POLLUTION PREVENTION
WASTE MANAGEMENT WORKSHOP
Save money – Reduce risk – Eliminate waste

Waste to Wins: Leveraging Smart Manufacturing for Cleaner, Leaner Operations

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

TMAC

The TMAC Mission

Increase **THE GLOBAL COMPETITIVENESS** of the Texas Economy by **GROWING** the Extended Manufacturing Enterprise

Our Commitment To Sustainability

91,103,706
Annual kWh Reduction

49,465
Carbon (tons) MTCO2e

24,118,564
Water Reductions (gallons)

30,488
Solid Waste Reductions (tons)

In the last 19 years, our assistance has enabled customers to lower energy expenses, improve operational efficiency, implement energy-saving technologies, and reduce their environmental footprint for a total of $39,769,905 Lean/Energy/Environmental dollars saved.

SMART MANUFACTUING - Definition

According to the National Institute of Standards and Technology (NIST)

"Smart Manufacturing are systems that are fully-integrated, collaborative manufacturing systems that respond in real time to meet changing demands and conditions in the factory, in the supply network, and in customer needs."

SMART MANUFACTUING

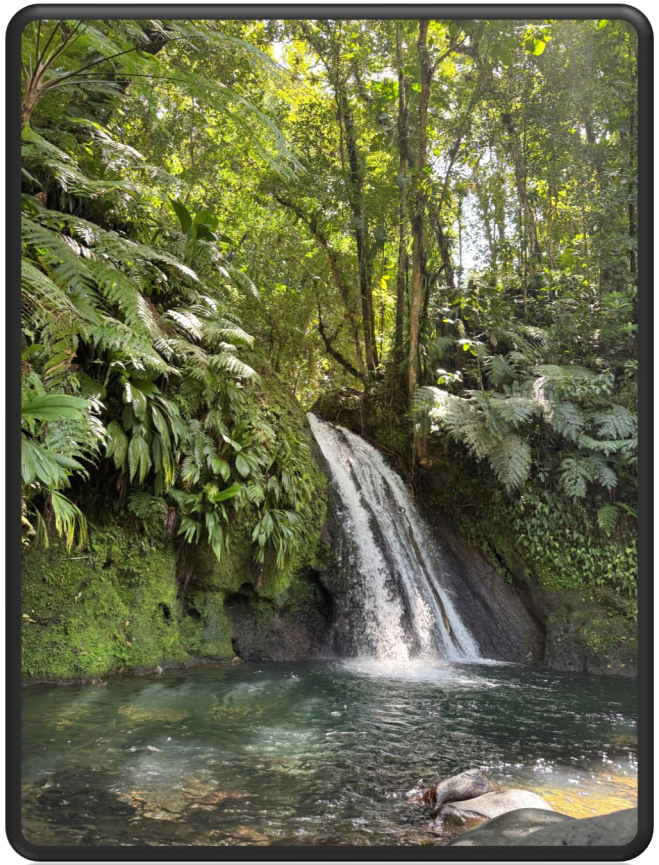
•**Real-Time Data Collection** – Use of sensors, IoT, and connected systems to monitor energy, water, emissions, and production performance continuously.

•**Intelligent Decision-Making** – Leveraging analytics, AI, and machine learning to turn raw data into actionable insights for efficiency, quality, and sustainability.

.

CLEANER ENVIRONMENT

- Environment: Surroundings in which an organization (your company, business, entity, community, etc.) operates, including:
- Air
- Water
- Land
- Natural resources
- Flora (plant life)
- Fauna (animal life)
- Humans, and their interrelation.



Lean Definition

- **“A systematic approach to identifying and eliminating waste (non-value-added activities) through continuous improvement by flowing the product at the pull of the customer in pursuit of perfection.”**

Lean Flow Exercise

Benefits of Flow

- Shorter cycle time = Increased sales
- Shorter cycle time = Less labor costs = Increased profitability
- Shorter cycle time = Less facility operation time = Reduced environmental impacts
- Shorter cycle time = Less inventory = Less scrap = Higher inventory turns
- Shorter cycle time = Less wasted movements = Lower safety risks

Defects

- Additional efforts caused by rework, scrap, and incorrect information
- Inspection and repair of material in inventory

