

Engineering Grand Challenge

Using Technology to Improve Cattle Ranching, by Assessing Biometric and Demographic Data

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Challenge Sponsor

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Introduction

In June 2018, the California Polytechnic State University (Cal Poly) Dean of Engineering along with the Department Chair for Computer Science engaged Cal Poly's Digital Transformation Hub (DxHub) to establish an 'Engineering Grand Challenge' (EGC) in the spirit of the yearly National Science Foundation program. An interdisciplinary group of students and faculty was formed and five students worked on the project over the course of the Summer and Fall quarter. During an Innovation Workshop with the group, the DxHub applied Amazon's Working Backwards process to identify their customer and reach consensus on a customer obsessed solution for that customer. Successively, a Solutions Workshop was held to define the solution prototype scope. By January 2019, an application prototype was developed by Cal Poly students, and Cal Poly DxHub personnel.

Problem Statement

The EGC team chose to focus on creating a solution to address the needs of cattle ranchers who operate in remote areas and have little to no communication infrastructure, or other smart agricultural oriented sensors to track cattle. Cattle ranchers often have difficulties tracking and monitoring their cattle in rolling and hilly terrain which can lead to unnecessary economic losses to the ranching operation. Ranchers also find it difficult to consistently manage their land to maximize economic output while promoting the mid to long-term sustainability of their grassland resources. This can be especially problematic in the face of variable weather and climate conditions, market volatility, and invasive species incursion. Furthermore, if a rancher doesn't ultimately manage federally leased land in a reasonably sustainable fashion, the Bureau of Land Management (BLM) can choose not to renew the rancher's license thus entirely depriving the ranch of economic opportunity.

Innovation Workshop

An Innovation Workshop was held by the DxHub, to guide the EGC team through Amazon's Working Backwards process. During this process, the diverse team examined the pain points and needs of two customer personas: a multi-generational rancher and a BLM administrator who manages rancher/community relationships and renews leases. Empathy mapping exercises revealed the following three overlapping insights between the personas:

1. National Environmental Protection Act (NEPA)
2. Weather variability and the need for adaptive management practices
3. A better/smarter way to "manage the land"

The team generated ideas based on these insights and came up with a variety of solutions including blimp-based low power communications, field sensors, remote monitors, and a cattle behavior control platform via the implementation of a 'geofence'. The team did not achieve consensus on a specific idea during the day of the workshop. In the following weeks, the team chose to work on a solution that addressed the specific pain point of the cattle rancher attempting to locate a 'mama cow' that had strayed and wasn't locatable due to her tendency to hide in ravines or areas of low visibility. The solution included a collar system that utilizes a low bandwidth, low energy sensor that consistently measures GPS location and body temperature. The ideated solution was honed further to include a broader vision of a comprehensively censored ranch, which was documented in the Press Release/Frequently Asked Questions (PR/FAQ), and used to provide a foundation for the proceeding Solutions Workshop ([Appendix 1](#)).

Solutions Workshop

During the Solutions Workshop, the team reunited to define the technical implementation and scope of the prototype. By creating a storyboard, the team was able to illustrate the customer experience and key customer benefits from the prototype solution ([Appendix 2](#)). A lean prototype was produced so the team could understand and demonstrate the technology required to bring the vision to life. The phase began with ordering collar hardware and fabricating a device that would fit comfortably on the cow while optimizing antenna placement. The collar went through 3 design revisions to meet customer requirements and improve battery life. In addition, a web application was developed to help visualize the data and provide an administrative interface to view summary data and individual cow data. This lightweight prototype ultimately was able to demonstrate that the technology was viable and prove the actual design could deliver a cost-effective solution ([Appendix 3](#)).

Value Proposition

The value proposition of the solution, as envisioned by the PR/FAQ, provides the rancher with a comprehensive, data-based assessment of the location and health of the herd (GPS, heart/body temp), as well as the status of ranch resources like water supply and soil moisture. In the use case of the pregnant "mama cow," a rancher can proactively know when the animal is in labor and her location, and is able to provide the necessary veterinarian attention needed to avoid a net economic loss. Additionally, the low-power wide-area network (LPWAN) sensor and communication infrastructure provides a cheap, low maintenance way to provide reliable status of the herd. The long-term vision of the PR/FAQ is to provide a monitoring platform that the rancher can use to exercise precision control over the herd and ranch territory with the aim of maximizing economic output while maintaining environmental sustainability.

Conclusion

This collaboration between the DxHub, students and faculty resulted in the development of a new engineering solution that will save ranchers time and money. This opportunity exposed students to a cross discipline project that brought together two different colleges as well as three different majors. This project was presented at the poster session during the [College of Engineering Summer Undergraduate Research Program Symposium](#) which resulted in a 2nd place finish at the Symposium and a cash reward for the students involved. For more information about this project and others like it check out the Challenges section of our web site <https://dxhub.calpoly.edu/challenge>.

Next Steps

The students involved in this challenge will continue to work on the design for their senior project. As they continue to evolve the design and mature the product, the students will evaluate the commercial viability of the product.

Special Thanks

Special thanks to the challenge participants including the Cal Poly faculty and students from the College of Engineering, and the College of Agriculture, Food and Environmental Sciences.

Appendix

Appendix 1

[Press Release / FAQ](#). During the Innovation Workshop, a fictional Press Release and nonfictional Frequently Asked Questions are drafted. This is a tool that is used to define the solution and why it matters to the customer.

Appendix 2

[Storyboard](#). A Working Backwards mechanism, used to articulate the customer experience and key customer benefit(s) of the application solution.

Appendix 3

[Solutions Architecture](#). The process diagrams