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Problem Statement

The design and manufacturability assessment for an in-field/pasture calving shelter that would allow for viability within the livestock market.

Disciplines

Bioresource and Agricultural Engineering | Industrial Technology

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TSM 416 Technology Capstone Project

Design and Manufacturability of an In-Field Cow/Calf Hutch

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Contact(s):

- Matt Mills, Owner of Mills Mid Iowa Machinery, millsmid-iowamachinery@gmail.com
- James and Justin Mathes, Owner JKM Farms, jkmfarms@mathes.cc

1. PROBLEM STATEMENT

The design and manufacturability assessment for an in-field/pasture calving shelter that would allow for viability within the livestock market.

Problem Statement

- Matt Mills, owner of Mills Mid Iowa Machinery, a short line farm and ranch equipment dealer for central Iowa. Along with selling new and used equipment, Mills Mid Iowa Machinery invests in designing, fabricating, and manufacturing of agricultural innovations.
- A working Cow/Calf Hutch prototype has been made, there are problems pertaining to manufacturability an ease of shipment.

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- Once the calves are born it's important that they are able to get under shelter and stay out of inclement weather. It can be hard for a calf to push its way in against other cows and calves if all of them want to get under the shelter.
- There currently is not a comparable portable calving shelter on the market that is designed for one cow to have her calf by herself. Market ready cattle typically weigh 1400 lbs. and were valued at \$1.30 a pound (“Market Report.” *Kalona Sales Barn*, 2017). If a calf is lost due to inclement weather and lack of shelter the farmer would lose \$1,820 of potential income, assuming the farmer raises calves to market weight versus selling their calves as feeders to another farmer who will feed them out (“Market Report.” *Kalona Sales Barn*, 2017).
- There are currently 965,000 beef cows in Iowa (Iowa Cattle Facts, 2018) many of which are calving in the elements with no shelter. The durability, versatility, and affordability of the Cow/Calf Hutch will meet the requirements of cattle farmers that currently are not equipped with calving shelters, providing them with the solution to prevent the loss of potential income from losing calves (Iowa Cattle Facts, 2018).

Business Case Statement

- A. The V1 design of the calving shelter was not designed to be efficiently mass produced or shipped and did not have the necessary amenities needed to ensure livestock health.
- B. The team designed for durability, manufacturability, portability, and affordability.
- C. Problems that occurred throughout the design and manufacturing process required unique solutions that we analyzed and decided on by our team and approved on by our project leads, Matt Mills, and James Mathes.
- D. Addressing these issues helped eliminate post-purchase problems resulting in a higher quality product. In addition, it made it easier to manufacture and more cost effective to the manufacturer and consumer.
- E. Resolved problems addressed in the design phase impacted both the manufacturer and customer. Ease of manufacturing resulted in lower cost, consistency, and repeatability, ensuring the same high-quality product desired by the customer each and every time at a more affordable cost.

2. GOAL STATEMENT

- A. With the production to the Cow/Calf Hutch, the goal was to give the consumer an opportunity to purchase a shelter that would have the means to decrease calf mortality rates especially those who calve during fall and winter months. At the time there was not a shelter on the market with features exclusive to the Cow/Calf Hutch design. It was our goal to make this an affordable solution to the livestock industry.
- B. The success of the Cow/Calf Hutch can be measured in the decrease of deaths within the cow-calf production of groups that are using this product as well as the overall health of calves using the shelter once calving is completed.
- C. The V1 prototype of this design had been used for one year and all data that has been observed is only what the designers, James and Justin Mathes, have seen firsthand in their livestock operation.

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- a. Cows did prefer the shelter over being outside in the elements.
- b. It has been used several times by cows to get out of the weather to calve.
- c. The V1 prototype could be moved moderately easily using extended pallet forks.
- D. Tangible results from the new design are that the V2 Cow/Calf Hutch can be shipped on a pallet that could fit into a pickup bed or a car trailer, with multiple kits able to be shipped on a flatbed semi-trailer.
- E. Added benefits included lower property taxes compared to if the farmer built a permanent shelter (property taxes are not paid on non-permanent structures), and that the shelter could be moved site to site.
- F. Other benefits that the Cow/Calf Hutch brought is healthier cattle, especially in the winter and fall calving seasons allowing cattle to escape the weather and to be more comfortable
- G. Project outcomes were concluded through observing how cattle interact with the facility during calving

Main Objective(s) and Specific Objectives

- A. The main objective was to: Finalize a v2 prototype design, assess it for manufacturability, and then construct the prototype.
 - a. Made a design manufacturing plan
 - a. Constructed v2 prototype
 - b. Developed assembly instructions for shipped prototypes
 - c. Analyzed solutions for durability, ventilation, manufacturability, portability, and cost
- B. **Rationale**
 - a. When the calf tree is fully functional the client would be able to manufacture the shelter so that it can be shipped with ease
 - b. The product would be able to be assembled by farmers with no special tools needed
 - c. Cows would be able to calf in pastures in comfort and in safer conditions

3. PROJECT PLAN/OUTLINE

A. Methods/Approach

- o Reference Material(s)
 - o Many of the materials that we found to be used where the use of Solid Works/ Inventor to get a visual of how our design and modifications looked when put together. Both programs also allowed for some analysis of the parts and materials that we used to manufacture.
 - o We looked into other livestock shelters that were on the market to research different designs. We had trouble finding a structure that would meet our constraints.
- o **Data collection:**
 - o We looked into an assortment of livestock shelters to see what works and what doesn't with the designs that already exist along with other livestock articles to

