TEXAS STATE
INGRAM SCHOOL OF ENGINEERING

I2.04- Ingram Hall Makerspace: Dream - Believe - Succeed

Ryan Powell, Jacob O'Neill, Jeff Davis, Daniel Ebuzeme
Mr. John Ivey

# Ingram Hall Makerspace EST. 2019

Problem Statement

- A predicted increase in traffic flow of 75% from Ingram School of Engineering's new Mechanical Engineering Program poses a facilitative concern to accessibility and safety within the Ingram Hall Makerspace tool room. Limited space within the tool room requires optimization of shelf and tool placement to improve the convenience of tool usage for a growing user population.

Objectives

- Optimize a floor plan for shelf placement within the tool room for accessibility using a prioritization Matrix comparing 4 different layouts.
- Use an initial and final time study to compare the original layout to the final layout design.
- Analyze data for tool usage within IHM for optimization of tool placement on the shelves based on distance to front desk.
- Optimize tool organization on shelves to allow for a larger capacity and room for tool expansion.
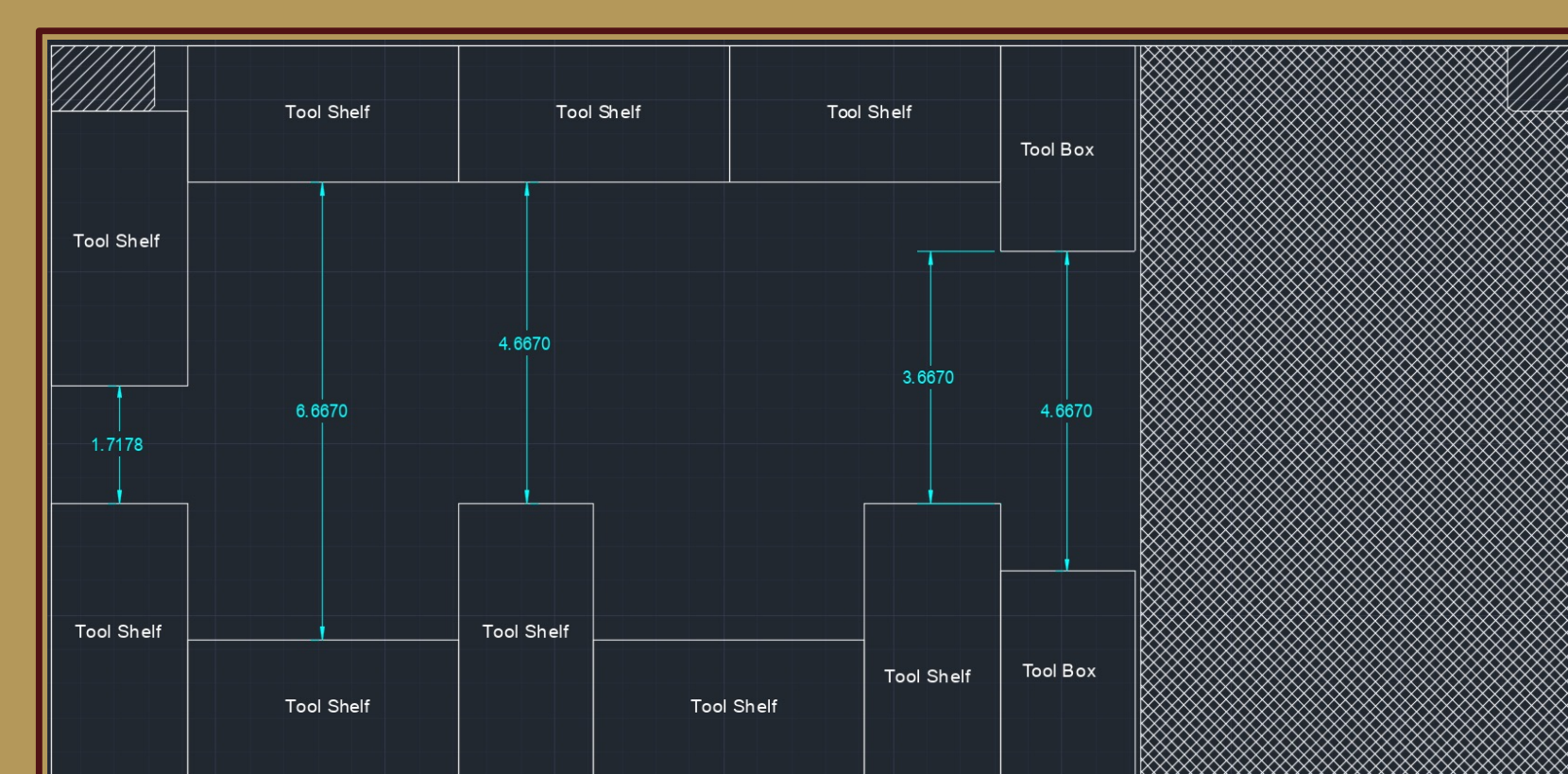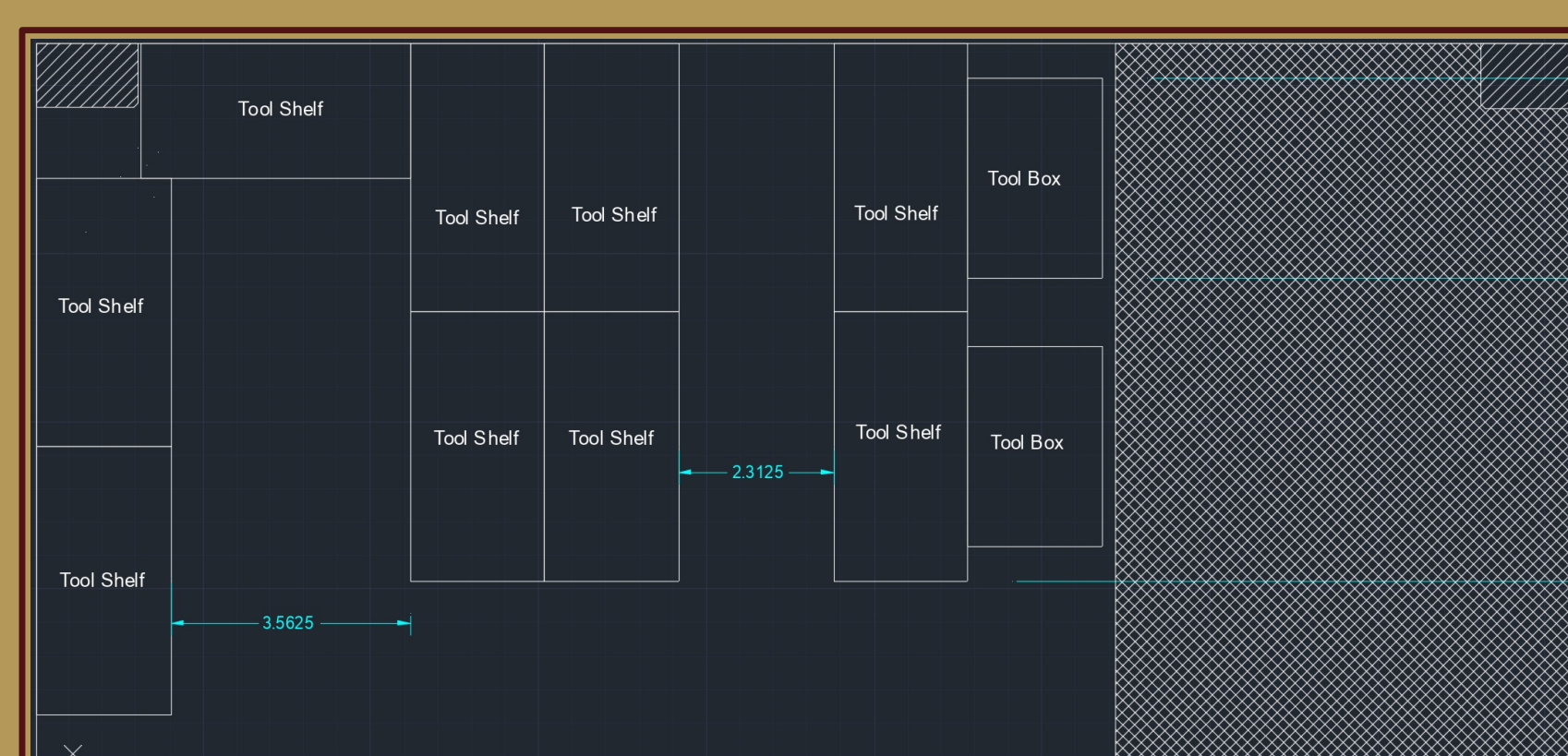
Schedule
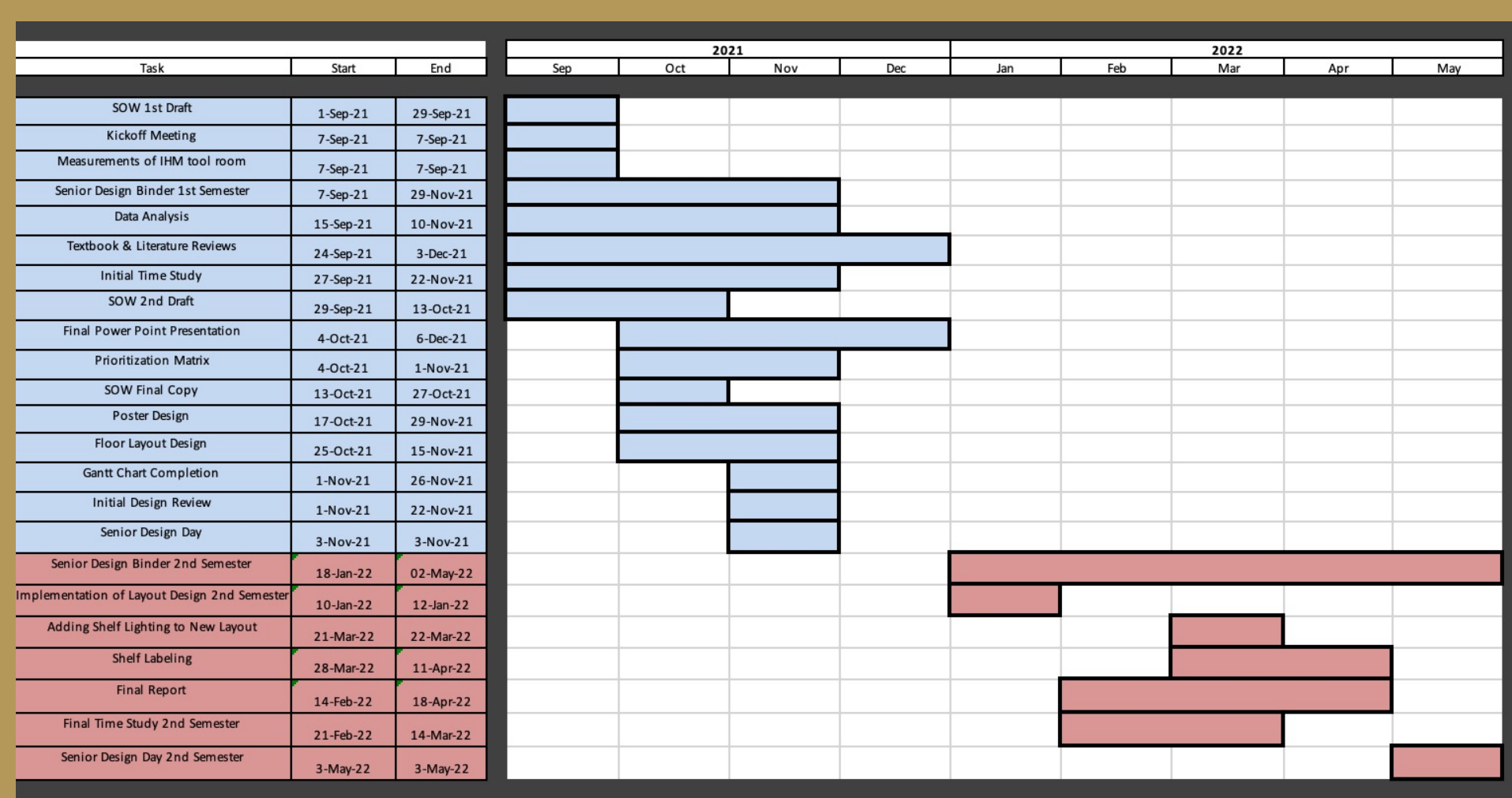
Methodology
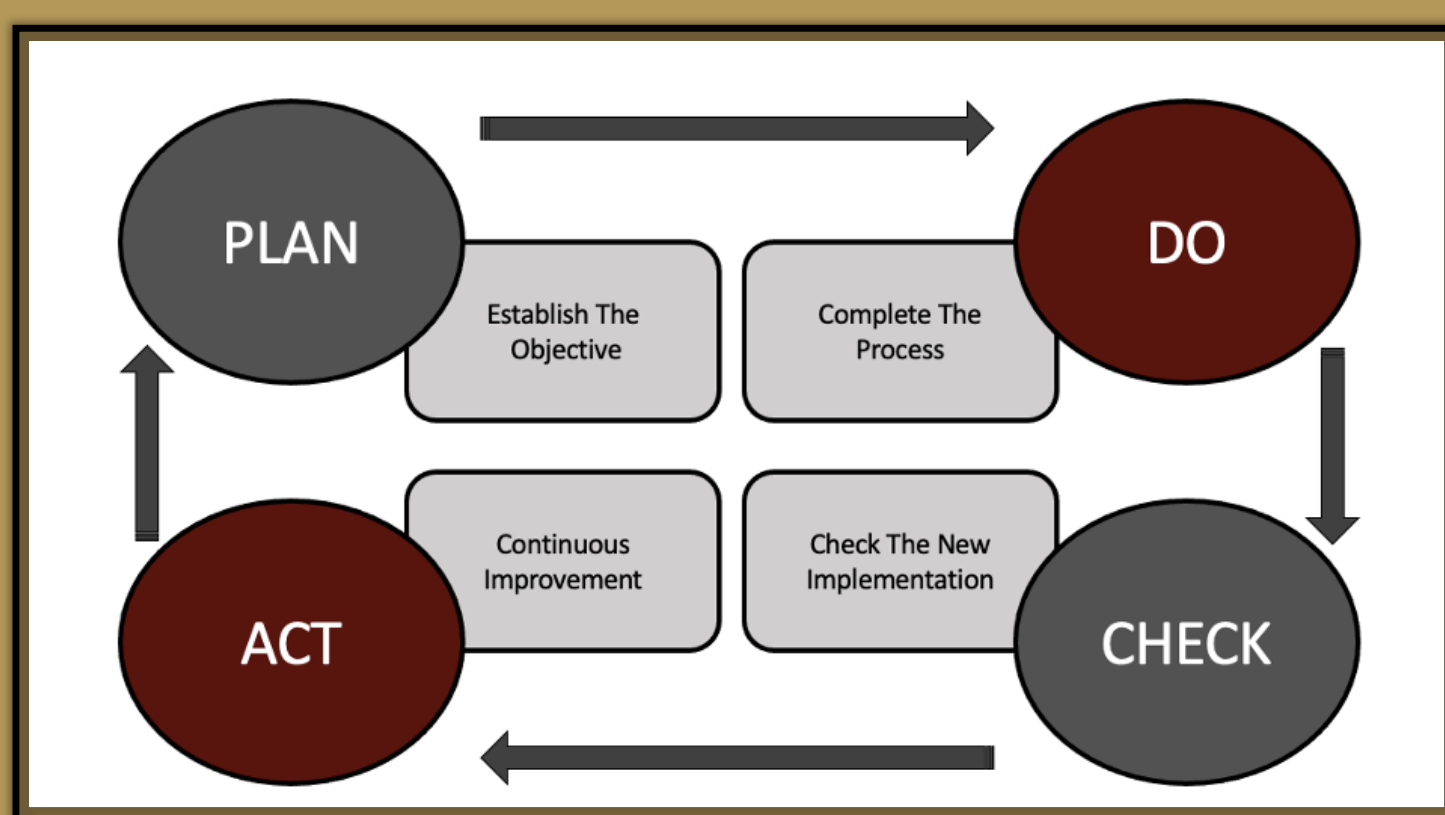
Team Members