Over Production

- Making more than is required by the customer
- Making earlier than is required by the customer
- Making a product the customer does not want

Waiting

- Interruptions to the flow of material and/or information causing delays.
- Idle time for employees or the product

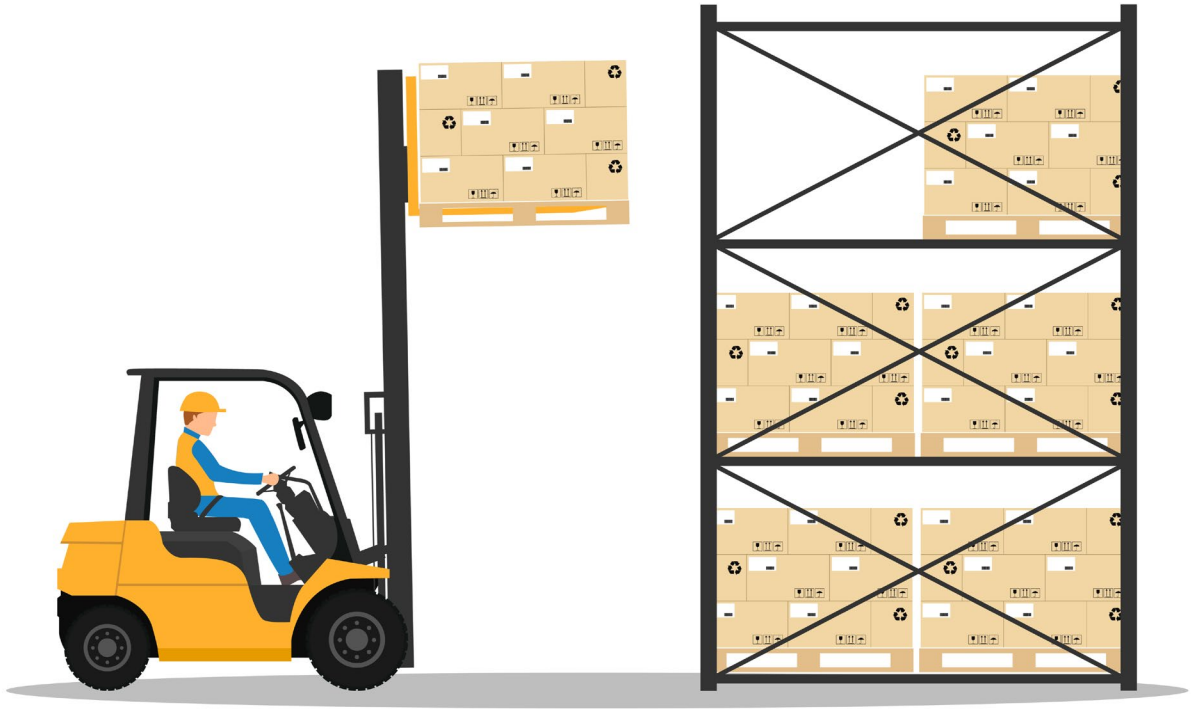
Non-Value Added

- Effort that adds no value to the product or service from the customers' viewpoint (doing more than what the customer requires)

- More work or higher quality than is required by the customer

Transportation

- Transporting parts and material around the plant



Inventory

- Any finished goods supply in excess of real customer demand
- When possible, reduce batching and stacking of materials during flow
- Reduce inventory with single piece flow when possible

Little's Law is a fundamental principle in queuing theory that relates the average number of items in a system (L), the arrival rate of items (λ), and the average time an item spends in the system (W). The law is expressed as:
$L = \lambda * W$

Motion

- Any movement of people or machines that does not add value to the product or service

