Industry Extension Services

Optimizing Operations: Benefits and Types of Work Measurement

August 20, 2026

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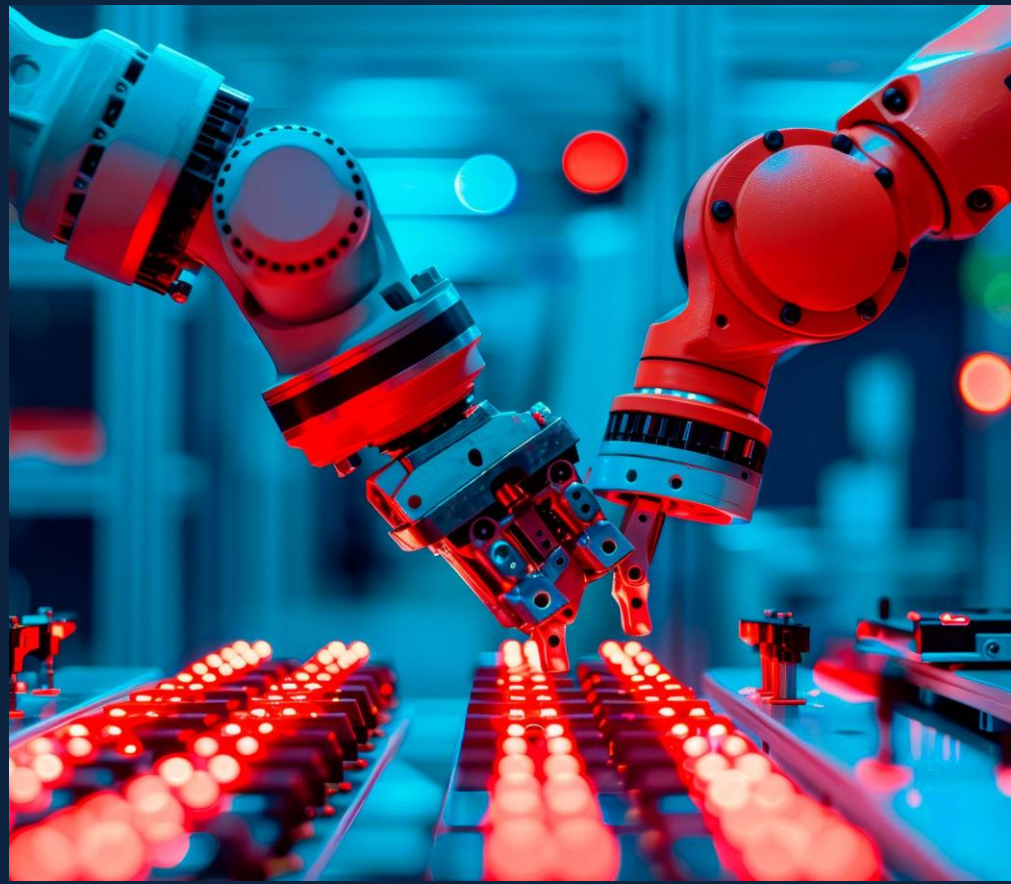

