m ring... 0.8m ring ‘fast to fill up’ (note however, that in most villagers, we’ve heard the opposite)
10. Will have to empty every 5-6 years with three 1m rings.
   a. Some empty into fields with a bucket.
   b. One mentions that he empties in dry season... covers in ash first, makes entire family not use for two weeks, mixes with cow dung and takes to field after one month.
3rd Round: Summary thoughts

The 3rd Round of field visits was really cut and dry and almost wholly focused on latrine components. We learned that locally-made concrete pans are out—too many bad experiences both on a daily basis and over the long term. For the most part, a ceramic pan is a ceramic pan—other than a bigger hole is better, villagers do not really perceive much difference between them unless pushed to. Similarly, the villagers did not even notice that the ring was 60% the normal ring thickness until we pointed it out. As long as it’ll work underground, they don’t really care.

Perhaps most exciting, however, was the evolution of the pan stand concept. What was just a stand for holding up the pan morphed into a chamber to funnel the waste into the drainpipe. There is potential for the pan stand to take the most difficult part of pour-flush latrine construction (in terms of skill and mental modeling) and put it in a pre-cast piece.
4th Round.

The 4th round of prototyping was focused on getting user and ring producer feedback on an evolved pan stand concept as well as getting ring producer feedback on the thin ring and tapered ring concepts.

We were trying to gauge the following:
- User understanding of the pan stand concept
- Ring producer concerns with the pan stand, thin ring and tapered ring concepts
- Ring producer feedback on potential mold designs and casting methods
- Ring producer and villager expression of the potential benefits of the ideas proposed
- Transportation costs and cost drivers for concrete rings and slabs.
4th Prototypes

The prototypes used in the 4th round of prototyping were full scale models of a thin concrete ring and an evolved pan stand, as well as two 1/5th-scale models of the tapered ring concept.

Pushing the limits, we brought a 2-cm wall thickness ring--0.5cm thinner than the ring used in the previous round.

The pan stand was likewise dematerialized and was a much smaller and more functional version of what we had shown previously. The new stand now served the function of an enclosed funneling chamber beneath the pour-flush pan which would channel the waste into the drainage pipe connected to the rings. The pan stand would take the place of the hand-built sloped brick chamber which currently requires skilled masons to build.

The tapered ring concept was testing the benefits of being able to more densely pack rings for transport on a moto cart or truck. We were trying to understand if volume or weight (or both) was the limiting factor on how many rings a producer could transport to villages at once.
4th Prototypes
4th Prototypes: Primary Learnings

1. Village men immediately understood function of the pan stand.

2. Villagers (including one mason) expected that pan stand would be much easier than building a chamber with bricks.

3. Villagers mentioned that many of them could build by themselves.

4. Ring producer currently makes two rings per day per mold. Would want to be able to make more rings per day per mold, if we could help him figure out how.

5. If introducing a new product and buying a new mold, ring producer wants to know that he has customers to buy product.

6. Ring producer willing to help market new latrine products and visit villages to promote his products.

7. Volume and weight limiting factors in ring transport.
1. Ring producer currently uses a motobike trailer and a truck for transporting rings.
   a. Can fit 5 rings on trailer and says that is limited by both space and weight--stacks 3 on bottom level and 2 offset on second level
   b. Stacks rings to three levels in truck
2. No surcharge for local transport, no discount if customer picks up themselves. Surcharge for long trips? 1000r/ring.
3. Ring producer worried that thin ring would break in transport, especially if a 1m diameter ring rather than a 0.8m ring.
4. Would add more cement to thin ring to make stronger.
5. Worried that tapered rings might stick together in transport.
6. Worried that tapered rings might break each other when stacked together in transport--even if cushioned would still break due to ‘disco road’.
7. Ring producer expected pan stand to cost 10,000 riel: looked like a difficult shape to make. He’d use ‘more rock to make stronger because people stand on it.’
8. Ring producer would be willing to purchase mold from Phnom Penh. Only cares about quality—how thick is the metal and how easy is it to open.

9. All villagers would build up a slab around the pan stand to the approximate level of the pan—they’d likely build it with bricks with a cement mortar cap.

