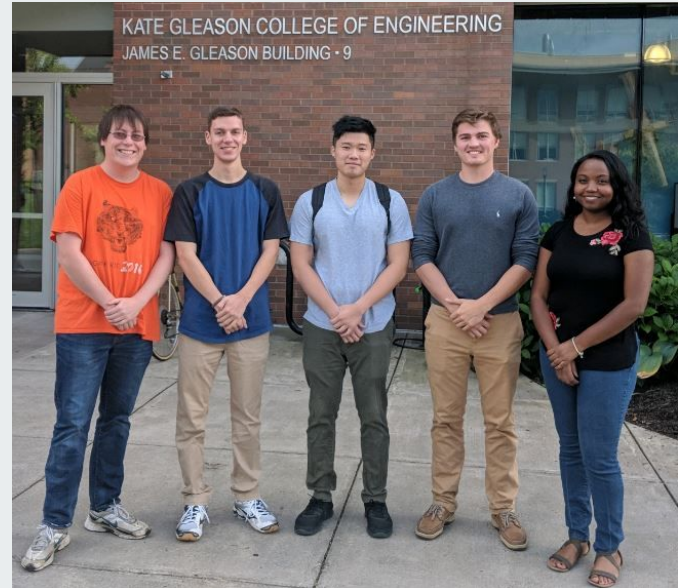

P.O.R.T.A.: Problem Definition Review

Team Members: Peter Killian, Owen Tinkler,
Ricky Ko, Timothy Turner, Aleah Starks



Roles

Peter Killian: Engineering Lead

Owen Tinkler: Project Manager

Ricky Ko: Systems Design Lead

Timothy Turner: Design Lead

Aleah Starks: Web Master



Team Values

- Team members are on time for meetings
- Everyone participates in group conversations
- Handing in work on time and in a satisfactory manner
- Receptive to feedback
- Acknowledging each others strengths and weaknesses





Project Background

- Haiti is a low income nation (~66% lacking adequate sanitation facilities)
- Diseases (like cholera) have been a larger issue since the 2010 earthquake which has increased infections
- Sustainable Organic Integrated Livelihoods (SOIL) provides resources that would usually be unavailable in Haiti
- A dry toilet model has been in the works to better help with sanitation issues (which separates urine and solid excrement into different buckets)

Team Vision

- The goal for this phase is to identify any improvements that can be made to the previous dry toilet model which, has some minor design failures (ex. diverter, toilet seat, etc.)
- Our team developed requirements, engineering metrics, house of quality, benchmarks and our project plan.





Problem Statement

Current Model

- Doesn't utilize running water
- Collects waste for manual removal
- Allows for different wastes to be separated and removed more easily
- Able to be used by any person (regardless of size)
- Should be cost-effective (plastic seats are currently very expensive)
- Some waste could miss the diverters and may not be contained



Project Goals and Key Deliverables

Goals:

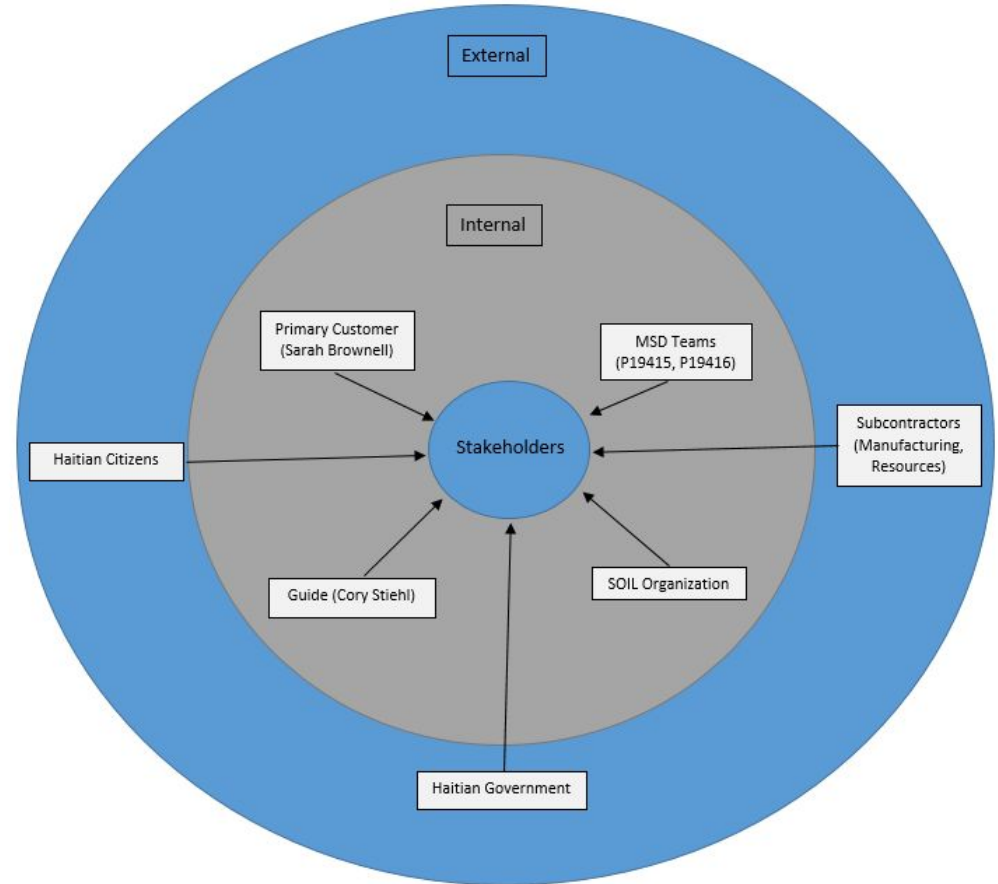
- To design an ergonomic dry toilet base with an improved diverter system
- Design a more efficient and customizable excrement collection method
- Reduce overall manufacturing time and costs

Deliverables:

- Working prototype of a redesigned ergonomic toilet base with an improved diverter system
- Custom waste collection methods
- Cutting costs in manufacturing by making all or most of the parts of the toilet locally
- Detailed design documentation with design changes

Stakeholders

1. Customer (Sarah Brownell)
2. Guide (Cory Stiehl)
3. SOIL
4. MSD teams (P19415, P19416)
5. Haitian citizens
6. Haitian government
7. Subcontractors (Manufacturing and resources)