Employee Utilization

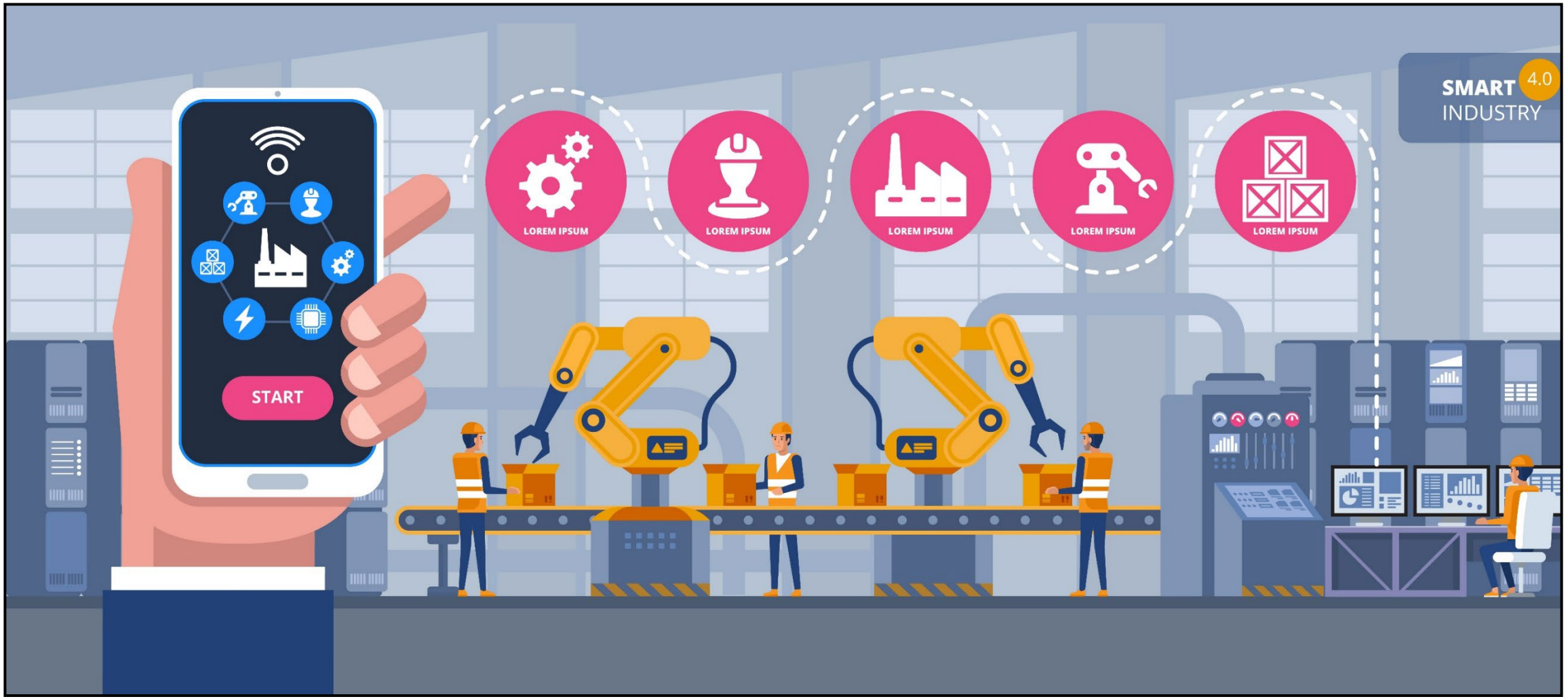
- The waste of not using people's mental, creative, and physical abilities

LEANER

- **L – Limit Waste**
  Identify and eliminate the 8 wastes (Defects, Over production, Waiting, Non-value, Transportation, Inventory, Motion, Employee utilization).
- **E – Enhance Flow**
  Streamline processes, balance workloads, and reduce downtime to keep materials and people moving efficiently.
- **A – Activate People**
  Engage employees at all levels, tap into their ideas, and build a culture of continuous improvement.
- **N – Never Stop Improving**
  Apply Kaizen, standard work, and data-driven problem solving to continuously refine operations.
- **E – Eliminate Variation**
  Use mistake-proofing, quality at the source, and standardization to reduce defects and rework.
- **R – Reduce Costs & Risks**
  Lower energy use, materials waste, safety risks, and compliance issues while boosting profitability.

Data to Decisions?

