



**THE UNIVERSITY OF TEXAS AT EL PASO**

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Elevating Efficiency: Implementing Industry 4.0  
at Eaton's LVA Manufacturing Center

Team 4 - Eaton

Jose Graells, Roberto Torres, Ivan Delgado, Eduardo Jaquez



# EATON

*Powering Business Worldwide*

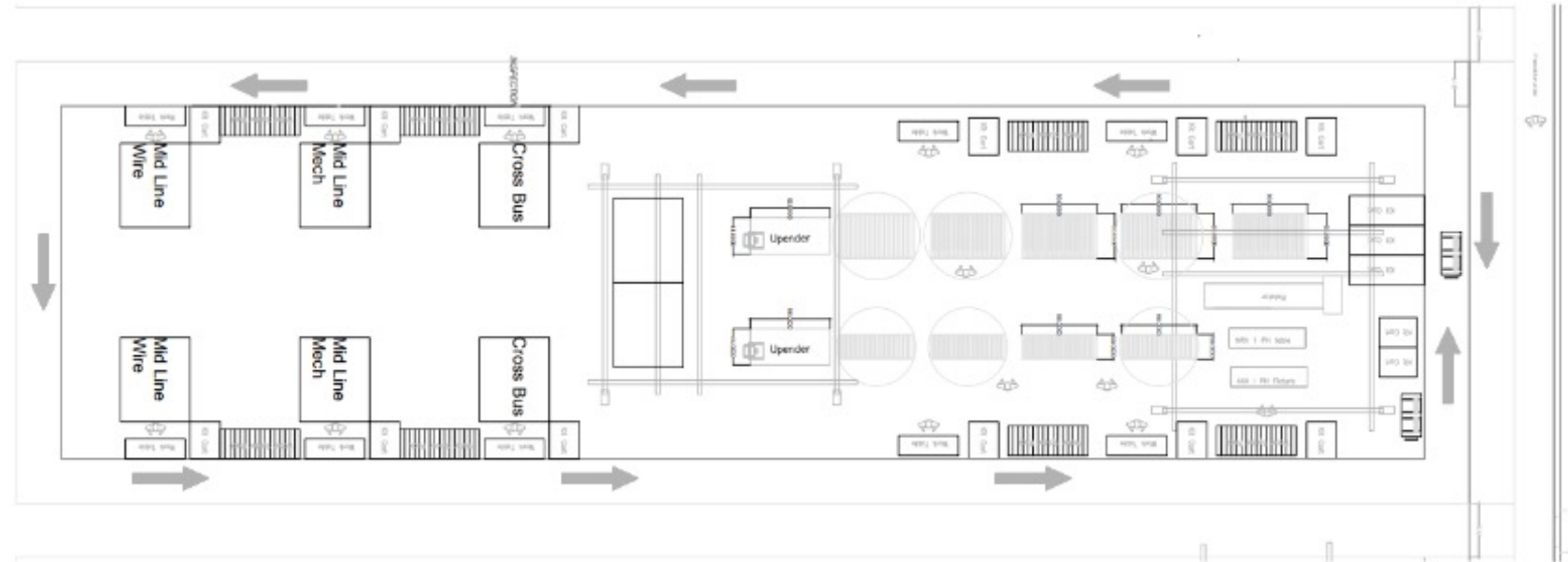
The function of a LVA (Low Voltage Assembly) is to provide electrical protection against thermal and mechanical stresses of short circuit currents. This is crucial in limiting the dangerous consequences of excessive currents and separating the defective current from the rest of the installation.

# Problem Overview

- The project endeavors to establish a world-class Engineer-to-Order Low Voltage Assembly center in El Paso, TX, for a futurist data center that will be develop by a company in the Computers Industry. By leveraging Industry 4.0 technologies, the UTEP Senior Design Team aims to optimize a new assembly line for a completely new LVA product, collaborating closely with EATON to integrate sustainability, safety, and standardization practices. The project emphasizes efficiency improvements, regulatory adherence, and meeting the dynamic market demands for innovative electrical solutions.

# Objective


We were provided with the proposed layout. This assembly line will produce Low Voltage Assembly Units, and the first goal was to verify and validate that the current layout propose is accurate and will be able to meet all the requirements needed.