Use Cases

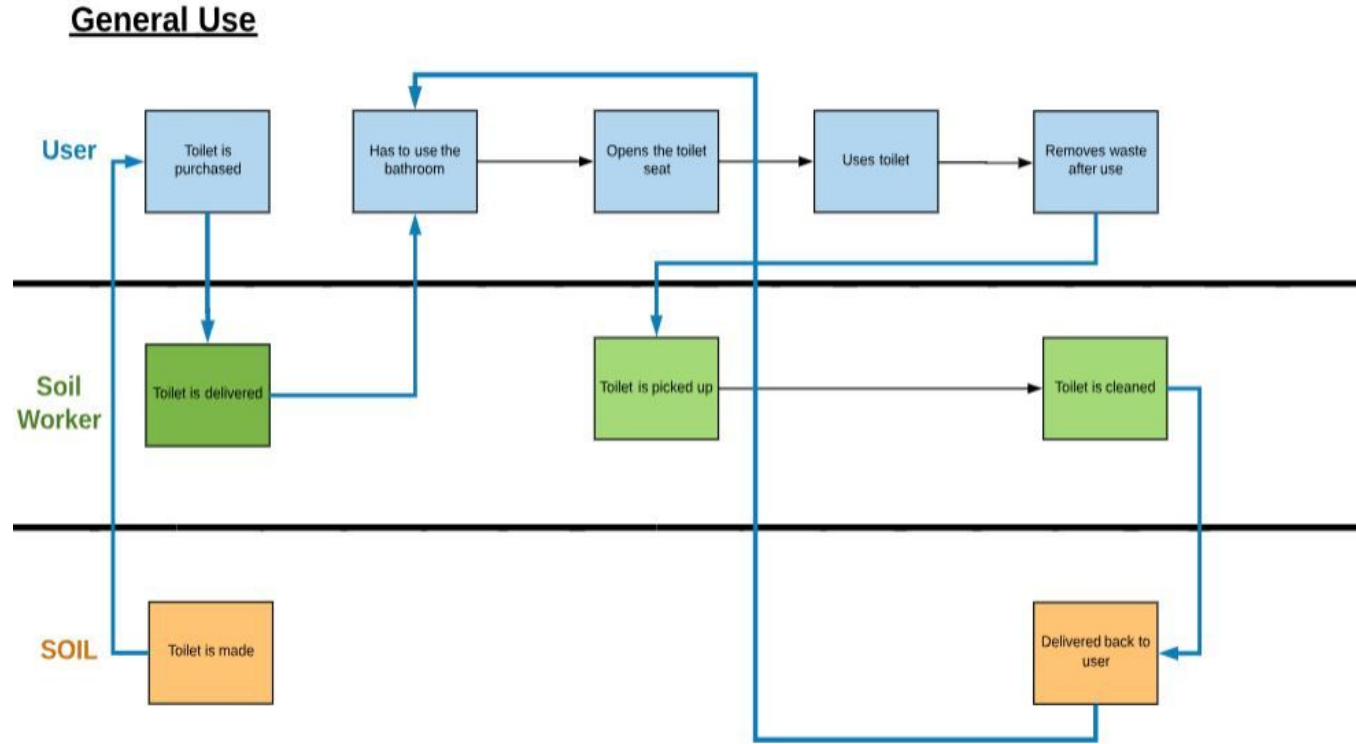
Currently for Phase I we have 2 scenarios for the dry toilet:

- General overall use
- User specific scenario based on gender (Male/Female)

As we progress with our project more scenarios will be created.