- Companies are required to constantly make decisions
  - Profits
  - Products
  - Processes
  - Technologies
  - People



Smart Factory – A connected Enterprise

Smart Manufacturing-Cameras & Sensors

Welding Operation Performance

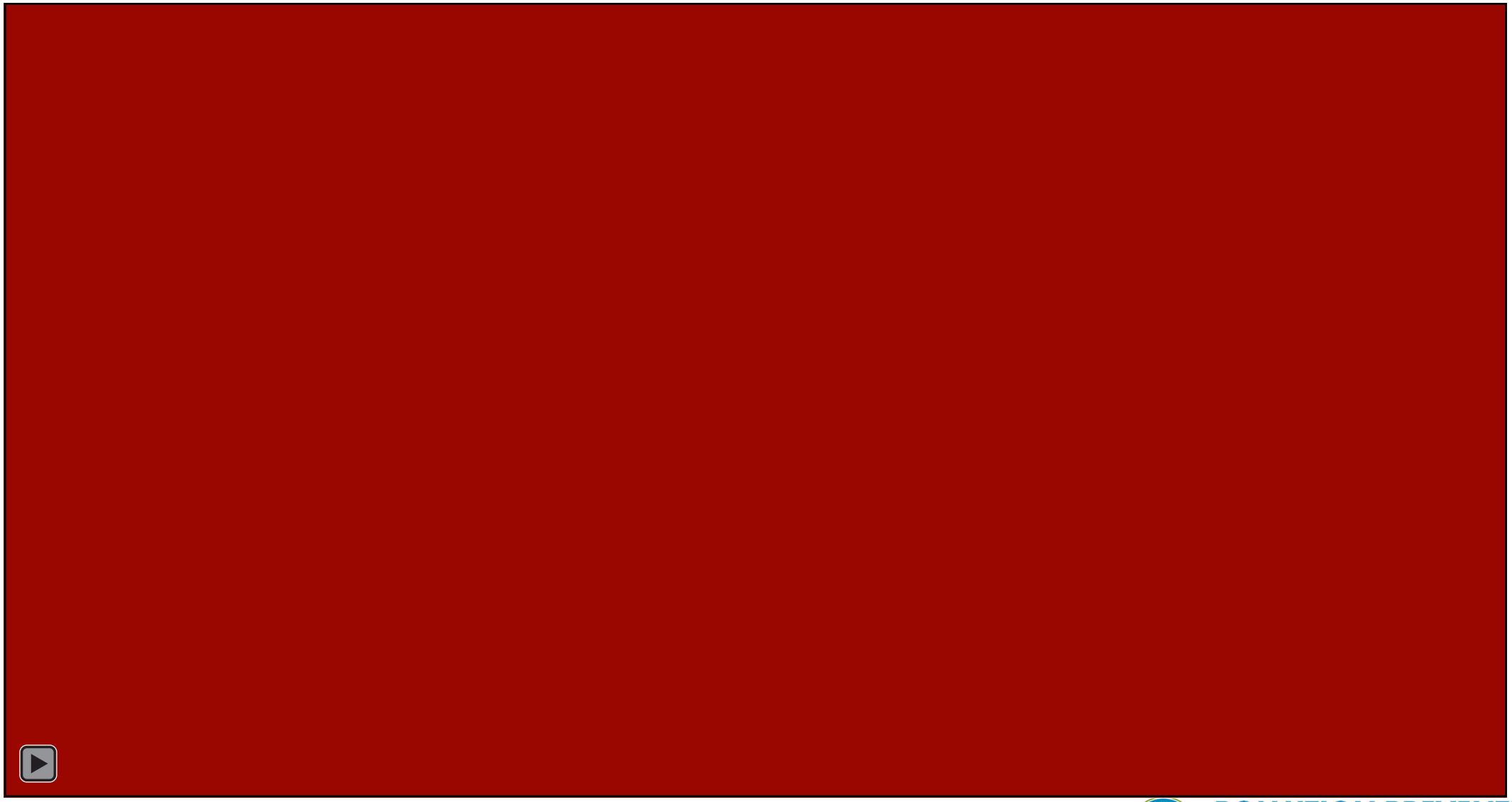