10. Villagers wanted a steeper reverse angle to the funnelling chamber, more clearance beneath the trap and more angled sides.

11. Some villagers mentioned that they would elevate the whole thing about 25 cm to avoid flooding problems.
4th Round: Summary thoughts

The very-focused 4th round of field visits helped refine the pan stand concept as well as point out some ring producer concerns with the pan stand and thin ring concepts. The tapered ring did not resonate well with the ring producer. Transportation density and costs did not seem like a big driver for him, so the potential for packing more rings on a trailer or truck bed were not readily apparent for him. Moreover, since the transportation is currently limited by both volume and weight, reducing volume alone does little good. Since reducing weight is a much harder task, we’ll focus there for now and return to the tapered ring should weight reduction prove successful.

The most exciting aspects of the field visit were the villagers’ immediate understanding of the pan stand concept, the excitement they displayed when looking at it and the ring producer’s seeming willingness and interest in helping promote latrine-related components, both new and old.
Design Direction.

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Design Direction.
Next Steps.
Design Direction.

Based on the original user learning plus further information gathered during the prototype iterations, the final design direction evolved. Not shown anywhere in this presentation are the many ideas that died in the process: blow molded pit linings; expanded polystyrene pit linings; fused rubber chip rings; foamed concrete rings; pervious concrete rings; brick aggregate concrete rings; precast concrete shelter walls; extruded plastic shelter walls; plastic forms for cast-in-place concrete rings, slabs and walls; rice husk ash concrete; roll-up concrete textiles for lining pits. . . the list is long and sad, but the final results shown here fit the Cambodian villager’s need and desires well. They (mostly) fit within the existing supply chain infrastructure. Some new skills and new ideas will need to be disseminated, but the education and preparation of the supply chain needed for villagers to access everything shown here should be achievable within the time constraints of the overall sanitation project.
Benefit Ladder

Very early in the project and in conjunction with the marketing effort, we developed the notion of a benefit ladder (shown on the next page). The ladder described the accrued benefits from building a latrine versus the investment in the latrine. We aimed to develop latrines at three separate price points (~$20, ~$70 and ~$150) that would provide increasing benefit with increasing investment. Interestingly, the ladder illustrates that the majority of needs and desires that villagers (and sanitation advocates) have are gained even at the lowest end of the ladder. Additional investment serves mostly higher order needs.

In promoting an upgradeable path, we wanted to clearly educate this fact: that the base level investment provided nearly the same benefit as the highest level investment. Throughout the design process, we kept this ladder philosophy in mind and attempted to incorporate it into our design. How could the design illustrate both the existence of an upgrade path and that the base investment provided most of the benefits of building a latrine?
This field note aims to explain the concept of household demand for sanitation in developing countries, what stimulates demand among new adopters, and how this knowledge can be used to develop marketing strategies to accelerate sanitation uptake. It draws these insights from an in-depth study of household latrine adoption behavior in rural Benin.
Latrine Core

From our field work and design iterations emerged the notion of a latrine core: a base set of elements that could be used for any latrine at any rung along the benefit ladder. The latrine core provides the sanitation function of a latrine—waste deposition and waste storage. As shown on the next page, the latrine core consists of a pan module, a pipe module and a ring module. These three elements together are all one needs to have a durable, sanitary latrine.
This field note aims to explain the concept of household demand for sanitation in developing countries, what stimulates demand among new adopters, and how this knowledge can be used to develop marketing strategies to accelerate sanitation uptake. It draws these insights from an in-depth study of household latrine adoption behavior in rural Benin.
Pan Module: Ceramic Pan

Based on our research, there are three main types of ceramic pans available in Cambodia: Thai, Chinese and Vietnamese. They typically price at $13, $10 and $8, respectively, though we have seen variation in price. As noted earlier, users typically do not notice the differences between the three and are often just as happy with the least expensive option. In reality, however, the pans do differ in terms of quality (thickness and strength of the porcelain and the size of the outlet hole) and aesthetics (overall shape, foot plate design and color). Since we cannot control which pan a villager will purchase and because village and commune retailers often will carry only one type, we need ensure that any of the pans will work with our core concept.