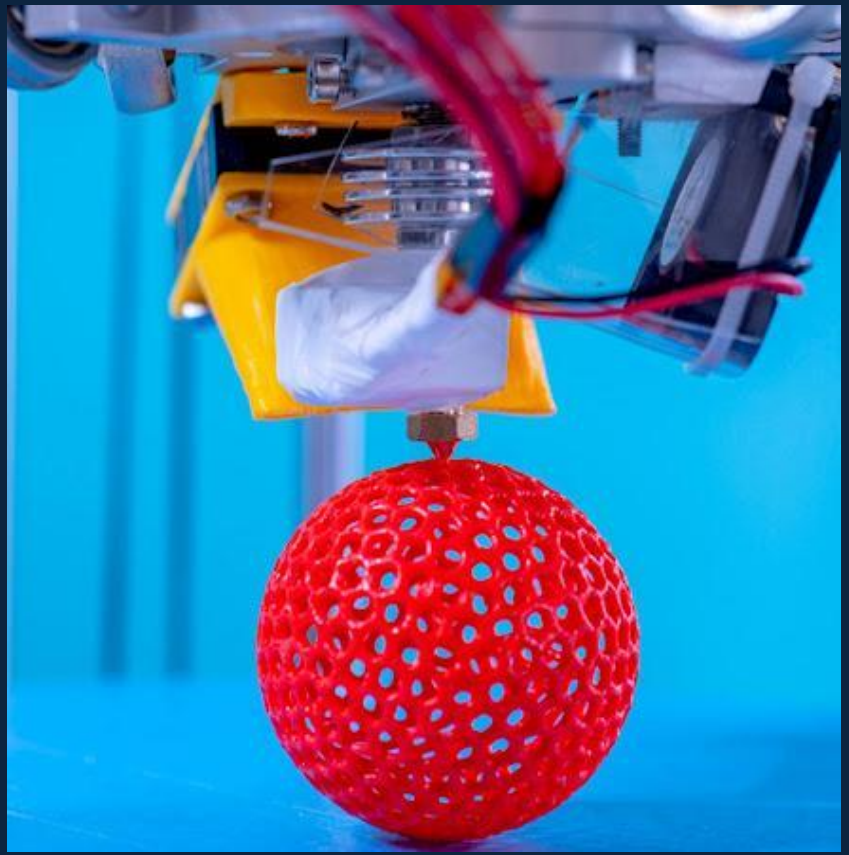

Who is Industry Extension Services?

NC State University Industry Extension Services (IES), established in 1955 as the outreach team for the NC State University College of Engineering, provides resources, tools, and customized training and coaching programs to help businesses survive, thrive, and grow.

A Public/Private Performance Model:

- State Appropriations
- Federal Funding
- Revenue-based Activities

Industries Served:

- Small-medium Size Manufacturers
- Educational and Research Institutions
- Healthcare and Pharmaceutical Companies
- Defense Contractors
- Aerospace and Energy Sectors
- Government Agencies

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Programs

- » Advanced Manufacturing & Technology Adoption
- » Business Growth, Innovation & Marketing Solutions
- » Cybersecurity Strategies
- » Defense Industry Initiatives
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- » Supply Chain Optimization + Supplier Matching
- » Talent & Workforce Development
- » Workplace Health + Safety

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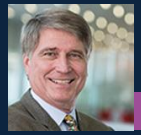

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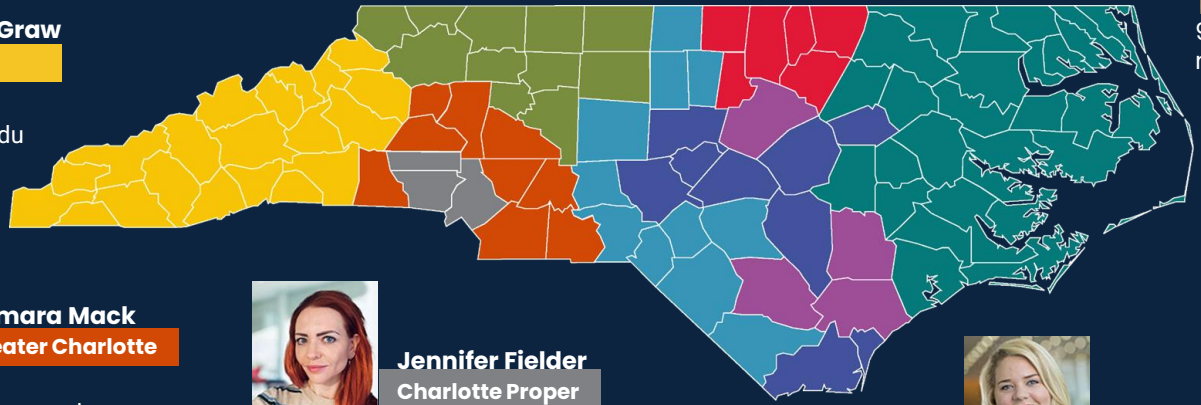

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Regional Managers

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SECTION 02

The Foundation of Work Measurement

Establishing objective baseline standards to eliminate waste, optimize labor capacity, and control manufacturing costs.

The Measurement Imperative

"You cannot manage what you do not measure."

— Attributed to Peter Drucker

— ATTRIBUTED TO PETER DRUCKER

Definition of Work Measurement

Work Measurement is the systematic process of determining the exact time and effort required for a qualified worker to complete a specific task under standard operating conditions.

Why Work Measurement?

Assess True Capacity

Establish precise baseline throughput, eliminate guesswork, and understand operational line limits across facility constraints.

Standardize Expectations

Define clear, objective, and repeatable performance standards across every shift, department, and manufacturing cell.