Wire Cutting Machine Performance

Drying Room Performance

Welder Operations Utilization-AI Cameras

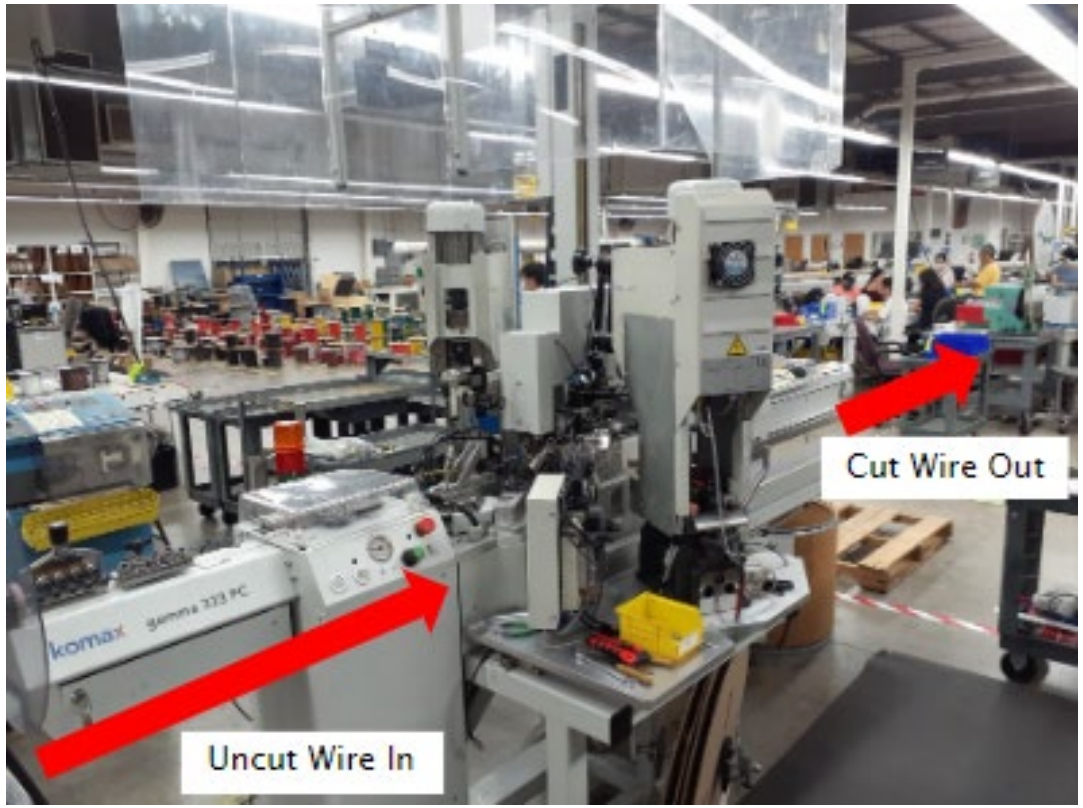
- Company welding operations not able to meet current production requirements.
  - How can I get welders to increase their productivity?