The pan should not be sold preattached to the pan stand. It should be mortared onto the stand after the stand has been installed on-site. This will help prevent accidental breakage, will make both components easier to transport and should slightly reduce overall costs because the mortaring labor can be provided cost-free by the home owner.

Estimated Cost: $5
Pan Module: Pan Stand

The pan stand replaces the brick and mortar construction currently used to funnel waste to the drain pipe. It can be made from a sand:cement admixture with no reinforcement or aggregate added. The current design is about 34cm high and weighs around 40kg. The pan stand should accommodate any of the ceramic pans currently on the Cambodian market. It fits none of the pans perfectly, but all of them good enough.

During installation, the pan stand will likely be placed directly on the ground and the slab built up around it. In areas with more persistent and higher flood levels, the villagers should elevate the pan stand above ground level by placing it on compacted earth, compacted gravel, bricks or other stable substrate. The pan and pipe should be mortared to the stand on-site—a good seal is critical to prevent odors and fluids from leaking out. The inside of the pan stand should be as smooth as possible to help prevent build-up and clogging.

Estimated Cost: $2
The pipe used in the latrine core is a standard 75mm OD PVC pipe. This is the diameter most typically used in latrine drainage applications in Cambodia. The most economical approach will be to use the shortest length possible in order to connect the pan stand to the rings. A 1m-length should suffice, but siting issues and user preference might necessitate a greater length. The pipe should be installed at a minimum slop of 1:15 (one unit of vertical drop for every fifteen units of length). The pipe will need to be mortared to both the stand and the rings. The integrity of these joints will be important for preventing leaks and odors.

Estimated Cost: $0.70/meter
Pit Module: Concrete Rings

Current concrete rings are incredibly overbuilt for a latrine application—the vertical loads and lateral earth pressure loads generate only a few psi of stress. The 4cm thickness is a result of multiple factors (adaptation from another use (culverts), ease of manufacturing, response to transport loads and legacy) but drives the high cost of a ring and makes transport more difficult. A standard ring has $2.50 of cement in it, and this is the main driver of ring cost.

The proposed concrete ring is a thin-walled version of the standard 1m OD x 0.5m high ring. The ring is targeted to have a wall thickness of 2.5cm and weigh 90kg (versus the standard 145kg). A 1m-OD ring is used rather than a 0.8m ring because the ratio of storage volume to cost is significantly better with the larger diameter ring. By retaining the same OD as the current rings, the outer pieces of existing ring molds can be reused. The 2.5cm wall thickness will be achieved by improving the strength and toughness of the concrete through a new admixture and improved reinforcement (either fibers or a smarter metal wire arrangement). This work is still in progress.

Estimated Cost: $4/ring -- $12
Pit Module: Concrete Cover

The 1m OD circular slabs currently available on the market can also be used for our latrine core application. It should be noted, however, that any improvements to the concrete used in the rings should be evaluated for their potential to reduce the weight and cost of the slab.

During installation, the slab does not need to be mortared onto the rings--its mass will keep it from being displaced. Since it will need to be moved when the pit needs to be emptied, mortaring it in place will likely lead to damage of the rings or slab when the slab needs to be removed. Either a solid slab or a slab with a removable port can be used, but the port will facilitate checking of fill level. Note, however, there is no need to ventilate the slab (and pit) with a PVC pipe.

Estimated Cost: $3
From a Core to a Latrine

The latrine core provides a consistent functional unit to be promoted regardless of latrine price point. Some villagers will opt to use four or even five rings instead of the three promoted in the latrine core images. Some will use five meters of pipe instead of one. This is all fine and should be supported. Likewise, villagers will express different preferences and abilities for building out the rest of the latrine. But regardless of what villagers choose to do, they will all follow a very similar process:
From a Core to a Latrine

1. Install the core
From a Core to a Latrine

1. Install the core
2. Build a slab
From a Core to a Latrine

1. Install the core
2. Build a slab
3. Build a shelter
On the slab and shelter... 

Since we heard repeatedly and consistently from villagers that they needed the most help with the below-ground aspects of the latrine (the core as we have designed it), we did not spend a lot of time on the design of the slab and shelter (we wish we could of, but time was short). Villagers are for the most part quite familiar with the construction of slab and shelter elements (or similar type structures) and can readily mimic examples we show them or examples set by neighbors. Villagers can readily improvise with materials they have on hand and with a few guidelines we set. Note that this is not the case for below-ground structures--they are hard to mimic because they are hard to see.
The slab.