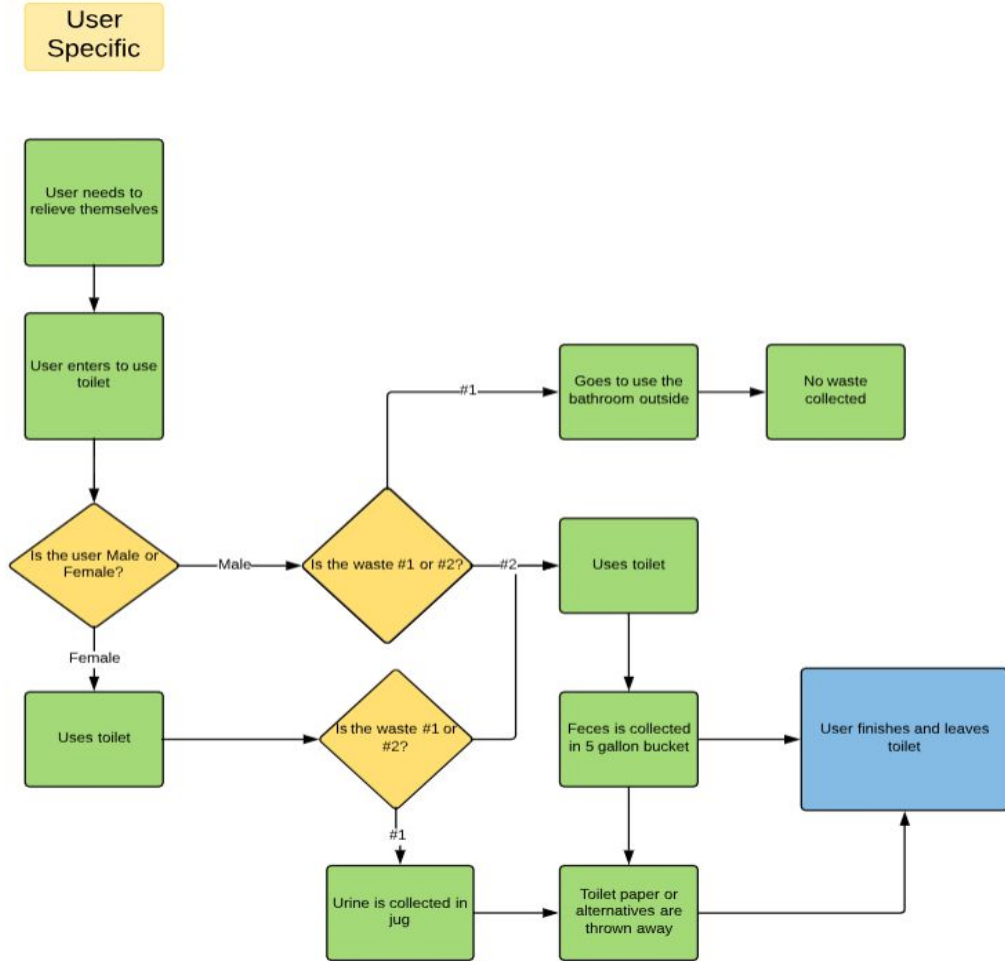
Use Case

- General Use



Use Cases

- User Specific





Customer Requirements

| CUST. REQ. # | PRIORITY | DESCRIPTION |
|--|----------|--|
| General | | |
| G01 | 9 | Reduced manufacturing time for the base |
| G02 | 1 | Less skill needed to produce a base |
| G03 | 1 | Easy to clean |
| G04 | 9 | Low cost - same or less than current model |
| G05 | 9 | Same or lighter weight than current model |
| G06 | 3 | Constructed from local materials and with skills/labor available in Haiti |
| G07 | 9 | Fits aesthetically in the house |
| User Specifications | | |
| US01 | 9 | Allows user to place buckets quickly |
| US02 | 9 | Allows normal use of the toilet (no unwanted interactions like touching, splashing...) |
| US03 | 9 | Makes it easier (faster with less chance of spills) for the user to manage urine |
| Urine Diversion and Management System | | |
| UD01 | 9 | Prevents urine from spilling on the floor |
| UD02 | 3 | Collects most of the urine separately from the feces |
| UD03 | 9 | Allows urine to be removed from the house easily |
| Toilet Necessities | | |
| TN01 | 3 | Keeps out pests like rodents, roaches and flies |
| TN02 | 9 | Works with existing gallon collection jug and 5 gallon feces collection bucket as well as any new designs for collecting urine |
| TN03 | 9 | Works with a standard 5 gallon collection bucket (but the team is welcome to suggest an alternative) |
| TN04 | 9 | Prevents feces from falling on the floor or into the urine diverter |
| TN05 | 9 | Provides a stable, comfortable and ergonomic place for the user to sit |
| TN06 | 3 | Allows ventilation to prevent humidity build up and bad smells |
| TN07 | 9 | Allows quick removal of the bucket through the top |



Engineering Requirements

| SPECS | TARGET | SOURCE | PRIORITY | COMMENTS |
|--|----------------------------------|------------------------|----------|---|
| Time to manufacture a base | 50% less than current | G01 | 9 | This is the main point of the project |
| Manufacturing skill level | basic or unskilled | G02 | 1 | Able to be manufactured by people with minimal training. |
| Time to clean up spills or clean all components | < 20 minutes | G03, UD01, UD02, TN04 | 1 | Spills shouldn't be common but the task shouldn't be strenuous. Time is an estimate but should be close. |
| Time to remove and replace bucket | < 15 seconds | US01, TN02, TN03, TN07 | 9 | A major concern for the collection company |
| Time to remove and replace urine gallon | < 15 seconds | US01, TN02, TN03, TN07 | 9 | A major concern for users. Shouldn't be a full task. |
| Full base costs (all components for house) | < \$45 | G04, G05, G06 | 9 | Current full toilet costs \$35 for base and \$12 for seat |
| Base weight that has to be carried as a unit | < 40 lbs per piece | G05, G06 | 9 | Average person should be able to carry/move toilet themselves. |
| Percent of locally purchased materials by cost | > 60% | G05, G06, G07 | 3 | Importing materials will cost more, but this is a general benchmark currently |
| Largest gap size | < 2 mm | UD01, UD02, TN01, TN04 | 3 | This will minimize the amount of pests that get into the product. Other solutions should lower this priority. |
| Percent of urine captured in urine container by weight | > 90% | US02, US03, UD01, UD02 | 3 | Want to minimize spillage and this is a reasonable metric. |
| Percent of urine on floor by weight | < 2% | US03, UD01, UD03 | 9 | Urine on the floor is rather inconvenient and smelly |
| Percent of users who think toilet is aesthetically pleasing in the house | > 75% | G06, G07 | 9 | Another main point of the project. They have to want to have it in their house. |
| Percent of users who think it is comfortable to use | > 75% | TN05, TN06 | 9 | Based on ergonomic measurements, people should feel comfortable in use. |
| Sitting height (ADA) | between 43 and 48 cm | TN05 | 3 | Based on ADA standards |
| Male clearance | > 10 cm ideal, > 7.5 cm marginal | TN05 | 9 | Another main point of the project. Men need to feel comfortable using it. |
| Percent of times urine spills when emptying nearly full container | < 10% | US03, UD01, UD03, TN02 | 9 | Want to minimize spillage and this is a reasonable metric. |

