Fixtures for Production of Modular Weld Tables

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Fixtures for Production of Modular Weld Tables

**Problem Statement**
The problem that we worked with our client to solve focuses on the production of modular weld tables. The design for the weld table was already completed at the time we took on our project. The problem was that assembly of the table took far too long to be feasible for a production run of multiple units. Lack of proper fixturing would also lead to variance in the tolerances of each unit produced.

**Disciplines**
Bioresource and Agricultural Engineering | Industrial Technology
Fixtures for Production of Modular Weld Tables

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1 PROBLEM STATEMENT

Problem Statement

- **Client Overview:** Fleenor Manufacturing is a company based in Pella, Iowa focused on developing solutions to problems in the agricultural, construction, forestry, mining, and utility mobile equipment markets. Once a problem is identified, the company works to develop an innovative solution and have it patented. Fleenor Manufacturing then partners with other companies who have the ability to effectively distribute the new innovation into its respective market.

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production of modular weld tables. The design for the weld table was already completed at the
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feasible for a production run of multiple units. Lack of proper fixturing would also lead to variance
in the tolerances of each unit produced.

- **What we needed to know:** It was known that we need to develop fixtures that allowed for quick
  and accurate assembly of multiple units. However, it wasn’t fully understood what type of
  features and tolerances the finished weld tables would need to have in order to be competitive in
  the market. For this reason, a market analysis was necessary to gather more details about the
  constraints of the finished product. These constraints had a heavy influence on how we designed
  the fixturing system.

- **What is already being done:** The goal of this project has already been achieved by other
  companies who manufacture similar tables. Any company who is manufacturing tables most likely
  has a fixturing system that they use. To be competitive with these companies, our fixturing system
  must be of a low enough cost that it will allow the finished product to be sold at a relatively low
  price. Our fixtures must also be versatile so that we can incorporate new and innovative features
  into the table as they are developed.

### Business Case Statement

A. **What:** We needed to create a system of jigs and fixtures to make it possible to assemble weld
tables in much less time while still yielding a quality product.

B. **How:** So far, only one modular weld table has been produced. Due to the difficult and time
consuming process, it isn’t logical to build more until a new method is devised. This project will
ultimately determine whether or not these tables are capable of seeing production.

C. **Why:** As noted above, there is a significant business opportunity associated with this
problem. Competitor weld tables are often expensive and there are many welders in the market
that would probably buy our table if it was priced below the others, given that it’s still a quality
product. Having the ability to produce these tables at the right price could mean significant
financial gain for Fleenor Manufacturing.

D. **Who:** Fleenor Manufacturing and their manufacturing partners have potential to benefit from
this project because, with our fixture design, it’s possible to take these weld tables to market
and earn a profit. The customers will also benefit from our work because they will have another
option that is both affordable and high quality when they are looking to purchase a welding
table.

### 2 Goal Statement

A. **Root Cause:** The root cause of the problem was simply that fixtures to produce the finished
marketable product did not exist.
B. The measure of the success for this project was how much additional information was given to the client that will ultimately help in the decision making process of how to produce the finished product. The reduction of assembly time also served as a measure of our success. It will be difficult to find a monetary value because material cost will remain the same and our client does the assembly themselves, so there is no labor cost being paid to a third party.

C. The overall cost to produce the fixturing is the parameter that was given the most consideration during our design and decision making process. The tolerances and functionality of the fixtures were also very influential in our decisions. These factors in combination with a few others (weight, physical dimensions, versatility, etc.) guided our design to becoming what it is.

- Tangible results delivered to our client were mostly in the form of planning and insight. Our design has the potential to reduce production cost and cycle time in a production setting. Knowing this, our client and their partners will be able to make a better informed decision about whether or not it would be advantageous to market these modular welding tables.

- Most results of our project were fairly difficult to measure objectively. There are no existing standards for the process that we can measure our improvements against. The only production table that has been built to date is the prototype that was assembled by hand. For this reason, there are no benchmarks for assembly time or final tolerances that we can compare our results with. It would be possible to benchmark ourselves against other competitor companies in the market, but that information isn’t readily available.

- After all designs and cost analyses are completed and approved, they will likely be given to Fleenor’s manufacturing partner. If the production and sale of these tables prove feasible, Praxair will likely be the company with whom our client partners to reach the target market.

**Main Objective(s) and Specific Objectives**

- **The main objective:** The main objective was to develop a design for a modular jig table with fixtures to hold the weld tables in place while being welded and assembled.

- **Specific objectives:**

  - Design a set of fixtures that meets the following criteria:
    - Parts should bolt on to the fixtures
    - Should be durable and withstand repeated use
    - Setup requires little to no manual positioning
    - The finished weld table requires no post-assembly machining

  - Create SolidWorks model of weld fixture table

  - Create, revise, and approve final design for weld table fixtures

  - Quote laser cutting price

  - Execute cost comparison

**Rationale**
When the jig table is built, our modular weld table will be able to be put into production. This table will allow our client to produce these tables while still maintaining the tolerances, quality, and reducing the time of production.