The two most important functions of the slab are to allow access to the pan and to provide a surface around the pan that will be cleanable and will not absorb fluids and odors. The slab should be built flush to the top of the pan stand and will likely have a step up to improve access. The minimum acceptable slab size is about 0.8m wide and 1m deep. Three potential slab designs are shown below, though the options are endless.

- **Elevated Bamboo Slab**
  - Bamboo frame
  - Bamboo slats
  - Mortar cap (>3cm thick)
  - Compacted earth, broken brick or rock fill
  - Sloped sides (45deg or shallower)
  - Mortar cap (>2cm thick)
  - Brick frame (~400 bricks)
  - Est. Cost: $0.25 (nails)

- **Capped Dirt Mound Slab**
  - Bamboo frame
  - Mortar cap (>3cm thick)
  - Sloped sides (45deg or shallower)
  - Compacted earth
  - Mortar cap (>2cm thick)
  - Capped dirt mound
  - Est. Cost: $2 (mortar)

- **Brick and Mortar Slab**
  - Brick frame
  - Mortar cap (>2cm thick)
  - Compacted earth
  - Mortar cap (>2cm thick)
  - Brick frame
  - Est. Cost: $4 (bricks & mortar)
The shelter provides privacy, security and comfort. It also plays a large role in the amount of status a latrine owner accrues from building a latrine. The range in costs of a shelter can vary dramatically, with shelters built from scavenged materials being essentially free to the nicest, largest concrete shelters costing hundreds of dollars. As with the slabs, villagers expressed a fair amount of knowledge and comfort in thinking about the design and construction of a shelter. For this project, we’re providing guidelines on the shelter selection, but we are not introducing anything significantly new. Below are three shelter options that span the range of costs--they’re all based on a 0.8 x 1m slab, though we acknowledge that at the higher end, the slab area increases significantly to accommodate bathing, water basins and increased desire for comfort.

### Natural Shelter
- Est. Cost: $1 (nails)
- Leaf roof
- Leaf walls
- Bamboo/palm frame
- Framing (palm/bamboo/wood)

### Zinc Shelter
- Est. Cost: $35
- Framed zinc-sheet door
- Zinc sheet roof
- Zinc sheet walls
  - 12 (0.8 x 2.5m) zinc sheets

### Concrete Shelter
- Est. Cost: $110
- Brick walls
- Mortar finish
- Plastic door
- Zinc roof

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Final Report 70
May 5, 2009
Latrine costs.

Since we are employing a consistent latrine core complemented by a user-selected slab and shelter, the cost variations from latrine-to-latrine are primarily dependent on the slab and shelter selected. And since all owners will have a latrine core, the upgrade path and upgrade costs will be focused on improvements to the slab and shelter.

We do realize, however, that additional rings can be added during the initial build and second pits can be added during upgrading. Though not necessary, these types of improvements should be supported.
Who Buys Latrines, Where and Why?

This field note aims to explain the concept of household demand for sanitation in developing countries, what stimulates demand among new adopters, and how this knowledge can be used to develop marketing strategies to accelerate sanitation uptake. It draws these insights from an in-depth study of household latrine adoption behavior in rural Benin.

Latrine Core:

<table>
<thead>
<tr>
<th>Pan module</th>
<th>Pipe Module</th>
<th>Ring Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pan: $10</td>
<td>1m: $0.50</td>
<td>3 rings: $12</td>
</tr>
<tr>
<td>Stand: $2</td>
<td></td>
<td>Slab: $3</td>
</tr>
</tbody>
</table>

Total Core: $27.50
$30 Latrine

Latrine Core + Dirt or Bamboo slab + **Local material walls & roof.**
$70 Latrine

Latrine Core + Brick slab + **Zinc walls and roof.**
$150+ Latrine

Latrine Core + Brick slab + **Concrete walls and zinc roof.**
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### Benefit Ladder Revisited

- **Cost**
  - ~$20
  - ~$30
  - ~$70
  - $150

- **Benefit**
  - Privacy
  - Safety
  - Convenience
  - No smell
  - No bugs
  - Place for guests
  - Some status
  - No shit eating
  - More permanence
  - More status
  - +bathing
  - +most status
  - +permanence
What about the $10-20 latrine?

