CAPSTONE EXPERIENCE 2011
Fountain Auger Grain Sampler

PURDUE UNIVERSITY

Agricultural & Biological ENGINEERING

Nathan Halcomb (ASM) Kevin Burger (ASM)
Alex Allaby (ANRE) Stephen Brunton (ANRE)

Problem Statement:

The objective is sampling the extent of grain damage sustained by crops while travelling through John Deere (JD) developmental combines. The project plan is to create a system that will sample the crop in the grain tank of combines. The system will be set up to sample the grain leaving the fountain auger. It will be caught by a drawer style collection divide (Fig 5) and then transported to a revolving style sample holding compartment (Fig 7). The system will take six samples from the fountain auger flow; the samples can then be removed and tested for damage.

Background Review:

At the John Deere facilities in Moline, Illinois the employees use developmental combines for research. In the past, to sample the grain that travelled through the combine an employee had to stand in the tank of the combine and use Ziploc bags to collect and store samples. As this is an undesirable and uncomfortable job, John Deere was interested in designing and building a system that would catch samples as the grain came out of the auger, to eliminate the need for an employee in the tank.

Alternative Solutions:

To determine which design would work best for the application, we used John Deere knowledge and expertise as well as their in house decision matrix (Fig 1). Some of the alternative designs are pictured in Figures 2 and 4. The original concept was of a sweep arm instead of a drawer style. It would not have sampled the flow of the auger accurately to sample damage.

`	Option #1		Meet	Not Meet	Option #2		Meet	Not Meet
	Ring Design				Pelican Design			
WANTS - Score good = 10, poor = 0	WT		PT				PT	
Financial Impact (SVA+)	15			110				80
Performance (Customer value)	41			220				233
Product Validation and Verification (reliability)	10			70				55
Impact on Machine Design	17			110				114
Manufacturing capability	35			170				375
Schedule Risk	8			56				54
Supply Management	0			0				0
Final Point Summary (Keep hidden until ranking is finished)								
Total Score			80.8%	736			100.0%	911

Figure 1 Decision Matrix showing two alternatives considered

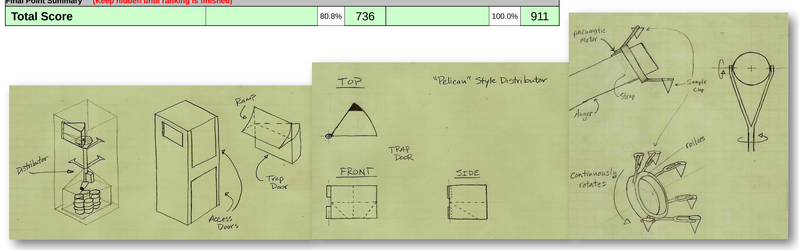


Figure 2 Early concept of the rotating Ring Design considered in the Decision Matrix

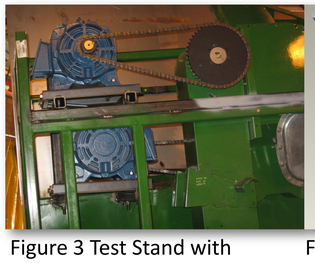


Figure 3 Test Stand with motors mounted

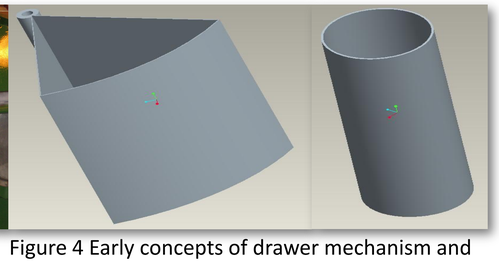


Figure 4 Early concepts of drawer mechanism and sampling cups

Economics:

The budget for the project both the test stand and the Drawer Sampling System are in Table 1. The economic impacts to our sponsor are increased productivity with their machines and increased performance, adding value to their equipment without adding to the price.