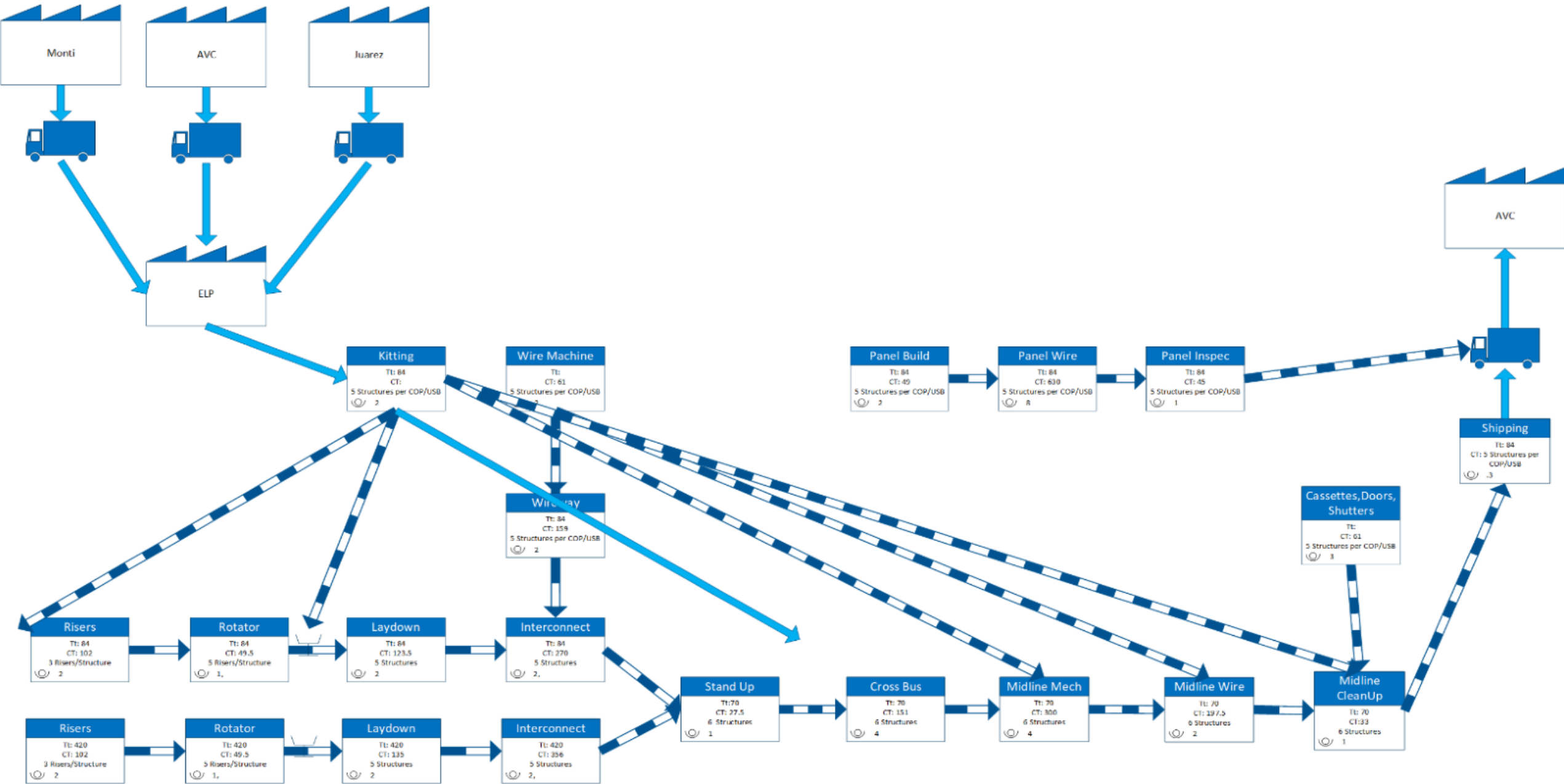
# Communication within the team and with Eaton engineers

During the past 3 months, we have been collaborating closely with Eaton's engineers, plant manager and workers to improve and optimize the proposed layout that we collaborate to produce. Getting into workshops, we all analyze what we see on paper to transfer it to real life, so we can obtain possible problems that the assembly line may encounter.