Left to Right:
-Ryan Powell-
-Jacob O'Neill-
-Daniel Ebuzeme-
-Jeff Davis-

Initial Layout vs. Implemented Layout

- Poor Visibility (not an open layout) when searching for tools.
- Tight walking space (areas less than 2'6").
- Human Factor concerns with removing/replacing tools.
- Less than 20% additional tool capacity for future growth.
- Limited Labeling on Shelves for finding tools.
- Barcodes are becoming worn causing scanning issues when checking out tools.

Adjustments
- Distance/Time
- Visualization
- Safety
- Capacity
- Walking Space
- Open floor plan improves access into the tool room.

Tool Data Analysis & Prioritization Matrix
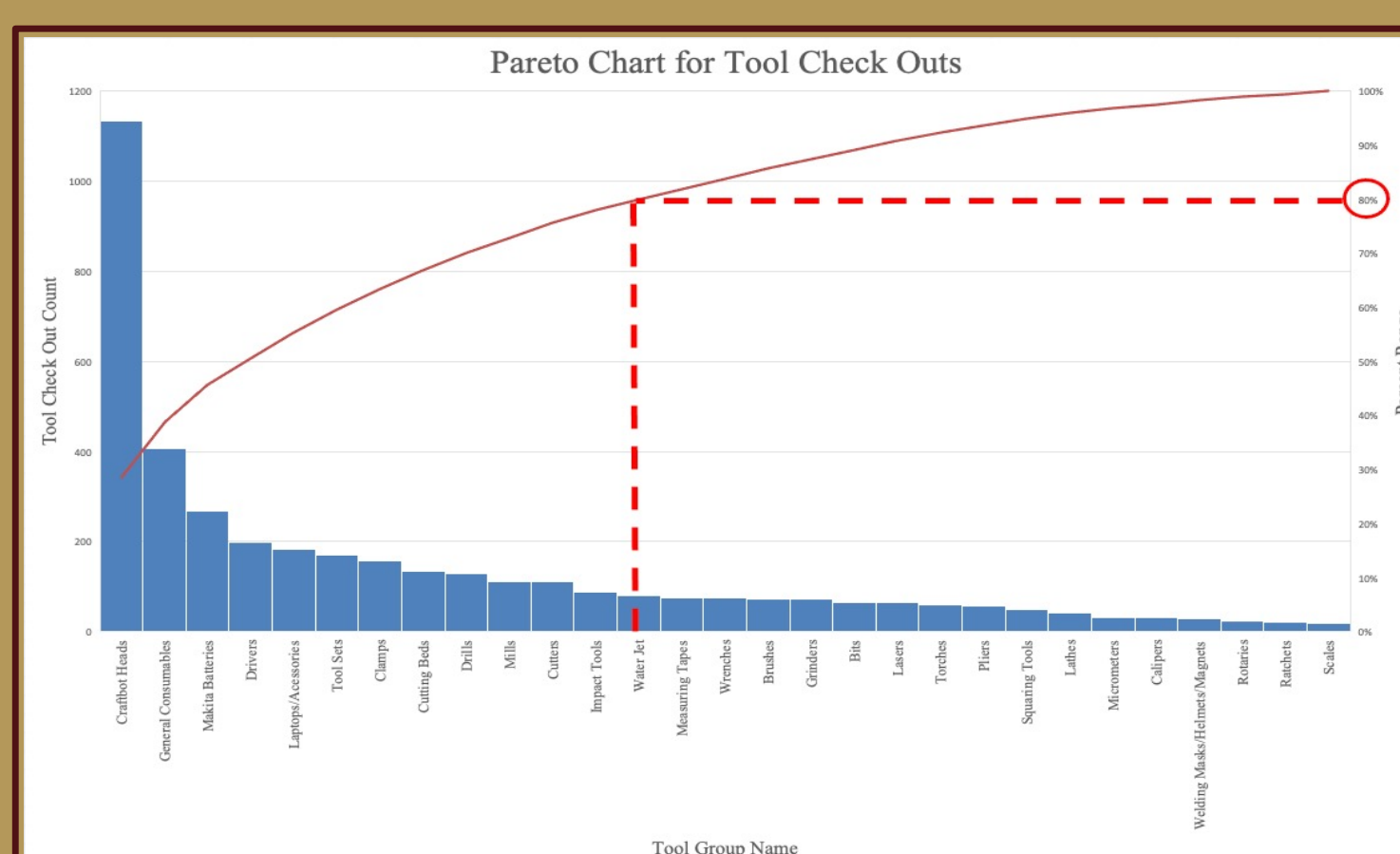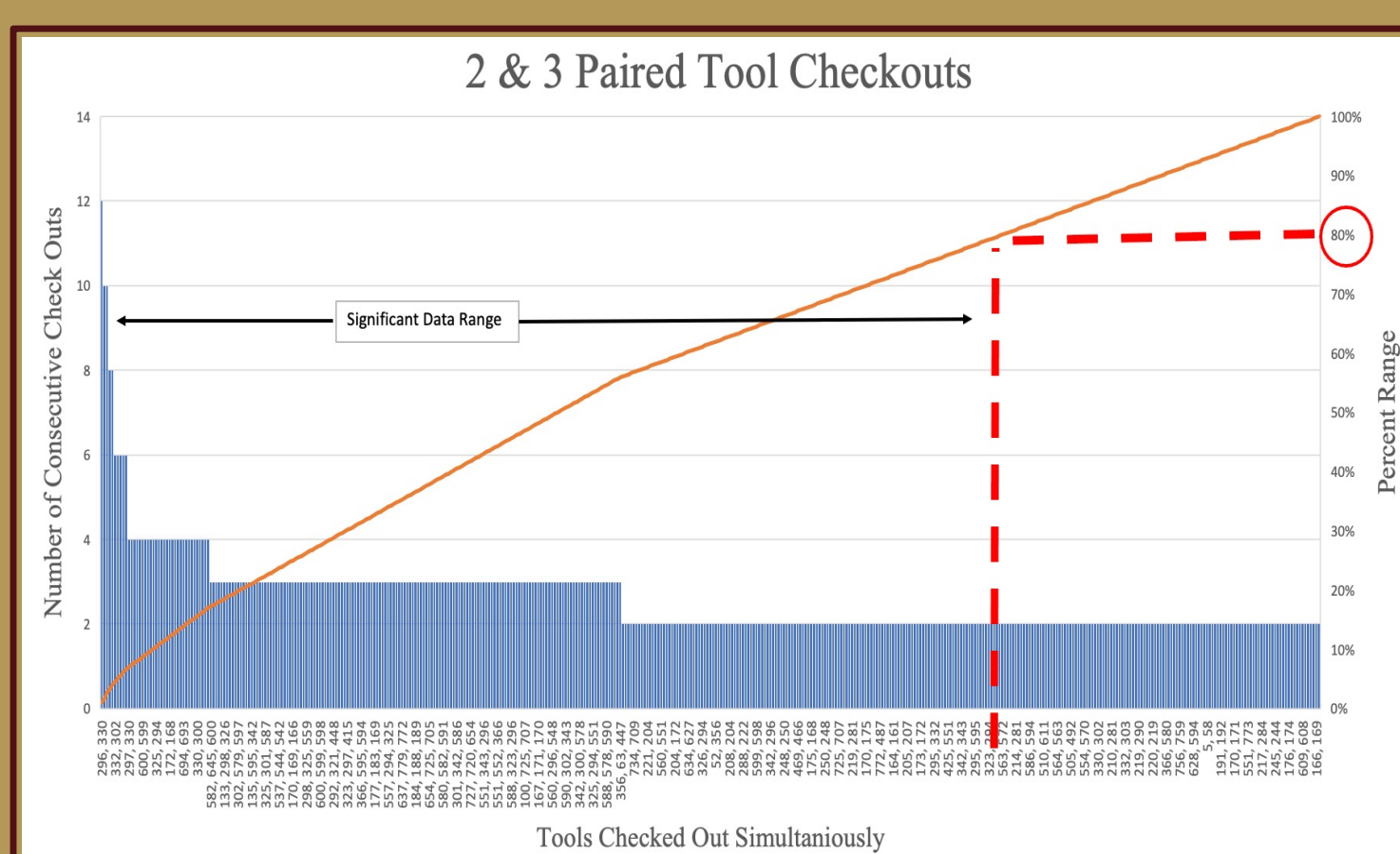
Categories	Weights	Layout 1	Layout 2	Layout 3	Layout 4	Current Layout
Distance/Time	2	5	4	4	4	3
Visualization	2	2	3	4	5	1
Safety	6	4	4	5	5	4
Lighting	4	3	4	5	5	5
Accessibility	3	5	4	2	3	4
Capacity	4	2	3	4	5	1
Walking Space	5	1	3	4	5	1
Total Weighted Score		78	93	108	122	73