Welder Utilization - AI Cameras

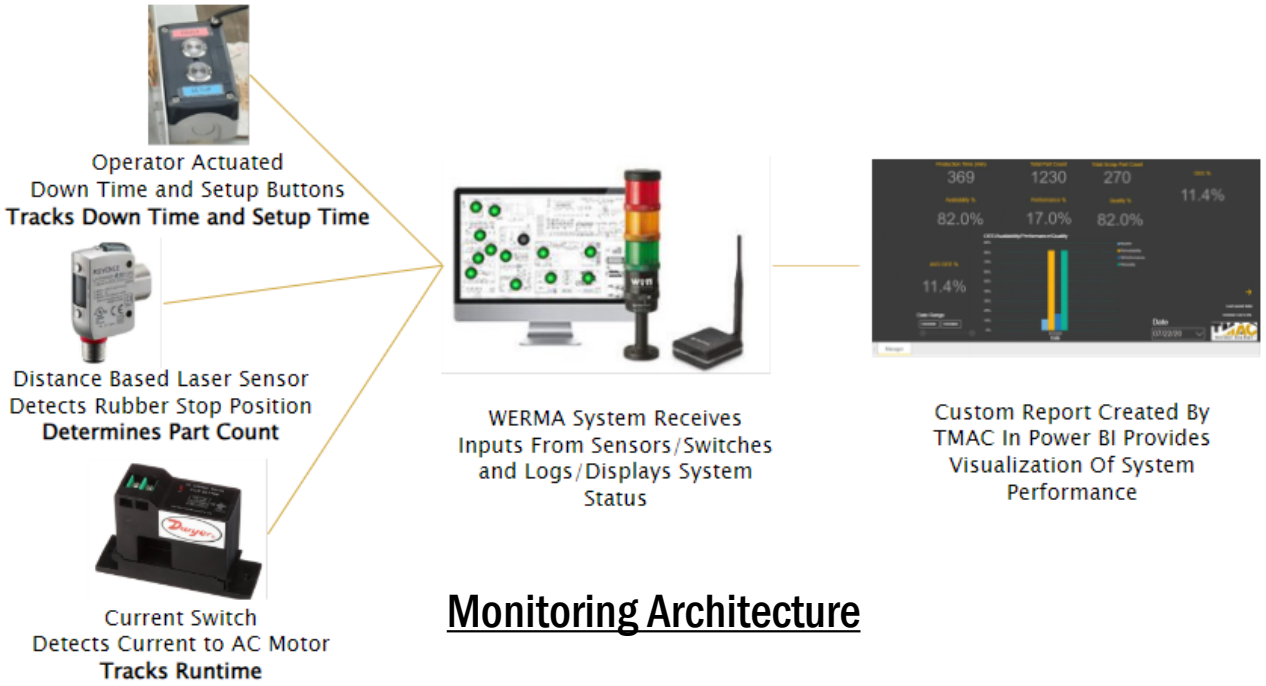


Wire Cutting Machine Performance

- Company wants to know if they should invest in a new piece of equipment.
  - What is the utilization of their current equipment?



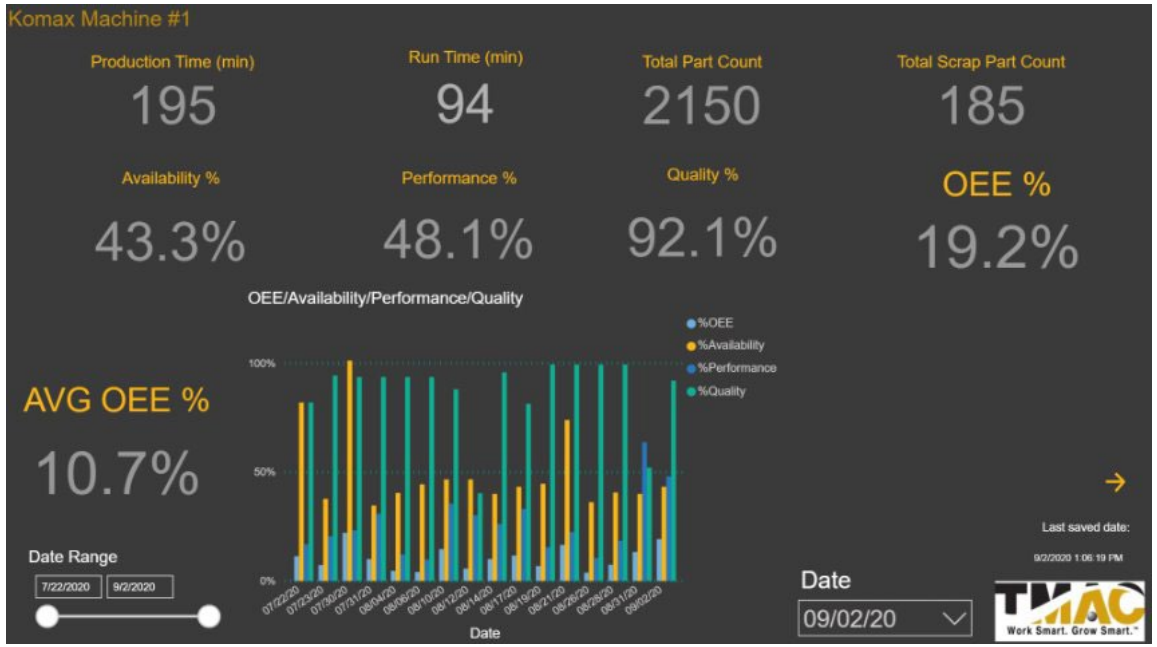
Situation



Monitoring Architecture

Wire Cutting Machine Performance

- Company wants to know if they should invest in a new piece of equipment.
  - What is the utilization of their current equipment? **Data shows 19.2%**
  - Owner can use this information to focus on changing workflow of operations to improve availability and performance