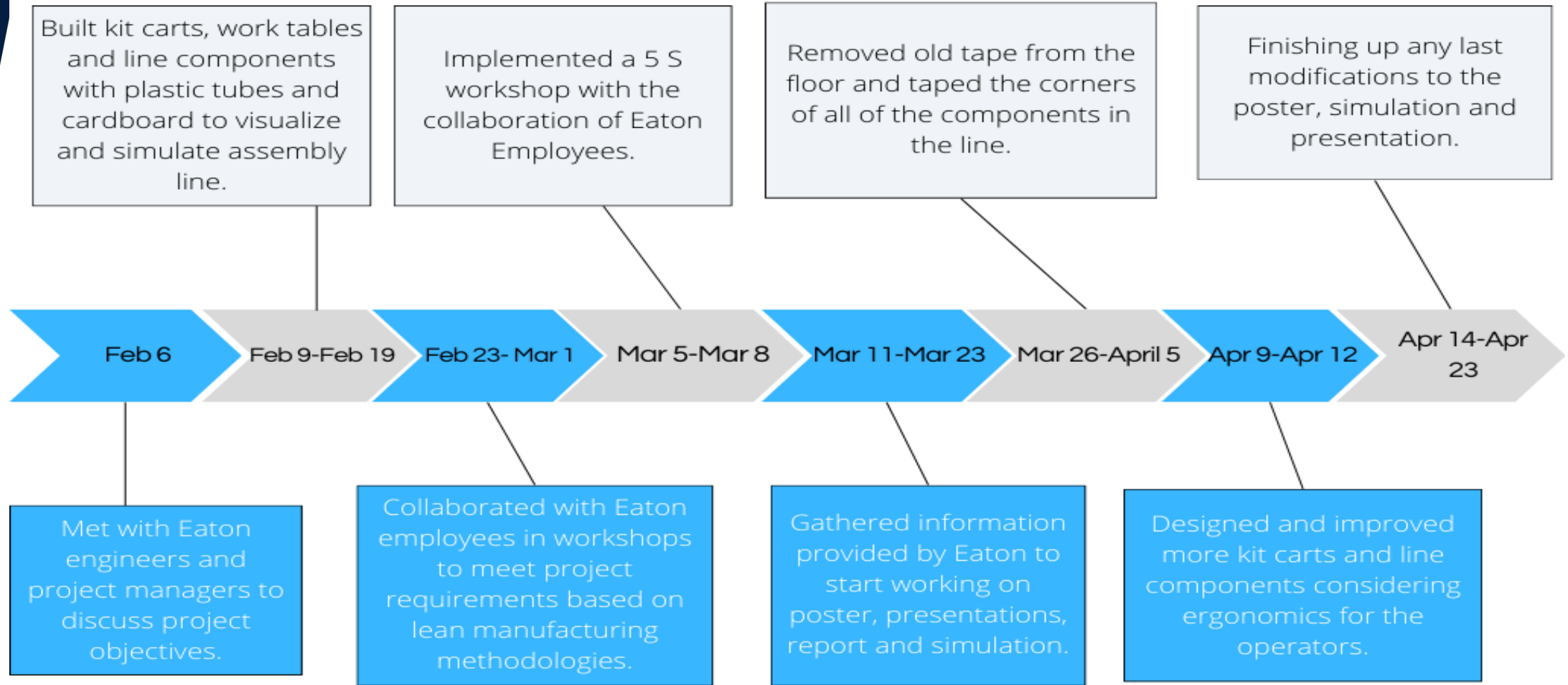
																			
		<b>Project Start Date:</b>		11/1/2023 (Wednesday)		<b>Display Week</b>		18				Week 18		Week 19		Week 20			
												26 Feb 2024		27 Feb 2024		28 Feb 2024		1 Mar 2024	
Area	Activity	TASK	LEAD	START	END	DAYS	% DONE	WORK DAYS	M	T	W	T	F	S	S	M	T	W	
Equipment	1	Machine Identification and Selection	Jorge	Wed 11/01/23	Fri 12/01/23	23	100%	23											
	2	Procurement of Equipment	Mauricio	Fri 12/01/23	Tue 1/30/24	43	100%	43											
	3	Mock Up of new line	Eduardo	Fri 2/23/24	Fri 3/01/24	3	100%	6											
	4	Installation of Equipment	Eduardo	Tue 3/05/24	Mon 4/15/24	3	0%	30											
	5	Validation of Equipment	Eduardo / Cesar	Mon 3/11/24	Mon 4/22/24		0%	31											
People	1	Identify Trainers and Team Leader	Claudia	Mon 2/26/24	Fri 3/08/24		0%	10											
	2	Hire New Employees	Claudia	Mon 2/26/24	Fri 3/29/24		0%	25											
	3	Training at ASH (Train the Trainer)	Claudia	Mon 4/01/24	Fri 4/19/24		0%	15											
	4	Training at ELP	Claudia	Mon 4/22/24	Fri 5/24/24		0%	25											
	5	Certify Employees at El Paso	Claudia	Mon 5/27/24	Fri 5/31/24		0%	5											
Quality	1	Eaton Internal TDD Self Assessment		Wed 3/20/24	Thu 3/21/24	2	0%	2											
	0.1	MSFT APR Self Assessment Preparation		Tue 4/23/24	Wed 4/24/24	2	0%	2											
	0.1	MSFT May TDD Official Audit		Tue 5/21/24	Wed 5/22/24	2	0%	2											
	0.1	Internal ISO 9K Audit (FEA)		Tue 6/04/24	Thu 6/06/24	3	0%	3											
	0.1	DNV Pre-Assessment		Tue 6/18/24	Wed 6/19/24	2	0%	2											
	0.1	DNV Stage 1 Readiness Review		Mon 7/29/24	Tue 7/30/24	2	0%	2											
Supply Chain	0.1	DNV Stage 2 Certification Audit		Tue 8/27/24	Fri 8/30/24	4	0%												
	1	Plan for Every Part	Victor	Mon 2/26/24	Fri 3/08/24		20%	10											
	2	Warehouse Arrangement	Victor	Mon 3/11/24	Mon 3/18/24		0%	6											
	3	Container Optimization	Victor	Mon 3/18/24	Fri 3/22/24		0%	5											
	4	Procurement of Material for Golden Units	Victor	Thu 2/22/24	Fri 3/29/24		20%	27											
Manufacturing	5	Parts Presentation/Delivery Routes	Victor/Eduardo	Mon 4/01/24	Fri 4/19/24		0%	15											
	1	Industrialization Unit at ASH	Eduardo	Mon 4/08/24	Fri 4/12/24		0%	5											
	2	Documentation of Work Instructions	Eduardo	Mon 4/08/24	Fri 4/12/24		0%	5											
	3	Dry Run	Eduardo	Mon 4/22/24	Fri 4/26/24		0%	5											
	4	Industrialization Unit at ELP	Eduardo	Mon 5/06/24	Fri 5/10/24		0%	5											
	5	Debug Of Line	Eduardo	Mon 5/13/24	Fri 5/24/24		0%	10											
6	Golden Unit at ELP	Eduardo	Mon 6/03/24	Fri 6/07/24		0%	5												