- Representation of repetition/sequences in a tool checked out with 1 or 2 addition tools at the same time.
- The data above will be used as a deciding factor on where tools will be within the new layout

- Current tool data from IHMMS database, divided into tool categories.
- The data above indicates tools with the most use to aid in tool placement within the new layout

- Allowed for the comparison of multiple layouts, while referencing initial layout. The weights gave value to aspects that were important to our Sponsor and Human Factors of the project.

Time Study Results
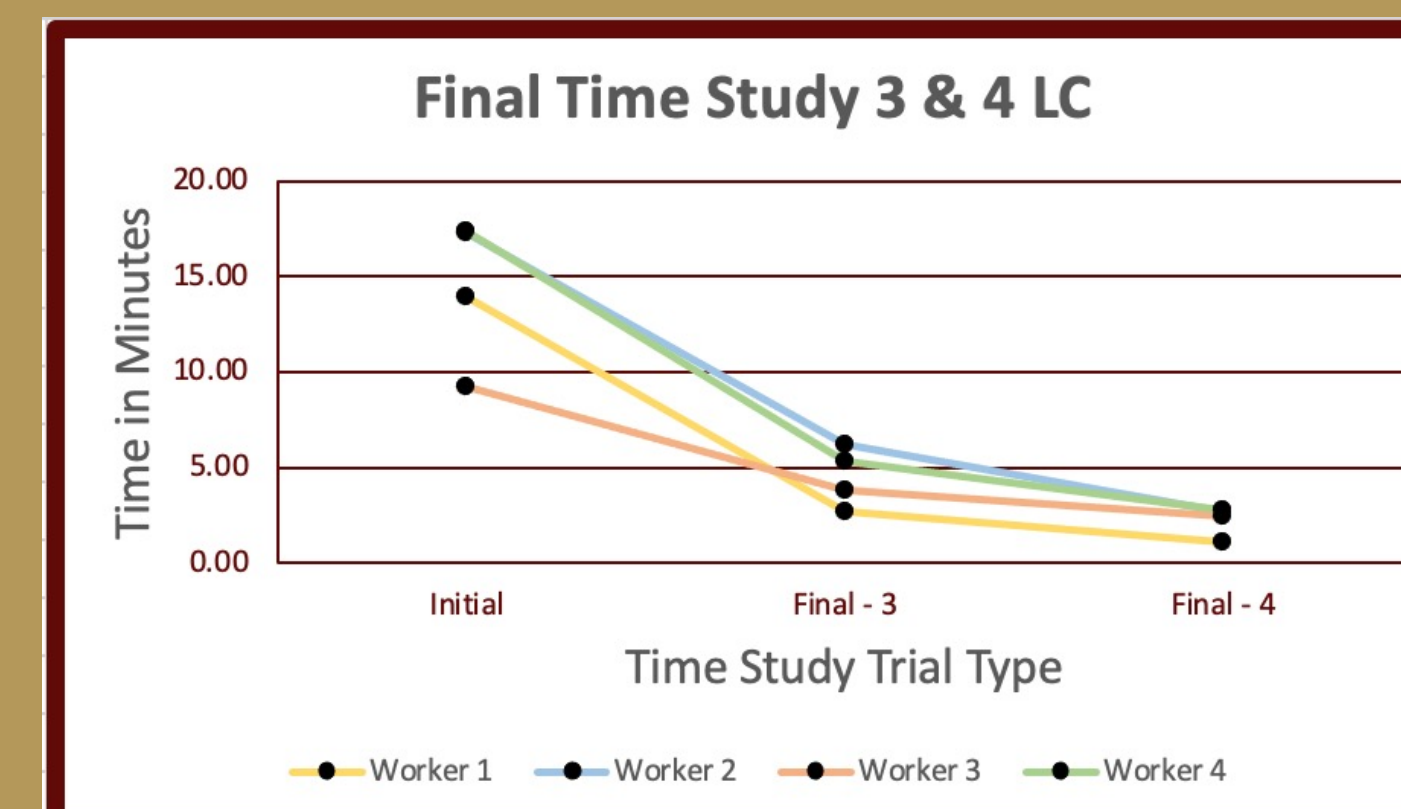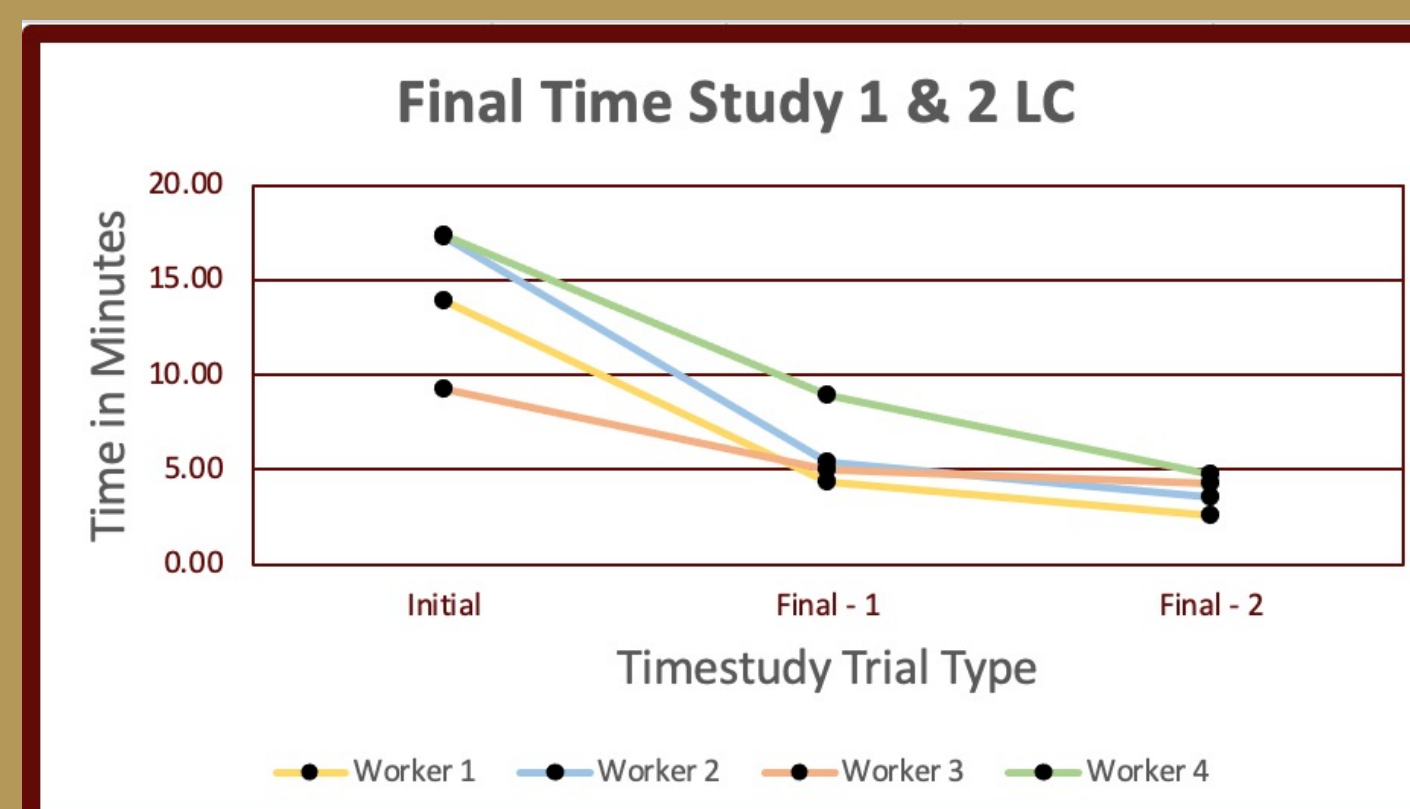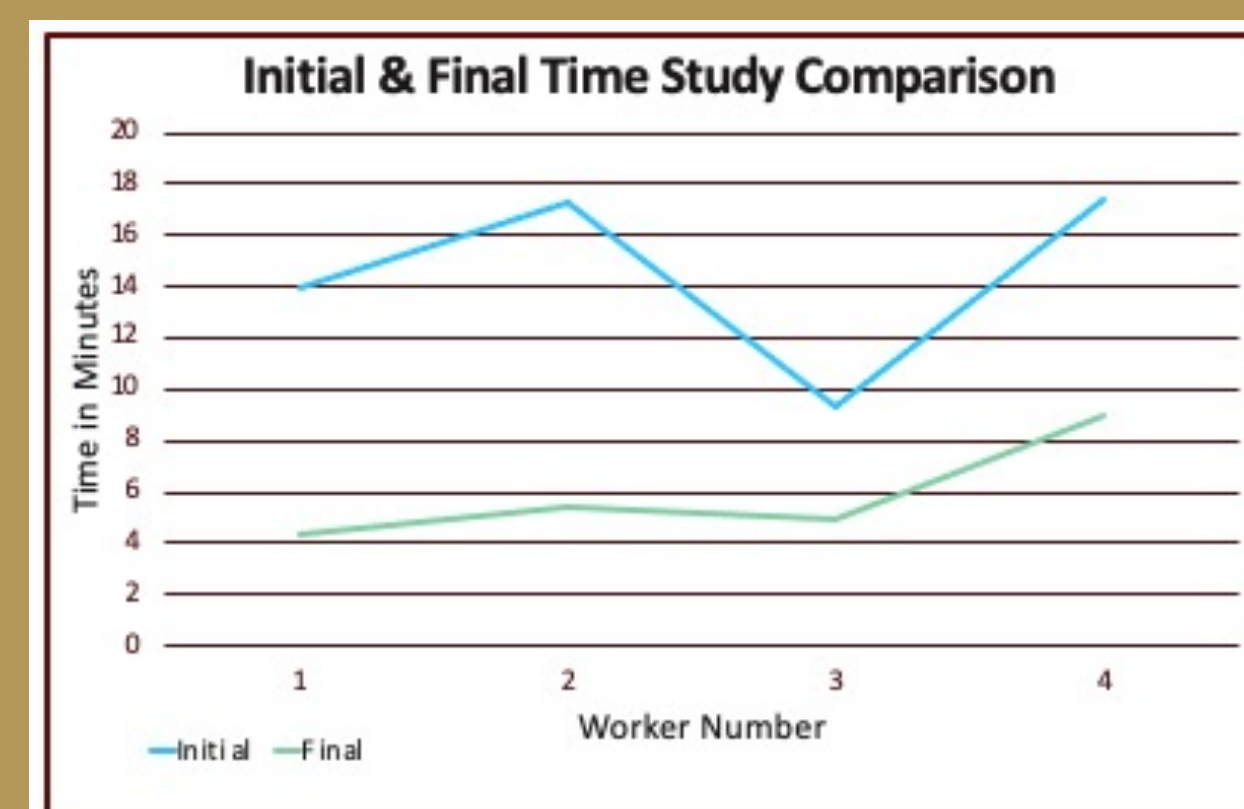
Total Times per Worker