House of Quality

| | | ENGINEERING METRICS | | | | | | | | | | | | | | | | | | |
|-----------------------|---------------------------------------|--|----------------------------|---------------------------|--|-----------------------------------|---|--|--|--|------------------|--|-------------------------------------|--|---|----------------------|----------------|--|---|--|
| | | <-- CUSTOMER WEIGHTS --> | Time to manufacture a base | Manufacturing skill level | Time to clean up spills or cleanall components | Time to remove and replace bucket | Time to remove and replace urine gallon | Full base costs (all components for house) | Base weight that has to be carried as a unit | Percent of locally purchased materials by cost | Largest gap size | Percent of urine captured in urine container by weight | Percent of urine on floor by weight | Percent of users who think toilet is aesthetically pleasing in the house | Percent of users who think it is comfortable to use | Sitting height (ADA) | Male clearance | Percent of times urine spills when emptying, nearly full container | | |
| | | ENGINEERING WEIGHTS --> | 9 | 1 | 1 | 9 | 9 | 9 | 9 | 3 | 3 | 3 | 9 | 9 | 9 | 3 | 9 | 9 | | |
| CUSTOMER REQUIREMENTS | General | Reduced manufacturing time for the base | 9 | X | | | | | | | | | | | | | | | | |
| | | Less skill needed to produce a base | 1 | | X | | | | | | | | | | | | | | | |
| | | Easy to clean | 1 | | | X | | | | | | | | | | | | | | |
| | | Low cost - same or less than current model | 9 | | | | | | X | | | | | | | | | | | |
| | | Same or lighter weight than current model | 9 | | | | | | X | X | X | | | | | | | | | |
| | | Constructed from local materials and with skills/labor available in Haiti | 3 | | | | | | X | X | X | | | | X | | | | | |
| | | Fits aesthetically in the house | 9 | | | | | | | | X | | | | X | | | | | |
| | User Specifications | Allows user to place buckets quickly | 9 | | | | X | X | | | | | | | | | | | | |
| | | Allows normal use of the toilet (no unwanted interactions like touching, splashing...) | 9 | | | | | | | | | X | | | | | | | | |
| | | Makes it easier (faster with less chance of spills) for the user to manage urine | 9 | | | | | | | | | X | X | | | | | | X | |
| | Urine Diversion and Management System | Prevents urine from spilling on the floor | 9 | | | X | | | | | X | X | X | | | | | | X | |
| | | Collects most of the urine separately from the feces | 3 | | | X | | | | | X | X | | | | | | | | |
| | | Allows urine to be removed from the house easily | 9 | | | | | | | | | | X | | | | | | X | |
| | Toilet Necessities | Keeps out pests like rodents, roaches and flies | 3 | | | | | | | | X | | | | | | | | | |
| | | Works with existing gallon collection jug and 5 gallon feces collection bucket as well as any new designs for collecting urine | 9 | | | | X | X | | | | | | | | | | | X | |
| | | Works with a standard 5 gallon collection bucket (but the team is welcome to suggest an alternative) | 9 | | | | X | X | | | | | | | | | | | | |
| | | Prevents feces from falling on the floor or into the urine diverter | 9 | | | X | | | | | | X | | | | | | | | |
| | | Provides a stable, comfortable and ergonomic place for the user to sit | 9 | | | | | | | | | | | | | X | X | X | | |
| | | Allows ventilation to prevent humidity build up and bad smells | 3 | | | | | | | | | | | | | X | | | | |
| | | Allows quick removal of the bucket through the top | 9 | | | | X | X | | | | | | | | | | | | |