# LVA ELP VSM, Current State



# Communication within the team and with Eaton engineers



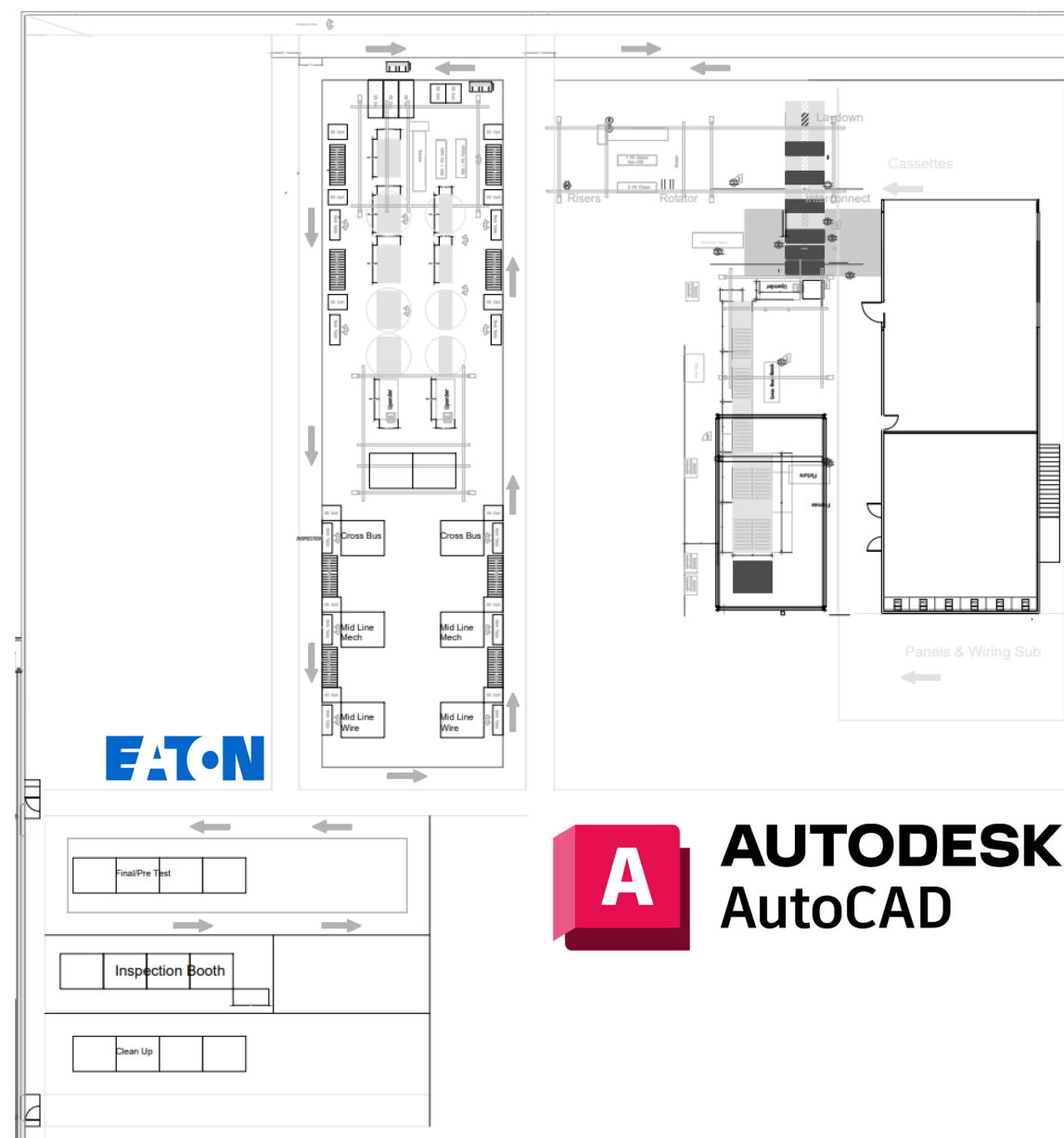
# Methodology

The CAD Drawings and Layouts for the new LVA assembly line has been defined and were ready to be implemented using **Industrial, Manufacturing, and Systems concepts**. The objective is to validate what has been defined electronically (CAD Drawings) **in order to be safe, efficient and functional**. Many methodologies were implemented throughout the whole collaboration process between UTEP Senior Design students and EATON Employees

"Not every technique is one-size-fits-all"

or

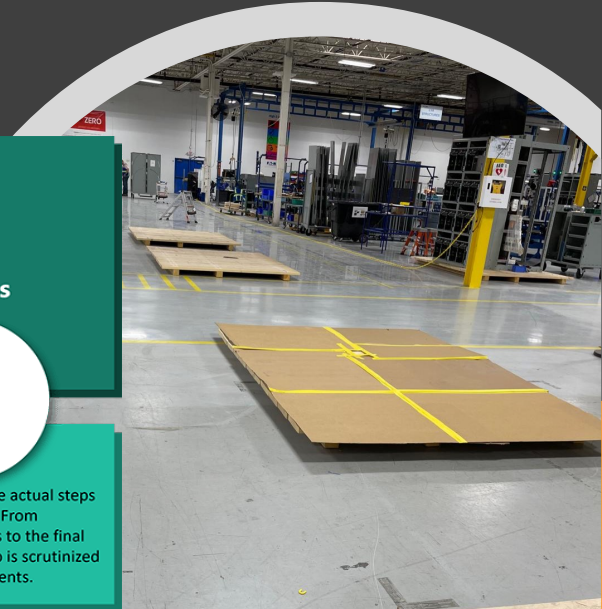
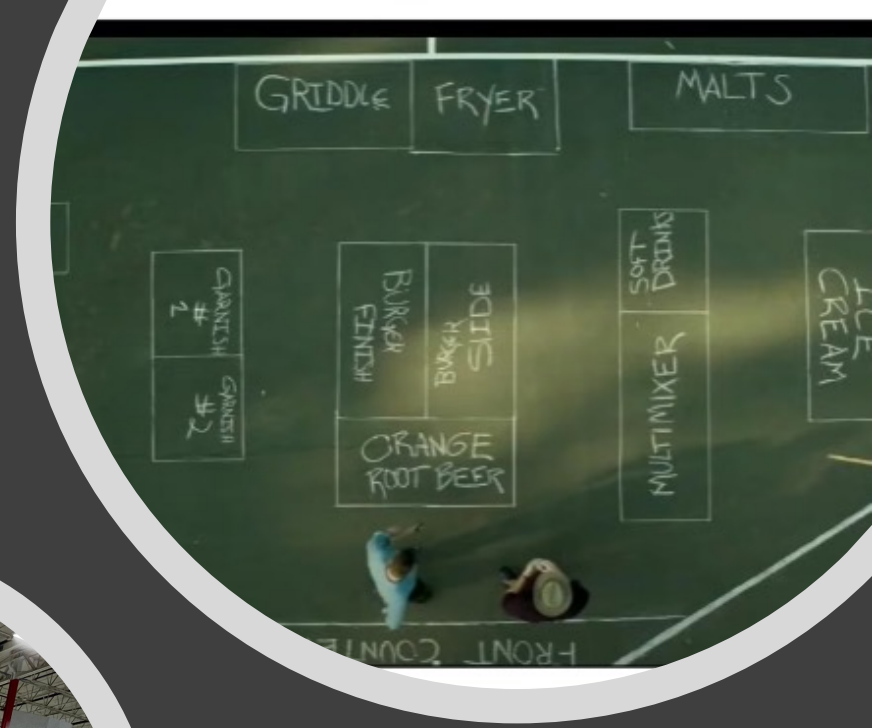
"Each technique isn't a universal solution."