Power BI Visualization

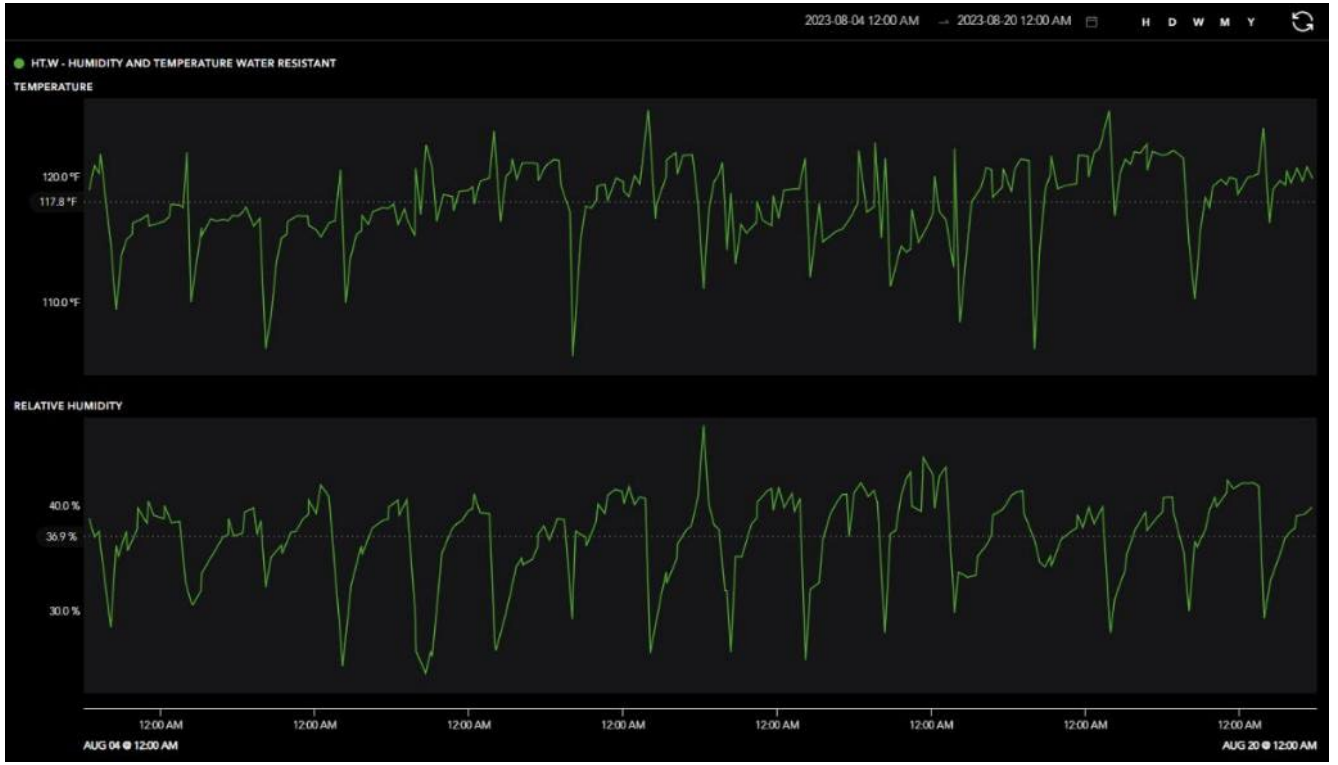
Drying Room Performance-Dog Treats

- TMAC asks questions about ways to reduce drying times.
  - How long should product stay in the drying rooms?

Product in Drying Room

Drying Room Performance-Smart Sensors

- How long should product stay in the drying rooms? Provided real time data for quality control and process engineers to use to shorten process times.



Timeseries Temperature and Humidity Data

Smart Drying with Sensors-Impacts

- Drying time reduced from 24 hours → under 2 hours
- 90% less electricity for heating → $11,970 & 133,000 kWh saved annually
- Natural gas savings: 1,805,700 CCF → $31,299 & 98.3 $MTCO_2e$ reduced yearly
- 50% faster production cycle → doubled output without new equipment or labor
- One sensor = millions in savings & major environmental benefits

Kurt Middelkoop
Kurt.Middelkoop@tmac.org
817-307-0613

Nate Sisler
Nate.Sisler@tmac.org
817-272-5128

TCEQ Environmental Excellence Award Link: TMAC Technology

https://youtu.be/WMcjgyi74Ko


TMAC
Work Smart. Grow Smart.™