Drive Accountability

Directly align daily shop-floor execution with core business targets, continuous improvement, and customer promises.

Where Do We Use Time Standards?

Operations & Costing

- **Product Costing:** Calculates exact labor cost per unit.
- **Delivery Promises:** Establishes reliable customer lead times.
- **Capacity Analysis:** Determines realistic plant throughput.
- **Equipment ROI:** Validates capital machinery investments.
- **System Simulation:** Models workflows prior to implementation.

Workforce & Strategy

- **Headcount Planning:** Projects accurate labor requirements.
- **Incentive Plans:** Structures fair performance wage systems.
- **Benchmarking:** Evaluates facility output vs. industry standards.
- **Lean Six Sigma:** Feeds accurate data into continuous improvement.
- **Labor Compliance:** Supports contract and work-hour mandates.

Historical Roots: Scientific Management

Frederick Winslow Taylor

Pioneered the Scientific Management movement in the late 19th century by introducing stopwatch timing to analyze worker motions and establish standard task times.

- Focused on maximizing individual worker efficiency and scientific task design.

Frank & Lillian Gilbreth

Developed motion study analytics and micro-motion breakdown ("Therbligs"), utilizing early motion picture cameras to study body mechanics.

- Pioneered surgical efficiency techniques still used in medical operating rooms today.

SECTION 03

Operational Applications & Costing

How standardized time data fuels every core decision across accounting, scheduling, workforce planning, and continuous improvement.

Where Are Time Standards Applied? (Costing)

Product Costing & Pricing

- **Standard Labor Costing:** Calculates exact labor dollars per finished SKU.
- **Margin Defense:** Prevents underquoting low-volume or complex product variants.
- **Overhead Allocation:** Distributes plant burden based on realistic machine times.

Delivery & Capital Planning

- **Delivery Promises:** Establishes firm, reliable lead times for customers.
- **Equipment ROI:** Validates expensive capital machinery investments prior to purchase.
- **System Simulation:** Models plant layout changes digitally before deployment.

Where Are Time Standards Applied? (Strategy)

Headcount & Incentive Planning

- **Staffing Models:** Projects required labor headcount based on seasonal demand forecasts.
- **Fair Pay Systems:** Structures objective performance wage incentives and bonuses.
- **Shift Scheduling:** Prevents excessive overtime while hitting production quotas.

Governance & Lean Execution

- **Benchmarking:** Compares plant productivity against national industry standards.
- **Lean Six Sigma:** Provides accurate baseline data for continuous improvement projects.
- **Labor Compliance:** Supports union negotiations and work-hour safety mandates.

Impact of Missing Standard Times

40%

Capacity Loss Potential

When operations rely on unverified estimates or inaccurate historical averages.

Major Business Vulnerabilities

- **Inaccurate Quoting:** Miscalculated labor overhead destroys gross profit margins.
- **Unbalanced Workloads:** Unregulated cycle times create severe shop-floor bottlenecks.
- **Unpredictable Lead Times:** Missed shipments erode customer loyalty.
- **Low Asset Utilization:** Poor return on expensive capital automation.

Real-World Case Study: "Lean Without Standards"

Industry Feedback

"My employer implemented a Lean initiative over 4 years ago, yet we still rely on very rudimentary time studies—essentially just converting inaccurate pay rates into time. The result? Waste has NOT been reduced."

— IISE (Institute of Industrial & Systems Engineers) Blog

Core Takeaway

Lean tools (5S, Value Stream Mapping, Kaizen) fail to yield sustainable ROI without accurate, scientifically verified standard work times:

- ✗ You cannot balance a line using guess-estimates.
- ✗ Waste stays hidden inside padded historical standards.
- ✓ Baseline measurement must precede process redesign.

SECTION 04

Work Measurement Methodologies

A detailed breakdown of the three primary measurement approaches: Estimation, Direct Observation, and Predetermined Motion Time Systems.

Taxonomy of Measurement Techniques

1. Estimation

- SWAG (Scientific Wild Guess)
- Historical Accounting Data

Fast & cheap, but highly subjective and unsuited for precision standards.

2. Direct Observation

- Time & Motion Studies
- Work Sampling at Gemba

Real-time shop floor visibility; captures actual conditions but requires maintenance.

3. Predetermined (PMTS)

- MODAPTS
- MOST / MTM

Synthetically builds standards from micro-body motions; 100% objective.

