U.S. Steel Tubular Mill Crop Handling Automation

Overview
The current U.S. Steel mill cropping process that the Lorain Ohio Plant is implementing uses of a operator to physically move the excess steel pipe cut-off from a cutting tool to a hydraulic press, and into a scrap bin. The cropping process includes safety risks due to worker fatigue, poor ergonomic positioning, worker time constraints and the risk of crops falling off the transfer table. Also crops can weigh up to 900 pounds and vary in size from 13 to 26 inches, so the worker is put into unrefined movements and positions that could lead to CTD related injuries. The redesign concept of this project will be able to increase the worker safety, and decrease the cost of labor and worker’s compensation.

Objectives
Design and analyze a new concept to reduce the operator’s risk of injury. This is accomplished by developing an automated system that the operator can safely monitor and operate.

Approach
- Observed U.S. Steels project description
- Generating group milestones
- Initial concept generations
- Selection of final concept through concept analysis
- Teleconference with sponsor to finalize idea and gather current system data from sponsor
- Visited plant for visual of project area and collect system dimension limitations
- Developed a CAD model with individual part files
- Fabricated a Lego’s NXT initial prototype of the chain drive.
- Fabricated a wooden roller conveyor, and cardboard crop initial prototype.
- Performed risk analysis, by analyzing current operation videos and comparing to fabricated prototypes.
- Several Concepts were drawn out and analyzed to find the best solution.
- Comparing the old system to the new system we found significant changes in the risk.
- Visiting the plant we found important measurements which helped with our new design.
- A Cumulative trauma disorder test was done on the worker to find the current risks.
- CAD models were drawn up to scale with the new design showing all of it’s workings.
- Multiple prototypes were made out of wood and legos to ensure this system would work.
- Testing was in the form of trial and error as well as drop force analysis testing.

Outcomes
- The sponsor will save the data obtained to help with the design.
- Risks of a worker were analyzed and reduced from 2.43 to 0.43.
- The project reduced the risk of injury and created a faster, more reliable solution.
- The implementation of our new design will give the company a safer work environment.