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# Modular Hydraulic Test Bench

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# Modular Hydraulic Test Bench

## **Problem Statement**

Our group is working to create a modular hydraulic test bench. This mobile bench will have improvements over current test benches through the use of a modular base frame and specifically design add-on features. Our mobile bench implements several key design features including: a drip pan, forklift support, adjustable back wheels to provide improved center of gravity to reduce tipping hazard, a handle for ease of moving, and an adjustable drawer attachment.

## **Disciplines**

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# IOWA STATE UNIVERSITY

Department of Agricultural and Biosystems Engineering (ABE)

TSM 416 Technology Capstone Project

## Modular Hydraulic Test Bench

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## 1 PROBLEM STATEMENT

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Our group is working to create a modular hydraulic test bench. This mobile bench will have improvements over current test benches through the use of a modular base frame and specifically design add-on features. Our mobile bench implements several key design features including: a drip pan, forklift support, adjustable back wheels to provide improved center of gravity to reduce tipping hazard, a handle for ease of moving, and an adjustable drawer attachment.

### Problem Statement

- Hydraulic test benches are used at Iowa State University in the TSM 337 fluid power lab. The University of Minnesota and Purdue University have both expressed interest in upgrading their test benches.
- The current test benches work for their desired purpose, but, by talking with those using the benches on a daily basis some areas have been identified that could use improvement. These areas of focus include; oil containment rated for overall circuit capacity, oil containment of hoses that are placed on the hose rack, improvement of the location of center of gravity, and the ability to move trainers around safely.

- By addressing the above problems and keeping a mindset on lean manufacturing with the goal of creating an improved modular hydraulic test bench, we will produce a design for a product that meets customer requirements while maintaining a competitive price point.
- During our research, we have not been able to find a single product that delivers all of the features ours has. The weld top table option is far less expensive than competitive weld tables (i.e. Bluco) while still offering the same mounting arrangements.

### Business Case Statement

- A. Current benches are single-use and don't offer the level of modularity that our mobile bench does, there is no current solution to collect leaking hydraulic oil, and current benches are prone to tip over.
- B. Benches in the fluid power lab were designed to fit their application, since their design, further design changes have been identified and expressed. The ability to purchase a more modular design that can fit other applications widens the opportunities of a customer's investment.
- C. The safety issues must be addressed to minimize the risk of getting injured using this product. By creating a versatile table that ensures oil containment in the case of a catastrophic circuit failure, we increase the desirability to consumers and make it more profitable for Fleenor Manufacturing.
- D. Some prospective colleges and businesses have expressed interest in these tables and what to integrate them into their classes or company.

## 2 GOAL STATEMENT

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- **Main Objective(s) and Specific Objectives**
  - **The main objective is to:** Create one base frame to be used for our modular hydraulic test bench that also allows consumers to use the frame for a variety of other industrial applications including a gunsmith vice, tool bench, and weld table.  
**Specific objectives include:**
  - Design a new modular hydraulic test bench that meets all client criteria and constraints:
    - Better oil containment; (improvement off of old capacity so it can now hold entirety of oil plus additional 5%)
    - Improved center of gravity and reduced tipping hazard compared to current benches in the fluid power lab.
    - Fork truck pockets for assistance in moving
    - Create a base frame that is compatible with various tops
    - Modular assembly with the opportunity to marketed as a kit
  - Utilize lean manufacturing to ensure that materials are standardized and the fewest number of materials as possible are used.
  - Identify and minimize injury-prone areas and processes to reduce injury risk. Create a bench that fits anthropometric data for the 5%-95% for females and males respectively.

- **Rationale**
  - By implementing the above design criteria and constraints, the outcome will be a modular test bench that is safer than current products on the market and also offers the ability to quickly change into: a hydraulic test bench, a standard work/tool bench, a welding station, and a gun smith tool bench.

### 3 PROJECT PLAN/OUTLINE

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#### A. **Methods/Approach**

- **Reference Material(s)**
  - To gain more insight on these benches and the issues they have, we spoke with Dr. Brian Steward, coordinator of all of the labs. We used his insight and that of one of our members who is currently taking the class to influence our project. We incorporated material we have learned throughout our time here at Iowa State as well as our personal experiences.
- **Data collection:**
  - Talking with industry professionals on their needs.
  - Meeting with Dr. Brian Steward to obtain professional insight on applicable changes he would like to see.
- **Skills:**
  - Working to meet customer requirements is a very important skill that we have learned from this project so that we can fully understand current problems and make the best product improvements.
  - Desirable skills required for this project consist of: manufacturing methods, 5S, SolidWorks, fabrication, and materials knowledge.
  - 3-D computer modeling software, knowledge of sheet metal operations, a center of gravity analysis, current manufacturing applications and abilities.
- **Solutions:** We developed solutions for this project through research, industry experts, past curriculum, and personal experiences. These solutions have been critiqued through the use of: modeling programs, our peers, and our industry contact. Each has been used to establish the best possible solution.
  - We utilized decision matrices to help establish what materials are better suited for our project.
  - We placed value in designing a table that meets anthropometric criteria for the 95<sup>th</sup> percentile male and the 5<sup>th</sup> percentile female. This means that our product will be ergonomically compatible to be worked on by anyone taller than the 5<sup>th</sup> percentile female and the shorter than the 95<sup>th</sup> percentile male.
  - We have correlated between the scope of our project and the customer requirements during the design phase to maintain consistency with our scope.
- **Organization:** Our team sent bi-weekly updates to our client or more frequently if necessary. These updates were either given to Jeff Fleenor in person, by email or phone.
  - We assigned work for our team at the group meetings throughout the spring semester. Work was assigned based on urgency and off of our Gantt chart.

- Major milestones for our design consisted of finalizing our design, design-build, and successful presentation to our peers.
- Setbacks were acknowledged by the team and made known to the client if needed. All issues were handled by the group or a sub-committee within the group. Solutions were found through research or other means of information.

#### A. Results/Deliverables

- Create a modular design in Solidworks with the new features incorporated in the design.
- Provide an accurate bill of materials.
- Create a parts list for the base frame.

## 4 BROADER OPPORTUNITY STATEMENT

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- A. The modularity of our base frame entices a larger market from everyday industry workers to weekend craftsmen to outdoor gun enthusiasts; one bench to meet many demands.
- B. Improving workplace safety, improve student understanding of course material through ease of use during labs, and improving education are all benefits our project provides.
- C. Industries relating to hydraulics, public universities, technical institutes, trade schools and training programs.
- D. Emerging focus on Universities starting technology degree programs.
- E. Currently, Universities, Technical Institutes, and industry are working around the problem by:
  - Creating their own tables to fit specific applications
  - Using much more expensive tables such as Bluco that provide tolerances beyond the applications need.
- F. With all of the modular features our project offers as add-ons, it allows for an investment mindset for our customers. Lean engineering was a mindset that was kept throughout the design and manufacturing processes of our project so prices are very competitive.

## 5 PROJECT SCOPE

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- A. From the initial design phase until the final prototype is designed, this project is governed by improving any existing models through the use of customer needs and demands. We want to do all of this while keeping the price lower than what is currently offered on the market.
- B. The scope of our project reaches the aspects within business including: design, research and development, customer service, manufacturing and fabrication, marketing, and shipping and receiving.
- C. Our team is not in charge of setting a budget; our budget will be set by our customer, Jeff Fleenor.

## 6 GRAPHICAL ABSTRACT