From the beginning of the project, this was the price point we were aiming for. Yet, the more we learned, the more we realized that building a sustainable latrine at this price point is seemingly impossible in Cambodia. By sustainable, we mean the following:

- pit will not collapse during the wet season
- pit will not degrade every year and require rebuilding
- pit will only need emptying once every 2 years, if not longer

The need for sustainability of the latrine was a key learning that came out of the early CLTS work in Cambodia. If the latrine is not sustainable, people will fall off the sanitation bandwagon. Yet, there still remained the potential to get villagers on the latrine upgrade path in a temporary fashion until they could make the additional subsequent investments to get to a sustainable latrine. Hence the $15 latrine was developed.
$15 Latrine

Low-cost latrine core + Dirt or bamboo slab + Local material walls & roof
The Water and Sanitation Program is an international partnership for improving water and sanitation sector policies, practices, and capacities to serve poor people.

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Low-Cost Latrine Core

1. Plastic Pan Module
2. (Larger) Pipe Module
3. Bamboo Pit Module
Plastic Pan Module: Plastic Pan

Seemingly, the best plastic pour-flush pan available on the market is manufactured by K.K. Nag Plastics, based in India. The complete pan set consists of two parts: 1) the squat pan with a vertical outlet and 2) a trap that attaches to the pan outlet and makes the water seal. K.K. Nag will provide either a gooseneck- or a P-trap (pictured at left). We recommend using the P-trap since a PVC pipe can plug directly into it. The injection-molded polypropylene pan is designed with a high-angle inner surface which helps minimize water use during flushing. Note that this pan is significantly deeper than the ceramic pans currently available in Cambodia. The pan does not incorporate foot rests.

The pan set retails for $3.35 out of the factory, and shipping from India adds $0.96 to $1.42 per set depending on the volume initially purchased. Additional local distribution and retail mark-up costs will need to be factored into the final retail price.

Estimated Cost: $5.50
Plastic Pan Module: ‘Plastic Pan’ Stand

The ‘plastic pan’ stand serves a significantly simpler function than the ‘ceramic pan’ stand. Since the pan plugs directly into the PVC pipe, the stand only serves to support the pan—it does not need to help funnel waste. Like the ‘ceramic pan’ stand, it can be made from a sand:cement admixture with no reinforcement or aggregate added. The current design is about 46cm high (12 cm higher than the ceramic version) and weighs around 25kg (15kg lighter than the ceramic version). The pan stand is designed specifically for the K.K. Nag plastic pan.

As with the ceramic version, the pan stand will likely be placed directly on the ground and the slab built up around it. In areas with more persistent and higher flood levels, the villagers should elevate the pan stand above ground level by placing it on compacted earth, compacted gravel, bricks or other stable substrate.

Estimated Cost: $1.50
(Larger) Pipe Module: PVC Pipe

The pipe used for the low-cost version of the latrine core is a standard 100mm OD PVC pipe. The larger pipe diameter (incidentally, the standard for European wastewater plumbing applications) is dictated by the trap design of the K.K. Nag plastic pan. As with the ceramic design, the most economical approach will be to use the shortest length possible in order to connect the pan to the rings. A 1m-length should suffice, but siting issues and user preference might necessitate a greater length. The pipe should be installed at a minimum slop of 1:15 (one unit of vertical drop for every fifteen units of length). The pipe will need to be mortared to the rings and joined to the trap using an appropriately selected plumbing adhesive (note that the material mismatch between the trap and the pipe--PP vs. PVC--may make this particularly tricky).

Estimated Cost: $0.70/meter
Natural-Reinforced Pit Module: Lining

The second round of user prototyping illustrated a villager willingness to build temporary, bamboo-lined latrine pits in order to initiate their latrine ownership. Though this is not a sustainable solution, it gets villagers on the path of latrine ownership. These latrine pits should only be expected to last for one season. As such, they can be constructed smaller than a standard pit: 1m diameter x 1m deep should suffice for a single season. Vertical sections of locally harvested bamboo, palm or other wood should be lashed together into a cylindrical lining for the pit. Wrappings of woven thatch or straw can be placed around the exterior of the cylinder in order to prevent soil from filling in the pit.