Key: 9 is highest priority, 3 is normal priority, 1 is lowest priority

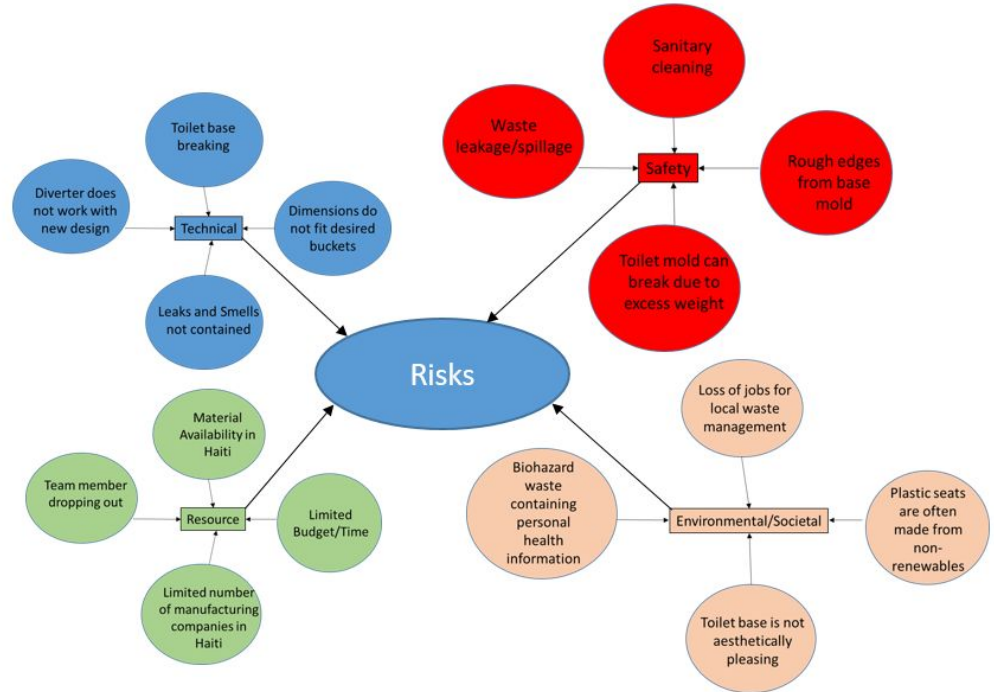


Constraints

- The final product will be a dry toilet which is ergonomic, moveable, successfully separates waste, and has minimal spillage.
- Cost of production will be reduced through local manufacturing (< \$45)
- The weight of the product will be easily carried by one person
- The base of the toilet will be compatible with the 5-gallon buckets being used
- Diverter will be more ergonomic and work for people of different sizes

Risk Assessment

- Rough edges causing cuts or general discomfort
- Fecal matter spills can cause spread of pathogens
- We are working with a limited budget
- We are working with limited material resources
- We risk not dissipating smells effectively





Plans for Next Phase

For the next phase, we plan on moving forward with basic concepts of our design. As of now we plan on:

- Researching materials that could be used for the product
- Finalizing the ergonomic standards needed for the toilet
- Look at and decompose the subsystems used for the design
- Continue meeting with Sarah Brownell
- Develop a basic test for our plan

We will also develop an in-depth project plan after the review has completed.

Questions?





Thank you!