Table 1 Budget

Item	Cost
Air Compressor	$205.00
Electric Motor	$357.79
Air Slide	$484.16
Converter, AC to DC	$299.50
Neoprene Roller	$14.48
Bolts	$1.77
Steel, plate and angle	$73.70
Total	$1,436.40

Using CAD to Vsualize Design:

Once the Drawer Sampling System was finalized, it was drawn in ProE. Many modifications were made to the final design after testing was done on the prototype in ProE. See Figure 2. The prototype was created in the ABE machine shop by group members. Certain tooling and fabricating was contracted out to the Purdue Central Machine Shop. Modeling and analysis for the prototype was completed with computer software such as ProE and Excel. The CAD visualizations in Figure 4 show the sample containers as well as the alternative to Figure 5 the design that became our final solution.

Figure 5 Detail of sample collection drawer, CAD compared to machined part

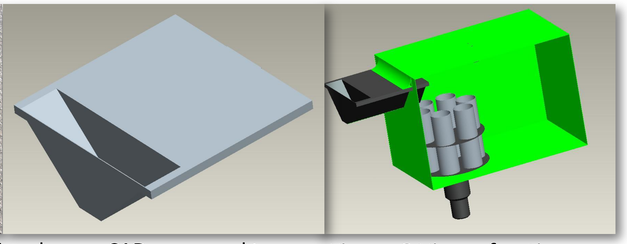


Figure 6 View of entire system in CAD

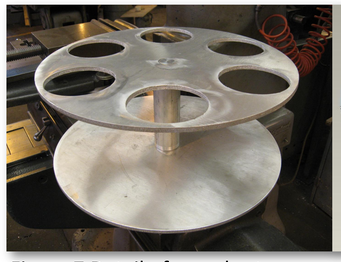
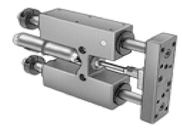
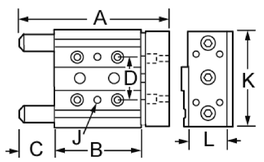


Figure 7 Detail of sample storage system, CAD compared to machined part

Figure 8 Internal Frame of Sampling System with bar for mounting actuator





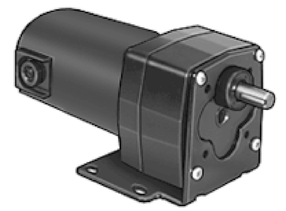


Figure 9 Details of Motor and Air Slide used in the construction of sampler

Design and Management Principles:

As the prototype was being designed and built, our group was simultaneously working on the test stand.. The test stand is quite large as it simulates a working combine. We needed to work closely with another Senior Design group sponsored by John Deere Harvester Works because we shared the test stand. We ordered two 15 horsepower motors to drive the test stand along with chains, roller chain sprockets and bushings to drive the augers in the test stand. We also had to modify the test stand to accommodate the test conditions of both groups through such means as jack stands, a floor inside the bin and extra sheet metal to keep the fountain auger from spilling test material around the shop. As the designs evolved, problem areas were discovered and with the help of our sponsors and technical advisor; we were able to address each issue with a thorough and well thought out solution to the problem. Parts of the system have been selected for maximum wear life by minimizing steel on steel contact which will reduce the rate of replacement of parts. Sustainability is further improved by increasing the yield coming from the field by minimizing losses of crop due to damage from harvesting.

Impacts and Sustainability:

John Deere by continuously improving equipment through research and development has been able to consistently increase yields which will be important as farmers struggle to feed more people from the finite land resources. Sustainability was achieved through careful selection of parts.

Sponsor: John Deere Harvester Works
Glenn Pope
Curt Elpers
Colter Kinney
Jared Puvak
Technical Advisor Patrick Murphy

JOHN DEERE

PURDUE AGRICULTURE
PURDUE UNIVERSITY

PURDUE ENGINEERING
Think impact.