After one season, the pit should be abandoned and a new pit dug with at least a 1 meter wall-to-wall distance between pits. This should be done during the dry season. The original pit should be let to rest for two months and then filled in with soil. A tree or garden can be planted on the site or, after 2 years rest, the soil can be harvested as a good source of fertilizer for farming.
Natural-Reinforced Pit Module: Cover

A cover for the pit should be fashioned out of similar materials as the pit itself. Parallel lengths of bamboo, palm or other wood should be lashed together and placed over the pit. A mud/straw mixture can be packed onto the top of the lashed pieces in order to improve the barrier. A PVC pipe vent does not need to be incorporated despite its presence in the picture at left.

Estimated Cost: $0
The Water and Sanitation Program is an international partnership for improving water and sanitation sector policies, practices, and capacities to serve poor people.

September 2004 Field Note

Who Buys Latrines, Where and Why?

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Sanitation and Hygiene Series

Final Benefit Ladder

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ pit permanence</td>
<td>$15</td>
</tr>
<tr>
<td>+ &gt;2yr emptying</td>
<td>$30</td>
</tr>
<tr>
<td>+ more status</td>
<td></td>
</tr>
<tr>
<td>Privacy</td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td></td>
</tr>
<tr>
<td>Convenience</td>
<td></td>
</tr>
<tr>
<td>No smell</td>
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<td></td>
</tr>
<tr>
<td>Place for guests</td>
<td></td>
</tr>
<tr>
<td>A little status</td>
<td></td>
</tr>
<tr>
<td>No shit eating</td>
<td></td>
</tr>
<tr>
<td>+ shelter permanence</td>
<td>$70</td>
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<tr>
<td>+ more status</td>
<td></td>
</tr>
<tr>
<td>+ shelter permanence</td>
<td></td>
</tr>
<tr>
<td>+ bathing</td>
<td>$150</td>
</tr>
<tr>
<td>+ more shelter permanence</td>
<td></td>
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<tr>
<td>+ more status</td>
<td></td>
</tr>
<tr>
<td>+ most status</td>
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</tr>
</tbody>
</table>
Next Steps.

Process Review.
User Research Review.
Prototype Reviews.
  1st Round.
  2nd Round.
  3rd Round.
  4th Round.
Design Direction Explained.
Next Steps.
Next Steps.

Though the design direction is in place, a few critical projects remain to be done. These are needed in order to fill in some gaps in our knowledge, prove feasibility of some of our ideas and transfer one-off prototypes to products that can be manufactured locally on a mass scale.
Pan Stand Design

The final design of the pan stand could use one more iteration based on the following:

1. A fully exhaustive survey of all of the ceramic pans available in Cambodia should be undertaken to ensure that the pan stand will work with all of them. Our original research uncovered the three models from the three manufacturing countries (Thailand, China and Vietnam) but there may be more models on the market. Note that we’re particularly concerned with those pans available in rural Cambodia versus in Phnom Penh.

2. The slope and funnelling curvature of the pan stand channel should be tested and optimized if needed. Note that increasing slope comes at the cost of a taller, heavier, more expensive design (as it leads to a thicker concrete section), so it is not without consequence.

3. Mortaring of the pipe to the pan stand should be prototyped (by a mason) so that the methods are understood and any needed improvements to the overall design can be made.

4. Similarly, mortaring of the pan to the pan stand should be prototyped by a mason.

5. As an alternative to mortaring, some time should be spent investigating the option of attaching the pan and pipe through the use of wax. This is standard practice to achieve a seal in many Western countries and may make self-assembly easier. Available wax alternatives, costs and supply chain requirements should be understood and prototype assembly with wax performed and tested.
Pan Stand Mold Making

We have already done a significant amount of investigation into the feasibility and design of a mold for casting the pan stand. Yet some work remains:

1. One mold for casting of the pan stand should be fabricated by a mold maker. Any changes required by the mold maker per their learnings during mold construction should be reviewed by IDE. Any resultant changes in the design of the pan stand should be well understood.