3 PROJECT PLAN/OUTLINE

A. Methods/Approach
   o Reference Material(s)
     o Our team has referenced marketing materials from several other companies to gain an understanding of our competition. We have also referred heavily to documentation of the design of the original production table that was developed by the previous capstone team.
   o Data collection:
     o Capable machining companies in the area were contacted in order to gather information about the cost and time requirements for doing the type of operations that we’re considering. In addition, we gathered as much data as possible about products that are currently available to gain a better understanding of the market climate.
   o Skills:
     o This project required frequent use of CAD programs such as Autodesk Inventor and SolidWorks. These programs were the main tool for developing the drawings and prints for our fixturing table and fixtures, as well as making any modifications to the design of the original table. General knowledge of welding and machining was also necessary. In order to determine the best methods of producing fixtures and the production tables themselves, you must know the advantages and disadvantages of all the machining and welding operations that could potentially be involved.
     o TSM 116 and 216 were useful because of what they taught us about using CAD software. TSM 240 and 340 provided us with basic knowledge about materials and machining methods that helped us to make decisions throughout the course of our project.
   o Solutions: The client had a rough idea of the solution when we came into the project. Over the course of several meetings, we refined the solution to include features that were necessary to achieve the goal of what the jig table was meant to do.
     o Each solution was analyzed from a cost standpoint combined with how well it met all the needs and wants of our client. In addition to cost, it was considered how well the solution would allow for assembly of the currently designed table as well as allowing for flexibility and changes in the designs of future production tables.
     o Client input was heavily considered when evaluating our different proposed
solutions. After any communication with the client, we would meet and discuss how well we were responding to the feedback our client.

- **Organization:**
  - Specific tasks and goals were assigned to each individual on our team on a weekly basis at our team meetings. At each meeting, we would discuss what our goals from the previous week were and how successful we were in achieving them.
  - The major milestones for our project were: creating, reviewing, and finalizing design, identifying capable machining companies, deciding on machining methods, gathering quotes for machining, and performing a cost analysis for assembling the fixtures.
  - When setbacks or unforeseen changes arose during our project, we met as a team and discussed possible solutions until we eventually unanimously decided on an option.

**Results/Deliverables**

- The major deliverable of this project was the completed and reviewed design of a fixturing system to produce modular weld tables. Other major deliverables included a cost analysis for the producing the fixtures and production tables as well as a market analysis to determine which features would be most competitive in the market.
- We were able to complete our project as planned within the time given throughout the semester. At the beginning, there was talk of assembling a prototype set of fixtures if time allowed. However, after a couple of weeks it was clear that our schedule would not allow for the actual creation of fixtures, and we decided instead to fully focus our efforts on design and analysis.
- In the future, there are a few key steps that our client will need to take if these tables are going to be put on the market. Fleenor manufacturing may choose to continue on with one of the quotes gathered during our project. Depending on the option, the table may be already assembled, or Fleenor may have to assemble the fixture table by themselves. Once the fixturing is built, it is at the discretion of Fleenor Manufacturing as to how and how often the fixture table is used for the production of weld tables. This number will be determined by future market analyses. Additional future work may include reworking the design of the production table to include features that competitors do not yet offer. This would lead to much higher profitability from selling these tables.

## 4 Broader Opportunity Statement

1. **Project appeal:** The benefits of our project appeal mainly to people that work in the welding and metal fabrication industry. The product that our project will help to produce will benefit them...
directly. However, the goal and scope of our project can easily be understood by the average person, even if they have limited knowledge of metalworking.

2. **Needs addressed:** Offering a quality welding table at a lower price will create a lot of opportunity for smaller welding shops to succeed and prosper by reducing equipment costs.

3. **Potential applications:** The potential application of our solution spans across many industries. Any company (large or small) that performs welding processes could benefit from a quality fixture table at a reduced cost.

4. **Trends affecting opportunity:** The need for welders to reduce overhead costs will naturally fluctuate with the general trend of our economy; however, people will always want to lower costs. This means that the market for what we are making should remain relatively constant.

5. **Other companies facing the same problem:** Other companies who manufacture welding tables are already capable of producing high quality tables. They use expensive, high tech industrial equipment to accomplish this. We have created a much simpler way to do the same thing. Other companies have the capability of producing high volumes and offering full product customization, but this capability requires an immense amount of initial investment. This high cost of investment is the reason why competitor prices are as high as they are.

## 5 Project Scope

A. **Boundaries:** The beginning boundary of our project was analyzing the design of the production table and gathering information about our project constraints. The ending boundary of our project was marked by the delivery of a fully completed design and cost estimate to our client.

B. **Included Aspects:** Design and cost analysis of the proposed fixtures were included in our project.

C. **Non-Included Aspects:** Actual construction of the fixtures was not included in the scope of our project, nor was making major changes to the design of the prototype weld table.

D. **Omitted Tasks & Materials:** There may be tasks that are crucial to this weld table becoming production ready that we have chosen to exclude from the scope of our project. This is because we are only allotted a certain amount of time and only have so much room in our schedules to complete this project. For that reason, our project will yield the best results if we focus on just the fixture table and executing it well. For the same reason, we decided to forego the construction of the fixtures and instead dedicate our full time to ensuring we have a well thought out and practical solution that our client can utilize.
6 Graphical Abstract

![Graphical Abstract](image)

7 Appendixes

Appendix A: Detailed Prints of Fixtures