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- see how they like to calve and what type of additions to the design will make it most effective in the field.
- It is important that we understood what type of features will make this product better than other shelters out there and ensure that customers would see value in purchasing the product, i.e. return on investment through use which included an increase in cow health and a decrease in cow and calf mortality rate.
- **Skills:**
 - Through this project, we furthered our skills in Solid works and Inventor through the design and modifications that we made. We gained communication skills not only with each other but professionally with the client and with manufacturing and suppliers that had been contacted to retrieve the best rates that we could for manufacturing and materials. This project allowed us to bring together many of the skills that we have learned throughout our program and see how they help us in industry.
 - TSM 240 gave us a touch of insight to how manufacturing works and helped us to see what solutions may be best to ensure that we get quality work done at the lowest cost we can. TSM 214 has helped us to set up a good project outline and map out the goals we had for this project.
- **Solutions:**
 - The proposed solutions were developed by Solid works and Inventor.
 - Solutions would be measured through the actual use of the constructed prototype that has to the initial developers Calf/cow operation in Columbia, Iowa. There it would be determined if the modifications were useful in the production of healthy happy livestock.
 - Visual analysis where used to see the reactions of the livestock with the shelter constructed.
 - The proposed solutions are quantified as being better than the original by the mortality rate of calves and the manufacturability of the shelter
 - The success of the project was defined by the use of the product by the livestock, the cost-effectiveness, and our ability to deliver everything that the client wanted.
 - The proposed solution was directly related to the project scope therefore if the solution was delivered properly then the project scope was being completed.
 - The proposed solutions are what the client has asked we just completed them in a way that made it the easiest, cheapest, most effective way that we could come up with based on our work, skills, and information that we had.
- **Organization:**
 - Our group met at the least once every week for 2 hours, the client was contacted when it was convenient for them, with once a week being the goal.
 - Work was divided up among the group members according to our strengths in different parts of the project

- Some members have a manufacturing background, some good with reports and others could connect well with the clients. All of this helped determine what tasks a member did

A. The major milestones for the Cow/Calf Hutch

- a. Analyzed V1 prototype
 - i. Reviewed materials
 - ii. Designed improvements
- b. Designed V2 prototype
 - i. Materials analysis
 - ii. Cost analysis
- c. Found materials
- d. Fabrication of V2 Cow/Calf Hutch
 - i. Field tested
- e. Meet with client to present them with constructed V2 Cow/Calf Hutch
 - i. 2nd Semester Report
 - ii. Oral Presentation

We responded to setbacks with a head-on approach. With the ordeal of getting our projects later than expected we called our client the week we got his information and set up a meeting date the following week, another setback was getting the desired plans for the V2 prototype due to the engineer being away on business, we overcame this by working on what we could and thinking on more ways to make the Cow/Calf Hutch better

B. Results/Deliverables

- Our main deliverables are a poster, 1st and 2nd-semester reports, and a constructed v2 Cow/Calf Hutch
- These deliverables are within our scope of the project. Our client got the newly designed Cow/Calf Hutch with manufacturing plans and our work along the way was presentable with our reports
- If milestones had not been completed on time we had set some time up at the end of the year so we could extend some aspects if needed and we had planned to meet more often as a group if needed to get more work done
- To keep our milestones on track with what our client wants we had been calling him weekly, updating him on what had been done and what was next on the to-do list.
- The next follow up steps for our client would be
 - Acquire manufacturing plans
 - Materials list
 - Cut list
 - Part drawings for side panels and roof panels
 - Find material suppliers
 - Find laborers to build more units
 - Find consumers

C. Timeline

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Week of:

- 10/23/2017
 - Contacted Client
- 11/01/2017
 - Analyzed V1 prototype Calf Tree
- 11/10/2017
 - Designed V2 prototype Calf Tree
 - Poster Drafted
- 11/27/2017
 - Final Poster submitted
- 12/4/2017
 - Contacted different canvas suppliers
- 12/11/2017
 - Got quotes from multiple manufacturers
- 1/8/2018
 - Gathered blueprints for manufacturers
- 2/5/2018
 - Began fabrication with manufacturers
- 3/19/2018
 - Had a model of Cow/Calf Hutch printed
- 3/26/2018
 - Presented
- 4/2/2018
 - Drafted Report

4. BROADER OPPORTUNITY STATEMENT

- A. Our project could be understood by most people in the way that we were trying to keep a birthing mother out of the elements
- B. This project addressed the big problem of livestock deaths due to the weather when they were giving birth
- C. All Farmers who have cows giving birth in a field or pasture would be affected by this project, If the cattle use this structure to give birth in they could keep their calf safer from the elements
- D. The cattle industry would be able to utilize this structure to minimize the loss of a newborn calf due to inclement weather conditions.
- E. At the time there was not a product on the market that is used for portable calving.
- F. In the short run the producers of the Cow/Calf Hutch will lose some money due to startup costs, Once the product is selling good profits will be made due to the fact that it would be cheaper to buy materials in bulk rather than enough for one structure at a time

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5. PROJECT SCOPE

- A. Our team started by defining constraints of the product with the client and characterizing the desired features of the Cow/Calf Hutch. We then used this information to construct a v2 design prototype that incorporated a welding jig for manufacturing. The goal was to have all Iowa suppliers and to keep all manufacturing in the state. There was a need to be an instruction manual on how to construct the shelter once it is delivered to the customer. This required extensive work on making sure it was very concise on how to perform each task.

6. REFERENCES

- “Iowa Cattle Facts.” *Iowa Beef Industry Council*, 2017, www.iabeef.org/on-the-farm/iowa-cattle-facts. (2018)
- “Market Report.” *Kalona Sales Barn*, 2017, <http://kalonasalesbarn.com/market-reports/>. (2017)