**Warren J. Baker Endowment**
*for Excellence in Project-Based Learning*
**Robert D. Koob Endowment** *for Student Success*

# Proposal Cover Page

**Title of Project:** Team 35: Malawi Maize Mill Senior Project

**Proposal Author:** Jose Delgado **Cal Poly Email:** jdelga07@calpoly.edu

**Student ID:** 008760982 **Signature (Optional):**_____

*Signature provides permission to check financial aid eligibility.*

Previous Baker/Koob Endowment funding? (circle one): **Yes** **No**

| Team Member(s) | Signature | Cal Poly Email | Department |
|---|---|---|---|
| Chad Steese | _____ | csteese@calpoly.edu | Mechanical Eng. |
| Wes Curtis | _____ | wccurtis@calpoly.edu | Mechanical Eng. |
| Jose Delgado | _____ | jdelga07@calpoly.edu | Mechanical Eng. |

**Faculty Advisor:** Eileen Rossman **Department:** Mechanical Engineering

**Faculty Advisor email:** erossman@calpoly.edu **Telephone:** (805) 472-0180

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**Anticipated Start Date:** October 4th, 2016

**Anticipated End Date:** June 2nd, 2017

**Total Funds Requested ($):** $950.00

**Signature of Faculty Advisor:** _____ **Date:** _____

## I. Abstract

Our senior project team is designing a corn flour mill to help provide future sustainability to cater to the nutrition needs of the Malawian people. Engineers Without Borders (EWB) has been working on this issue for the past four years, but they have not achieved as high of yield of corn flour as desired. Using their advice, and the technical skills our team has learned through schooling, we will research, design, and eventually build a working prototype to address this issue. So far we have identified our customers needs, and done extensive background research into possible solutions. We have estimated project costs based on research and EWB past costs. We appreciate taking our project into consideration and any financial support.

## II. Introduction

The people of Malawi go through many struggles just to create corn flour for their famous nsima. The scope of the Maize Mill senior project is to provide an alternative to the current mill, which is hours away, and provide Malawi with a sustainable replacement. Our project will work with the Power Transmission senior project whose main objective is to transmit bicycle input power to shaft output power. Together both of the projects will provide Malawi with alternative milling method.

Our sponsor Geoffrey Wheeler, an experienced Mechanical Engineer, and an EWB non-profit team have been attempting to develop a solution for the past few years. With guidance from their experiences, the Maize Mill project team will provide Malawi with a sustainable, reliable, sanitary and easy-to-use mill that can be operated and powered by one person.

## III. Objective(s)

The main source of food for a village in Malawi, Africa is a corn flour pancake called seema. Currently, corn is ground into flour using a distant, unreliable, electric powered maize mill. The goal of our project is to create a reliable, sanitary, and easy to manufacture maize mill that can be operated with the power output capable of an adult individual.

We, with our sponsors guidance, have established several objectives and specifications from the understanding of the problem presented above. These specifications will work as goals throughout our project and will guide the design of our maize mill. Our design objectives/specifications are as follows:

1. Power: The amount of power supplied to the mill. The mill will be operated by one male or female adult.
2. Grinding Rate: The output rate of maize flower in kg/hr for the mill. Our mill should be at least as time efficient as travelling to an electric mill.
3. Cost: the cost of our mill to be manufactured in Malawi. The manufacturing of our mill should be affordable enough to be paid for by Malawian villages.
4. Sanitation: The requirement of our mill to produce edible flour. All flour produced by our mill should be free of metal flakes.
5. Fineness: the particle size of the the flour output by the mill. Particles should meet industry standards of fine corn flour.
6. Production Efficiency: The percent (by mass) of the input corn that is output as fine flour.

The exact quantitative values for our specifications can be seen in the specification table below:

Table 1. Engineering specifications for the Maize Mill project.

| Spec. # | Parameter Description | Requirement or Target (units) | Tolerance | Risk | Compliance |
|---|---|---|---|---|---|
| 1 | Power | 150 (Watts) | Max | M | A,T |
| 2 | Grinding Rate | 20 kg/ 2 hrs | Min | H | T |
| 3 | Production Cost | $300 | Max | H | A |
| 4 | Sanitation | 0 kg of metal bits | Max | M | T |
| 5 | Fineness | #25 mesh | Max | L | T |
| 6 | Efficiency | 80% fine flour by mass | Min | H | T |

Risk:
L = Low Risk
M = Medium Risk
H = High Risk

Compliance:
A = Analysis
T = Testing

This specification table demonstrates all of our quantifiable specifications/objectives along with their corresponding target value. The tolerance indicates whether or not the specified target is a minimum or maximum. The risk column indicates the expected relative difficulty of meeting the corresponding target. The compliance column expresses the manner in which we intend to qualify our design in its ability to meet the designated parameter.