Method 1: Estimation Techniques

Expert Opinion / SWAG

Estimates provided by experienced supervisors, engineers, or long-tenured operators without formal timing.

- ✓ High speed of application for custom job-shop quotes.
- ✗ Heavily biased by individual perspective and safety padding.

Historical Production Records

Deriving standards from previous shop floor job traveler tickets or ERP machine logging history.

- ✓ Readily available in company software systems.
- ✗ Bakes historical downtime and operational inefficiency directly into future standards.

Estimation: Trade-off Evaluation

Advantages

- ✓ **Zero Implementation Cost:** Requires no specialized timing equipment or trained industrial engineers.
- ✓ **Immediate Results:** Standards can be generated in minutes for quick customer bidding.
- ✓ **Low Complexity:** Minimal disruption to daily production floor activities.

Disadvantages

- ✗ **Highly Subjective:** Results vary wildly between estimators.
- ✗ **Inflated Times:** Padds task durations with unrecorded downtime and operator breaks.
- ✗ **Inability to Improve:** Provides no insight into motion waste or line balancing.

Method 2: Direct Gemba Observation

On-Site Operational Timing

Direct Observation involves physically going to the Gemba (where the work happens) to record operator cycle times, motion patterns, and process delays using stopwatches or digital video software.

- Captures true operating realities vs. ideal procedures.
- Fosters collaborative dialogue with frontline operators.
- Identifies non-value-added steps (NVAA) on the spot.

Stopwatch Study vs. Work Sampling

Stopwatch Time Study

Continuous Observation: An analyst continuously times a qualified operator over multiple consecutive cycles to calculate normal and standard times.

- Best for short-cycle, highly repetitive manufacturing.
- Yields precise elemental time distributions.

Work Sampling

Discrete Observation: Collecting a large volume of instantaneous, random observations over time to determine percentage activity breakdown.

- Ideal for long-cycle, non-repetitive, or multi-operator work.
- Excellent for measuring machine utilization and idle time.

Direct Observation: Trade-off Evaluation

Advantages

- ✓ **Real Gemba Data:** Evaluates exact operating conditions and ergonomic challenges.
- ✓ **High Accuracy:** Delivers precise statistical confidence intervals.
- ✓ **Operator Engagement:** Promotes trust through open communication with shop floor teams.

Disadvantages

- ✗ **Hawthorne Effect:** Workers may alter their natural pace when observed.
- ✗ **Performance Rating Bias:** Requires subjectively rating operator pace.
- ✗ **Labor Intensive:** High analyst time cost to capture and document cycles.

Method 3: Predetermined Time Systems

MODAPTS

Modular Arrangement of Predetermined Time Standards. Uses simple 1-MOD units (0.129 sec) for rapid, highly intuitive motion analysis.

MOST

Maynard Operation Sequence Technique. Focuses on sequence models of object movement (General Move, Controlled Move, Tool Use).

MTM

Methods-Time Measurement. The foundational micro-motion system analyzing reaches, grasps, moves, and releases in TMUs (100,000/hr).