# Methodology: Engineering Design and Techniques

For the hands-on aspect of this project, Eaton's engineers used, for the most part, the Lean 3P (Production, Preparation, Process) methodology, as depicted in the movie "The Founders." This approach, known for its emphasis on innovation and efficiency, guided our team through the design process. To ensure the feasibility of EATON CAD layout proposal, EATON conducted a series of Rapid Improvement Workshops in collaboration with UTEP students. These workshops facilitated constructive feedback and fostered a culture of continuous improvement within our project.



## 3P METHOD

Production



The first "P" focuses on the actual production line. The goal here is to create a workflow that maximizes efficiency, minimizes waste, and optimally uses resources.

Preparation



This involves setting up the production environment for success. It includes choosing the right equipment, layout, and materials to ensure seamless production.

Process

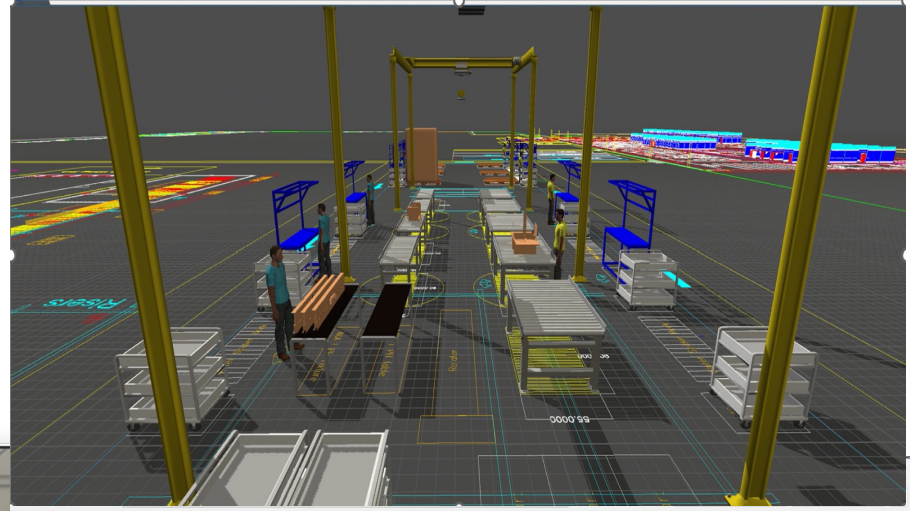


Here, the focus is on the actual steps involved in production. From procuring raw materials to the final quality check, each step is scrutinized for potential improvements.



# Methodology: Industry 4.0 and Engineering Concepts/Principles

JACK

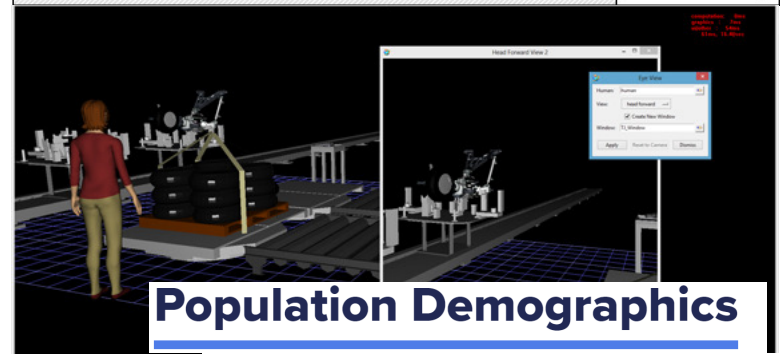
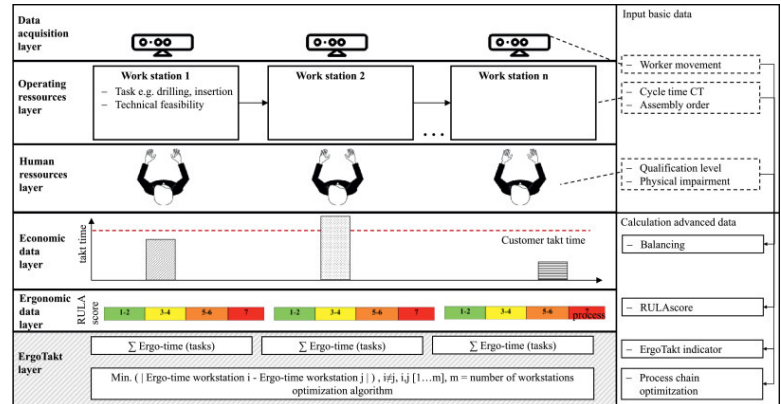


Jobs Run Advanced

Name	Experiment1			
Warmup Time	0.00	8:00:00 AM	11/15/2023	
Stop Time	28800.00	4:00:00 PM	11/15/2023	
Replications per Scenario	100			

Parameters	Scenarios					
	Separator1X	Separator2X	Processor1X	Processor2X	Combiner2X	Combiner3X
Center	70	70	64	64	58	58
All-Left	67	67	61	61	55	55
All-Right	73	73	67	67	61	61
Far-Apart	73	73	64	64	55	55
Close	67	67	64	64	61	55

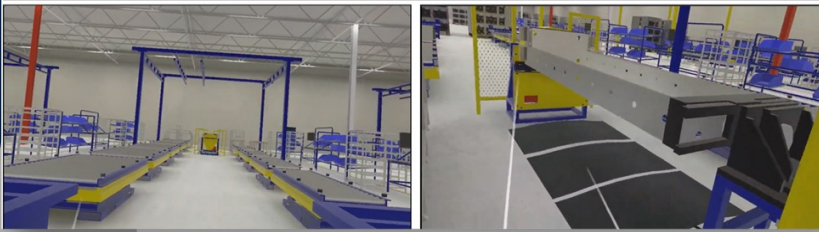
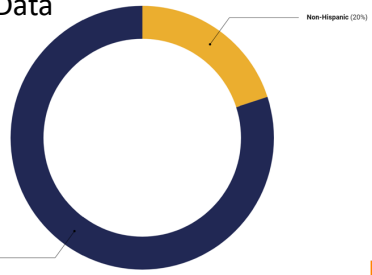