Worker Number	Initial	Final	Time Units	Time Reduction
1	13.97	4.38	minutes	68.65%
2	17.31	5.38	minutes	68.92%
3	9.28	4.96	minutes	53.45%
4	17.4	8.93	minutes	48.68%

Final Time Study 1 & 2 LC

Trial Number	Worker 1	Worker 2	Worker 3	Worker 4
Initial	13.97	17.31	9.28	17.40
Final - 1	4.38	5.38	4.96	8.93
Final - 2	2.55	3.55	4.23	4.78
Percent Time Reduction	81.77%	79.49%	54.43%	72.53%

Final Time Study 3 & 4 LC

Trial Number	Worker 1	Worker 2	Worker 3	Worker 4
Initial	13.97	17.31	9.28	17.40
Final - 3	2.68	6.23	3.84	5.31
Final - 4	1.14	2.69	2.49	2.77
Percent Time Reduction	91.87%	84.44%	73.12%	84.08%

A Look Inside

Human Factors

Visualization
- Average eye height of US adult male is 68" (upper 95%).
- Open floor layout allows adequate room to view bottom shelves (4") without bending down.

Safety
- Average elbow height of US adult female is 36.9" (lower 5%).
- Adjusting middle shelves to a height of 36.9" will account for smaller users and give an optimal location for most used tools.

Future Plans

- Updating/Adding tool location to IHMMS system (shelf row and column labeling). [Partially Done]
- Addition internal shelf lighting. [DONE]
- Finding optimal location for mounted tools. [DONE]

Acknowledgements

We would like to extend special thanks for their patience, guidance, and collaboration to:

- Mr. John Ivey, Texas State University
- Dr. Michelle Londa, Texas State University
- Dr. Clara Novoa, Texas State University