PMTS: Trade-off Evaluation

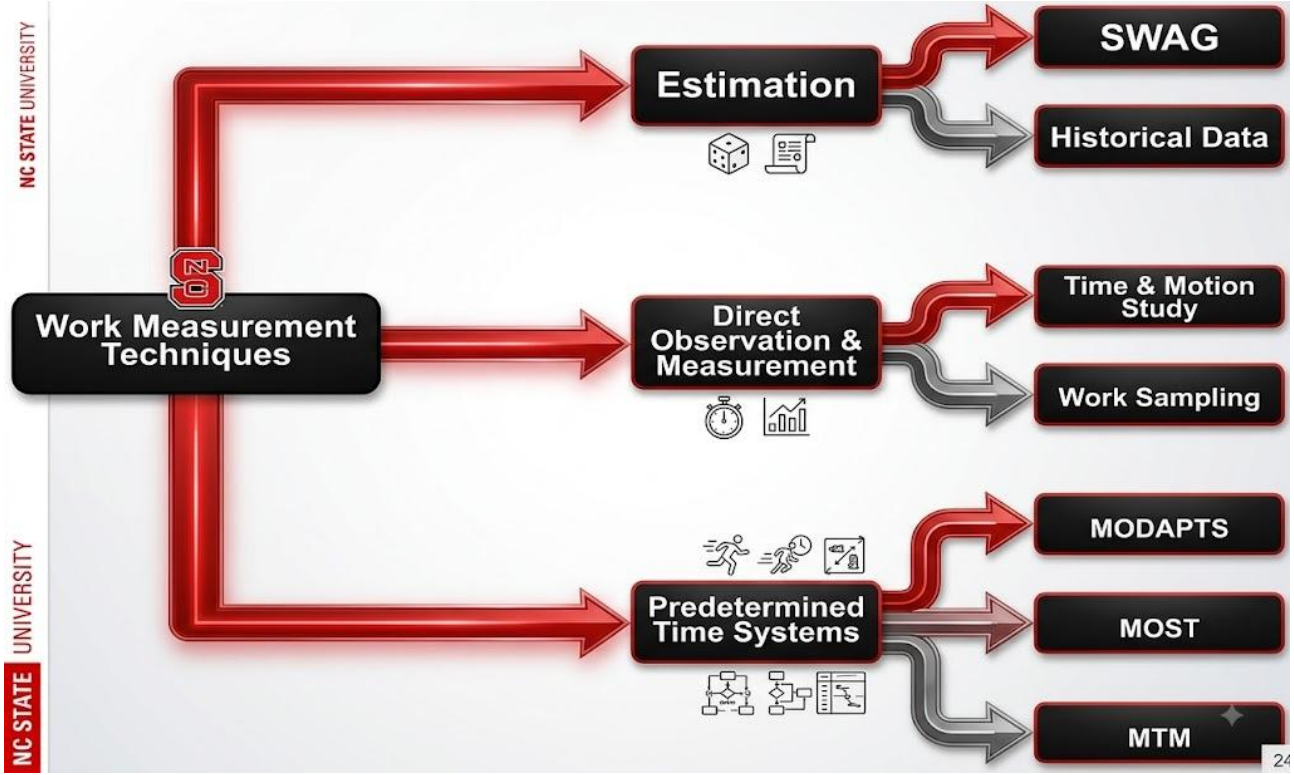
Advantages

- ✓ **100% Objective:** Completely eliminates subjective pace rating and stopwatch bias.
- ✓ **Pre-Production Capability:** Establishes labor standards during product engineering design.
- ✓ **Method Improvement:** Directly exposes excess body reaches, bends, and re-grasps.

Disadvantages

- ✗ **Human Motion Only:** Does not calculate machine processing or chemical cure times.
- ✗ **Training Requirement:** Requires certified practitioners to code motion sequences.
- ✗ **Non-Repetitive Unsuited:** Economically unfeasible for custom, low-volume jobs.

Work Measurement Methods



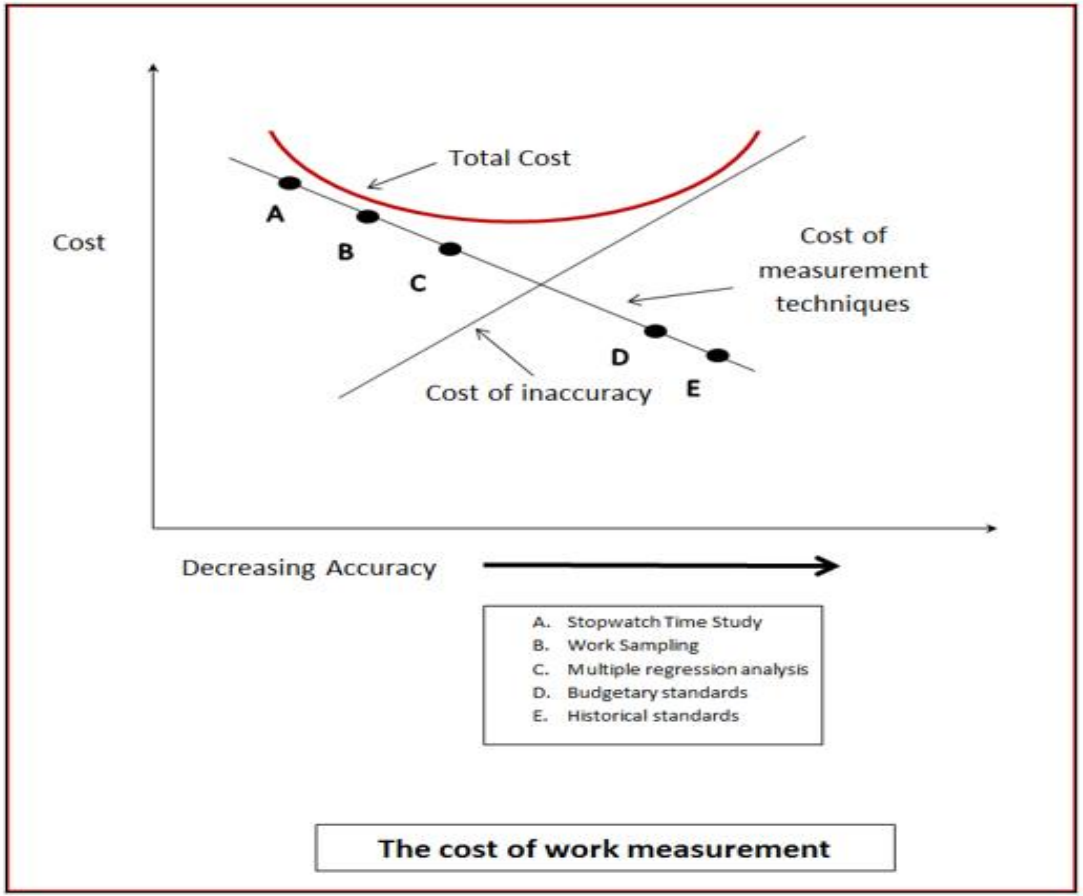
Which Method?