## Population Demographics

Population by Race/Ethnicity

Electronic Medical Record (EMR) and U.S. Census Bureau Data

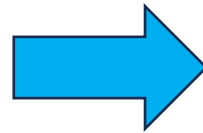
- EL Paso, TX:
- 80% Hispanics
  - The average height:
    - Man is 5'9,
    - Woman 5'4





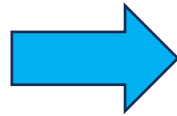
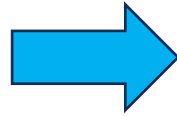
# Ergonomics

After reviewing Eaton's current kit carts and worktables, we identified an opportunity to enhance them using Creeform materials. This decision was informed by a demographic study we conducted, leveraging data from Electronic Medical Records (EMR) and the U.S. Census Bureau. Our analysis revealed that the average height of Eaton's workforce is between 5'4" and 5'9", including both men and women of Hispanic descent. Based on this data, we opted to set a height limit of 5 feet for the components. This modification aimed to improve accessibility and safety for operators, ultimately enhancing their performance.



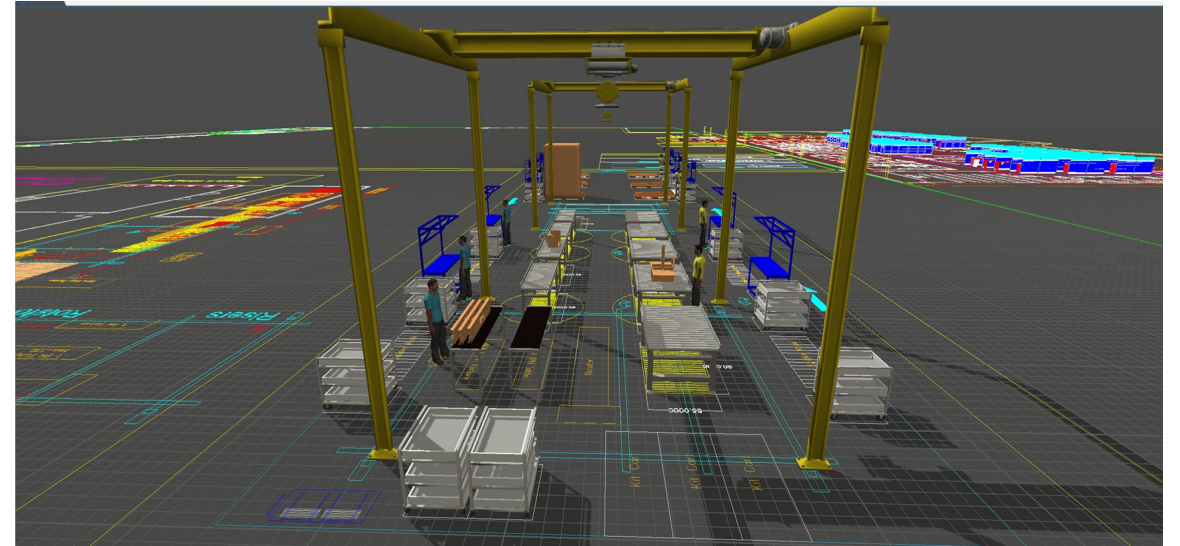


# Ergonomics



# Industry 4.0

Below is the virtual reality video that was provided to us by Eaton management which shows the assembly lines layout with all its required components as well as our Industry 4.0 simulation. The VR video aided us with the design of the simulation as it allowed us to effectively oversee the layout with the approach to propose this tool to Eaton for future advancements.



## [AI Video](#)

<https://drive.google.com/file/d/1g5CaZgc4dtJtBo4FWNdAQDCBLjBdUiqh/view>



# Results

- For our results we were able to validate the assembly line's layout with our industry 4.0 simulation as well as our successful collaboration with Eaton employees through our lean manufacturing workshops. We verified that the layout of the line will have a continuous flow with a pull system being integrated and most importantly a safe environment for the operators to work.



work safely      prevent incidents      reduce risk

**We choose ZERO**

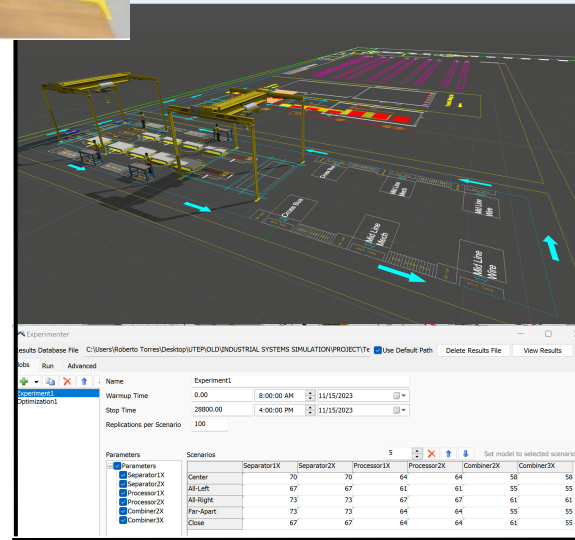
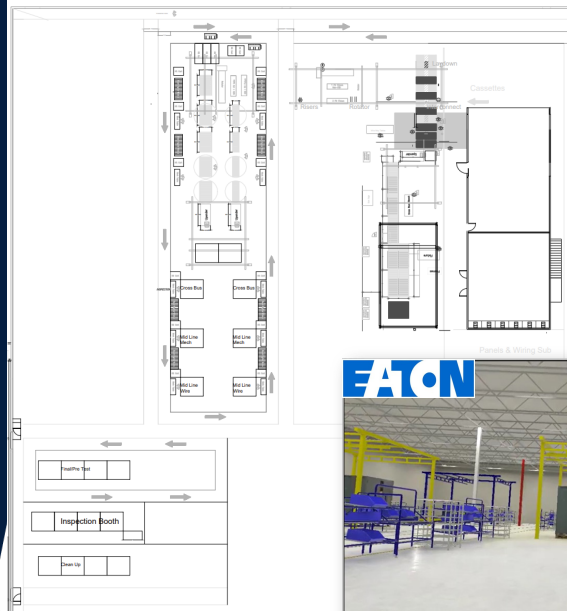
remove hazards      protect co-workers