2. The mold should then be taken to the field for prototype use by ring producers. Have them produce a few pan stands over the course of a few days. Use their feedback to make improvements to the pan stand design or mold, should any be required.

3. Understand cost drivers for mold construction. Work with mold maker to reduce costs where possible without negatively impacting the design of the pan stand.

4. Choose between strategy of producing molds centrally in Phnom Penh or having molds constructed by the commune-level mold makers. If working centrally, it is probably worth partnering with 2-3 mold makers to avoid issues of single-sourcing (price gouging, limited capacity to meet demand, etc.).
Plastic Pan

As a new product to the Cambodian market, the plastic pan needs further evaluation from a user and business perspective:

1. Since we did not receive a plastic pan in time to perform field tests, we were unable to gauge user perception of the product. Once a plastic pan is in hand, a quick field survey of user perceptions should be conducted. Comparisons to the ceramic pan should be made and relevant pricing information shared with users.

2. Final retail costs of the plastic pan need to be more fully understood. We have a good sense of import costs, but local distribution and retail mark-ups need to be understood.

3. The supply chain for the plastic pan needs to be planned and developed. Who will sell the pans to users? How will the plans get to the seller?
Plastic Pan Stand

The plastic pan stand is a few steps behind the ceramic pan stand and will need to play catchup:

1. A full-scale prototype of the pan stand needs to be built and taken out to users. This should occur at the same time that the plastic pan is first shown to users. The complete pan and panstand combinations can be shared along with their expected retail prices, and consumer preferences and opinions gathered.

2. The plastic pan stand should then undergo a few of the same development steps as the ceramic pan stand, including garnering ring producer and mold maker feedback, having a mold maker build a prototype mold, having ring producers use that mold and testing the assembly of a latrine using the plastic pan with stand, including the step of mortaring the pan to the stand.
Ring Design

Perhaps the most significant remaining piece of work is understanding what we can do to reduce the cost of the concrete ring. There are four avenues that we are pursuing. We expect some or all of them to pay off and each to contribute to reducing ring cost:

1. Perhaps the most impactful change would be in reducing the amount of cement required for ring production. This can be accomplished by reducing the amount of cement in the admixture and/or reducing the overall amount of concrete in a ring (i.e., making a thinner ring). Experiments with fiber reinforcement and smarter metal reinforcement are underway.

2. The potential for producing more rings per day from one mold should be explored further. Two per day is quite a low number and processes developed in the West can be somewhat readily ported over to ring producer here to triple or double their daily ring output from one mold.

3. Overall ring geometry, particularly geometries such as the tapered ring that can improve packing density, should be revisited once a lighter weight ring is developed. Full-scale prototypes should be brought to ring producer so they can experiment with transportation and see if there is benefit. Fixtures to help keep the rings separate during transport should be developed and shown to the ring producers.
Construction Prototyping

To date we have worked on a component level in the development of the latrine concepts. And though we have solicited a great amount of feedback from future users and installers, we have not put our ideas into their hands. It will be critical moving forward to start building fully-integrated prototypes and let users build with our designs:

1. Ring and pan stand molds should be brought to ring producers so they can cast parts. Any new techniques that we’ll be advocating should be conveyed. And any improvements to help with filling and/or demolding should be incorporated.

2. Locally-cast rings should be transported to villages to test how well they survive loading, unloading, the trip and being installed in a pit.

3. Villagers and masons should be enlisted to build full latrines from the components we have designed and using the instructions we will design. See what works, what doesn’t, where they have difficulty, where they have questions. And see what creative solutions and designs they come up with. Record all of this diligently and make necessary changes to the designs and/or the instructions.

4. When building the full latrines, the labor and material costs should be recorded in detail in order to obtain more accurate cost estimates for each of the latrine models. Any opportunities to reduce cost should be identified.
Thank you . . .

. . . to the core team: Savath, Kimsan, Sopheak, Hengly, Satya and Chhoeurn
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. . . to the advisors: Lyn, Phyrum, Dr. Samnang, Pierre, Jan Willem, RainWater Mike, Sophon, Kim Hor and Judy
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