VOLUME	CYCLE TIME	RECOMMENDED TECHNIQUE
1000'S	LONG	Work Sampling
	MEDIUM	Work Sampling, Time & Motion Study
	SHORT	PTSS
100'S	LONG	Work sampling, Time & Motion Study
	MEDIUM	Time & Motion Study, Work Sampling
	SHORT	PTSS , Time & Motion
10'S	LONG	SWAG, Work sampling, Historical Data
	MEDIUM	SWAG, Historical Data
	SHORT	Time & Motion Study

KEY CONSEQUENCES ACROSS THE BUSINESS

- Inaccurate Quoting & Margins
- Unbalanced Workloads & Bottlenecks
- Unpredictable Lead Times & Damaged Trust
- Poor Equipment & Labor Utilization

Cost of Work Measurement



Technology Integration: Timer Pro & AI Video

Digital Video Analytics

Modern work measurement utilizes digital video capture tools (e.g., Timer Pro) to revolutionize traditional stopwatch timing:

- Frame-by-frame Gemba activity analysis.
- Instant line balancing with Toyota Yamazumi charts.
- Automated Standard Work Instruction sheet generation.

Measurable Plant Impact

Bridging the gap between engineering measurement and shop floor daily execution:

- **70% Faster** study documentation speed.
- Visual ergonomic risk identification for operator safety.
- Direct ERP integration for standard cost updating.

Three Pillars for Operational Excellence

1. Method First

Standardize and optimize the process before measuring. Quality inputs prevent "garbage in, garbage out" standard times.

2. Match Strategy

Balance accuracy against measurement overhead by selecting the proper tool (PMTS, Observation, or Sampling) based on volume.

3. Leverage Video AI

Utilize modern video analytics software (e.g., Timer Pro) to capture Gemba execution, balance lines, and update work instructions.

Engineering Student Projects

Connecting NC State Engineering talent with real-world industry challenges

NC STATE EXTENSION

All Engineering Disciplines

- **Cross-Functional Talent:** Industrial, Mechanical, Electrical, Chemical, Computer Science, and Materials Science.
- **Customized Alignment:** Project teams tailored specifically to your plant's operational challenges.

All Experience Levels

- **Senior Project Leads:** Upper-level capstone seniors drive technical analysis, modeling, and system design.
- **Underclassmen Support:** Underclassmen assist with Gemba observations, time studies, and raw data capture.

Faculty & IES Supervision

- **Expert Mentorship:** Every student team is directly guided by NC State IES engineering advisors.
- **Quality Assured:** Guarantees rigorous, industry-standard methodology and actionable deliverables.

Realized Industry Value

- **Zero/Low Cost Solution:** High-caliber engineering analysis without heavy consulting fees.
- **Pipeline for Talent:** Evaluate potential future engineering hires in your plant environment.

Host a Student Project: Gain immediate Gemba time studies, line balancing, and capacity optimization for your plant.

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NC STATE INDUSTRY EXTENSION SERVICES

Thank You for Your Time!

Ready to optimize your operations? Connect with our statewide engineering team.

PRESENTER

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