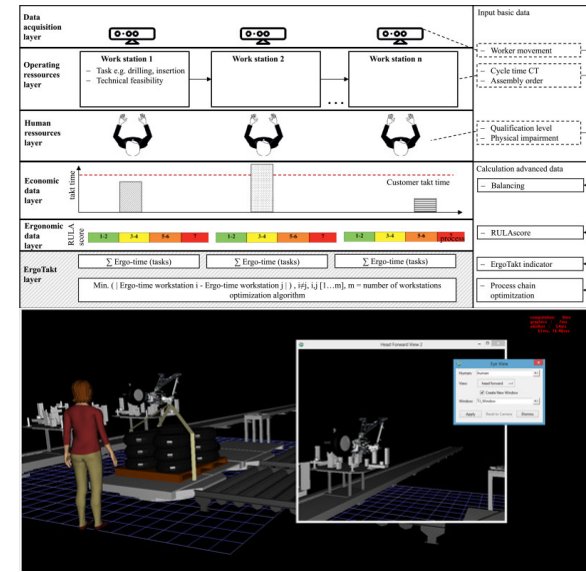
Together we can create a zero incident safety culture.



# ABET 2: ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.



## JACK

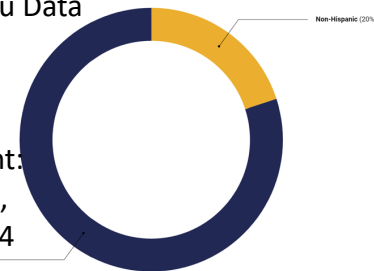


## Population Demographics

Population by Race/Ethnicity  
Electronic Medical Record (EMR)  
and U.S. Census Bureau Data

EL Paso, TX:

- 80% Hispanics
- The average height:
  - Man is 5'9,
  - Woman 5'4



work safely    prevent incidents    reduce risk  
**We choose ZERO**  
remove hazards    protect co-workers



Together we can create a zero incident safety culture.



BRIGHTLAYER

How we're bringing the digital future into focus



ENERGY TRANSITION

Advancing a new energy future

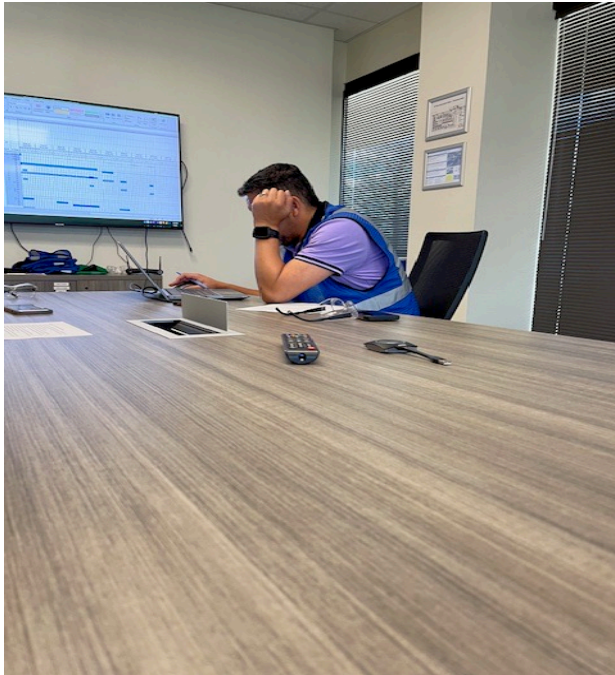


SUSTAINABILITY

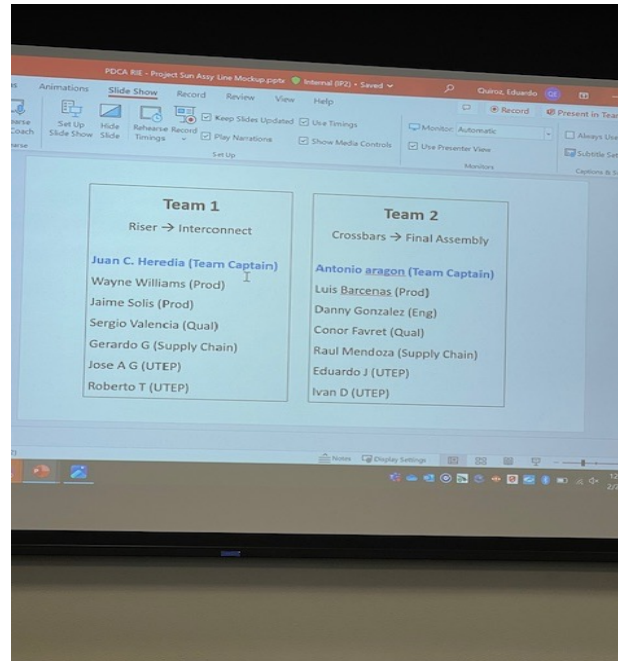
Eaton operations to be carbon neutral by 2030