## IV. Methodology

To help optimize our time over the next year, our team has outlined a series of steps we will take. Following these steps, our team will converge on the best possible solution to the Maize Mill project.

1. First, our team will further specify the need, so that we fully understand the issue that needs to be addressed.
2. Our team will shape the design process based on what the people of Malawi need.
3. Research how similar problems have been solved.
4. Brainstorm many solutions and perform various tests to pinpoint the best design.
5. After considering all the background information we obtained and the results from our tests, we will choose a final design.
6. Using our engineering skills from previous courses, we will perform part analyses and develop a detailed design.
7. Using the detailed design, we will start prototyping and testing.
8. Through testing, the prototype will be further modified to fine tune our final product.

## V. Timeline

Our project will follow the Mechanical Engineering Senior Project guidelines. The guidelines include four major reports that will be presented in the following order: Project Proposal, Preliminary Design Review (PDR), Critical Design Review (CDR), and Final Design Review (FDR). The first report, the Project Proposal, has already been submitted. It focused on understanding the problem presented to us

and also establishing a direction/method that will be used to finish the project. The PDR will be completed and presented on November 17, 2016. This report will showcase all concept designs, the process of narrowing down to one design, analysis and modeling of that design also future testing plans. The CDR will be finished on February 7, 2017, this report will cover manufacturing and test plans for our chosen design. Results from the manufacturing and the testing will be presented in the FDR as well as recommendations for future projects. The FDR will be completed on June 2nd, 2017 along with a presentation at the Mechanical Engineering Senior Expo.

## VI. Final Products and Dissemination

Over the course of the project our team will perform various ideation sessions in order to produce multiple designs that encompass the required objectives. Through an extensive selection process of all our designs will help in choosing one final design. The final design will be able to fulfill all the objectives as best as possible. With only 1.5 quarters of work on a single design it is not expected to be 100% accurate to the engineering specifications detailed in the objectives section. Dimensions and geometries for our final design have yet to be determined as well as major manufacturing processes that may be used. The final senior project will be made and presented along with a operators/manufacturing manual at Cal Poly's Mechanical Engineering Senior Expo, June 2nd, 2017. Along with the presentation at Senior Expo our project and the FDR will be presented to our Sponsor Geoffrey Wheeler and he will decide the future implementations of our project.

## VII. Budget Justification

There are only three list items on our budget sheet: non-computer supplies and materials, printing/duplication and postage/shipping. Our materials cost of $500 is estimated from the past Engineers Without Borders project iterations. The last iteration of the maize mill project cost approximately $300 in materials. We anticipate that our project will likely cost more than the last iteration since we intend on improving on the durability, lifetime and overall functionality of the mill. We intend on incorporating more advanced manufacturing processes such as milling and/or casting whereas the last project iteration required very little to no advanced manufacturing techniques. We also intend on doing more prototyping than past iterations. Our printing/duplication budget of $25 is simply the standard cost for a spool of 3D printing filament. We intend to use 3D printing in prototyping as well as in the development of sand casting patterns. Finally, our budget of $425 for shipping is based on the estimated price of sending our final design materials to Malawi upon the completion of our project. This price was acquired as a quote from FedEx for sending a 15 lb package from San Luis Obispo to Balntyre, Malawi. We intend to send the people of Malawi our final designs, a manufacturing manual, an operation manual and any specialized components necessary to the manufacturing of the mill (such as casting patterns).

# PROPOSAL BUDGET

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|---|---|
| **Student Applicant(s):** | Wesley Curtis, Chad Steese, Jose Delgado |
| **Faculty Advisor:** | Eileen Rossman |
| **Project Title:** | **Requested Endowment Funding** |
| **Travel** *subtotal* | **$0** |
| Travel: In-state | **$0** |
| Travel: Out-of-state | **$0** |
| Travel: International | **$0** |
| | |
| **Operating Expenses** *subtotal* | **$950** |
| Non-computer Supplies & Materials | **$500** |
| Computer Supplies & Materials | **$0** |
| Software/Software Licenses | **$0** |
| Printing/Duplication | **$25** |
| Postage/Shipping | **$425** |
| Registration | **$0** |
| Membership Dues & Subscriptions | **$0** |
| Multimedia Services | **$0** |
| Advertising | **$0** |
| Journal Publication Costs | **$0** |
| | |
| **Contractual Services** *subtotal* | **$0** |
| Contracted Services | **$0** |
| Equipment Rental/Lease Agreements | **$0** |
| Service/Maintenance Agreements | **$0** |
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| **TOTAL** | **$950** |