# ABET 3 Effective Communication



Clarity and Understanding



Coordination and Collaboration



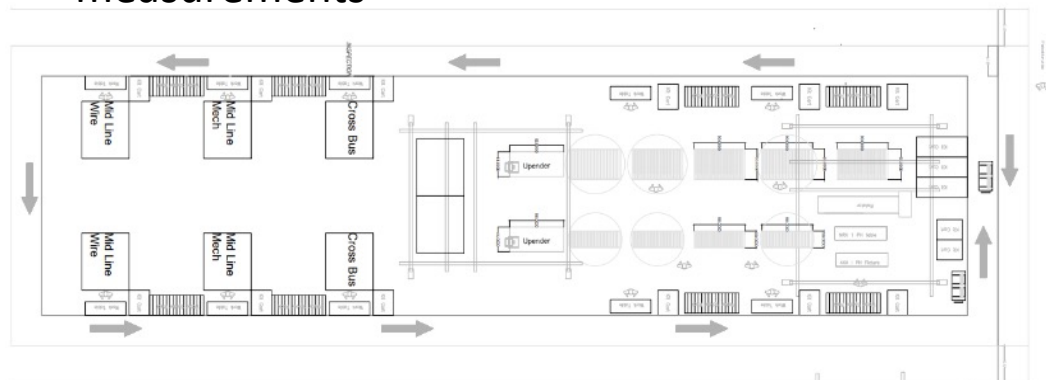
Problem solving and decision making



# ABET 5 : function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

During the past 2 months, we have been collaborating closely with Eaton's engineers, plant manager and workers to improve and optimize the proposed layout that we collaborate to produce. Getting into workshops, we all analyze what we see on paper to transfer it to real life, so we can obtain possible problems that the assembly line may encounter.

- Space between structures
- Cranes positioning
- Ergonomic workstations
- Compliance with measurements



# ABET 7: APPLICATION OF NEW KNOWLEDGE AND LEARNING STRATEGIES

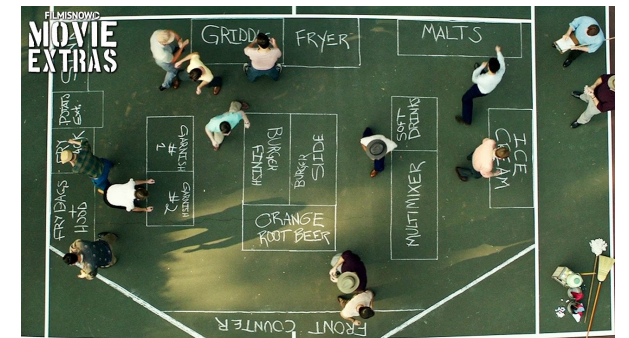
Since the start of the project, Eaton has provided us with some great knowledge regarding different methodologies that are helpful for optimizing the assembly line. These methodologies have been useful tools to deliver potential and professional solutions as well as getting us closer to our goal. Throughout this project we have incorporated Industry 4.0 solutions which is known as technological advancements such as simulations, data analysis or even ergonomic reports which we used to verify and demonstrate positive results to our project mentors. We also know that technology is advancing rapidly in today's world, and we are not far away from Industry 5.0 being the essential piece for manufacturing processes and optimization.

Below is a video that demonstrates how Eaton started to use Industry 5.0 in the installation of the LVA Assembly line.



[AI Video](#)

<https://drive.google.com/file/d/1g5CaZgc4dtJtBo4FWNdAQDCBLjBdUiqh/view>



INVENTORY



NON-UTILIZED TALENT



OVERPRODUCTION



EXTRA PROCESSING



WAITING



RESOURCES



DEFECTS

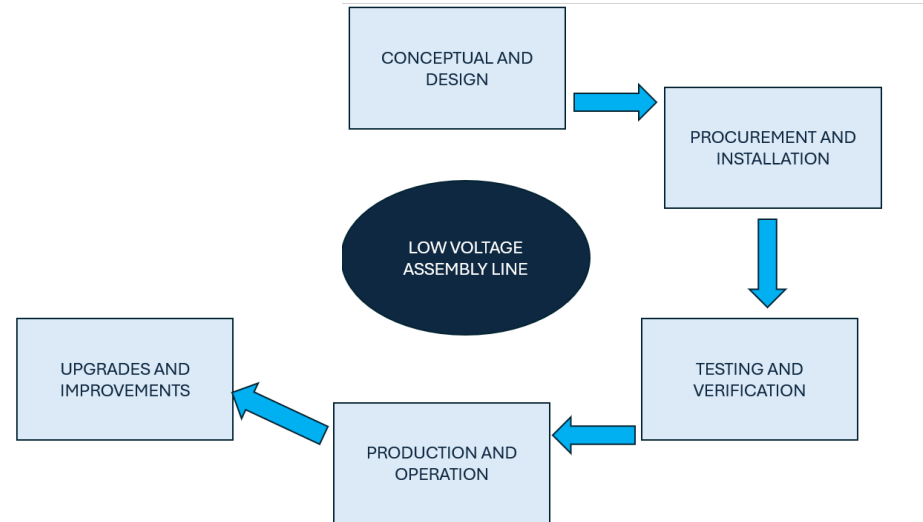


MOTION





# Conclusion





# Acknowledgements

**UTEP Faculty and Teachers:** "A sincere thank you to the esteemed faculty and teachers of UTEP, especially to Dr. Fashiar Rahman, Dr. Sergio Luna, and Dr. Contreras for their guidance and mentorship to our project journey. Your expertise and support have been instrumental in shaping our growth and success."

**EATON Management and Employees:** "We extend our heartfelt gratitude to our project sponsor EATON, especially to Jorge Mena, Eduardo Quiroz, and Danny Gonzalez. Your invaluable contributions and expertise have significantly enriched our work and propelled us towards excellence."

**Team Members:** "To our incredible team members, Jose Graells, Eduardo Jaquez, Ivan Delgado, Roberto Torres, thank you for your hard work, creativity, and relentless determination. Your passion and teamwork have made this journey both rewarding and memorable."

**Thank you !!**

