Instrument Mechanical Integrity and Reliability

Setting the foundation for long term **sustainability, s**afety and competitive advantage

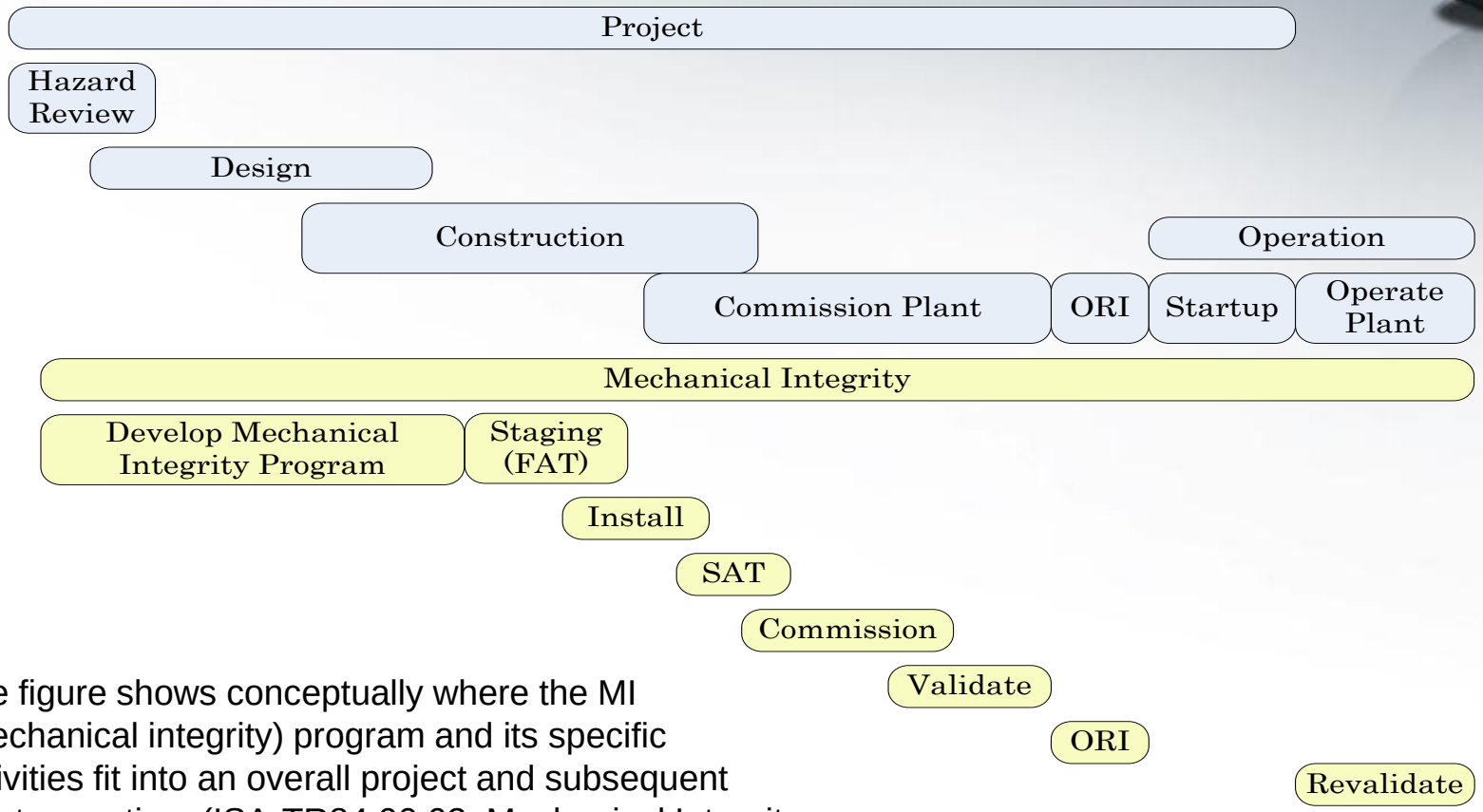
Objectives

- Establish purpose of instrument reliability program
- **Identify the key program elements**
- Understand the barriers to the program
- **Identify target metrics**
- **Show preliminary benchmarking results**
- **Identify causes of gaps**
- **Build support through understanding**
- Learn techniques to drive reliability improvement
- **Communicate plans for path forward**

Two Components

- Mechanical Integrity (The Foundation)
  - Equipment is properly designed, installed, commissioned, documented and maintained across the life cycle to enable a specified performance
- Reliability
  - (With sound MI) equipment performs its required function under the specified conditions for a specified time (mission time)
  - If equipment does not meet this mission time we need good data to determine why

MI Lifecycle



The figure shows conceptually where the MI (mechanical integrity) program and its specific activities fit into an overall project and subsequent plant operation. (ISA-TR84.00.03: Mechanical Integrity of Safety Instrumented Systems (SIS)

Why Instrument Reliability?

- Instrumentation is the process central nervous system
  - Ensures Safe and Reliable Operations
  - Ensures Product Quality and Customer Satisfaction
  - Optimizes Production Capability
    - Process Uptime/Availability
    - Product Waste
    - Energy Efficiency
    - Maintenance Effectiveness
- *Healthcare* for Instruments

Who Cares?
OSHA

- 1910.119 (j)(6) Quality assurance.
  - In the construction of new plants and equipment, the employer shall assure that equipment as it is fabricated **is suitable for the process application** for which they will be used.
  - **Appropriate checks and inspections** shall be performed to assure that equipment is installed properly and consistent with design specifications and the manufacturer's instructions.

Who Cares?

IEC 61511/ISA 84.00.01

- Clause 5.2.5.3
  - Procedures shall be implemented to **evaluate the performance** of the safety instrumented system against its safety requirements
- Clause 11.5.3.1
  - Appropriate evidence shall be available that the components and subsystems **are suitable** for use in the safety instrumented system.
- Clause 16.3.1.5
  - At some periodic interval (determined by the user), **the frequency of testing shall be re-evaluated** based on various factors including historical test data, plant experience, hardware degradation, and software reliability.

The Evolution of Instrument Reliability

- The Early Days
  - Fix It When It Breaks
- Present Day
  - Scheduled PPM with (?) value
- What we Want
  - Condition based maintenance
- But how do we know??
  - Are you doing too much or not enough?
  - Is it done at the right time?
  - Where's the "herd"? (Ken Bond—Shell)

Where Should We Begin?

- Survey Says: Some results from November Survey….

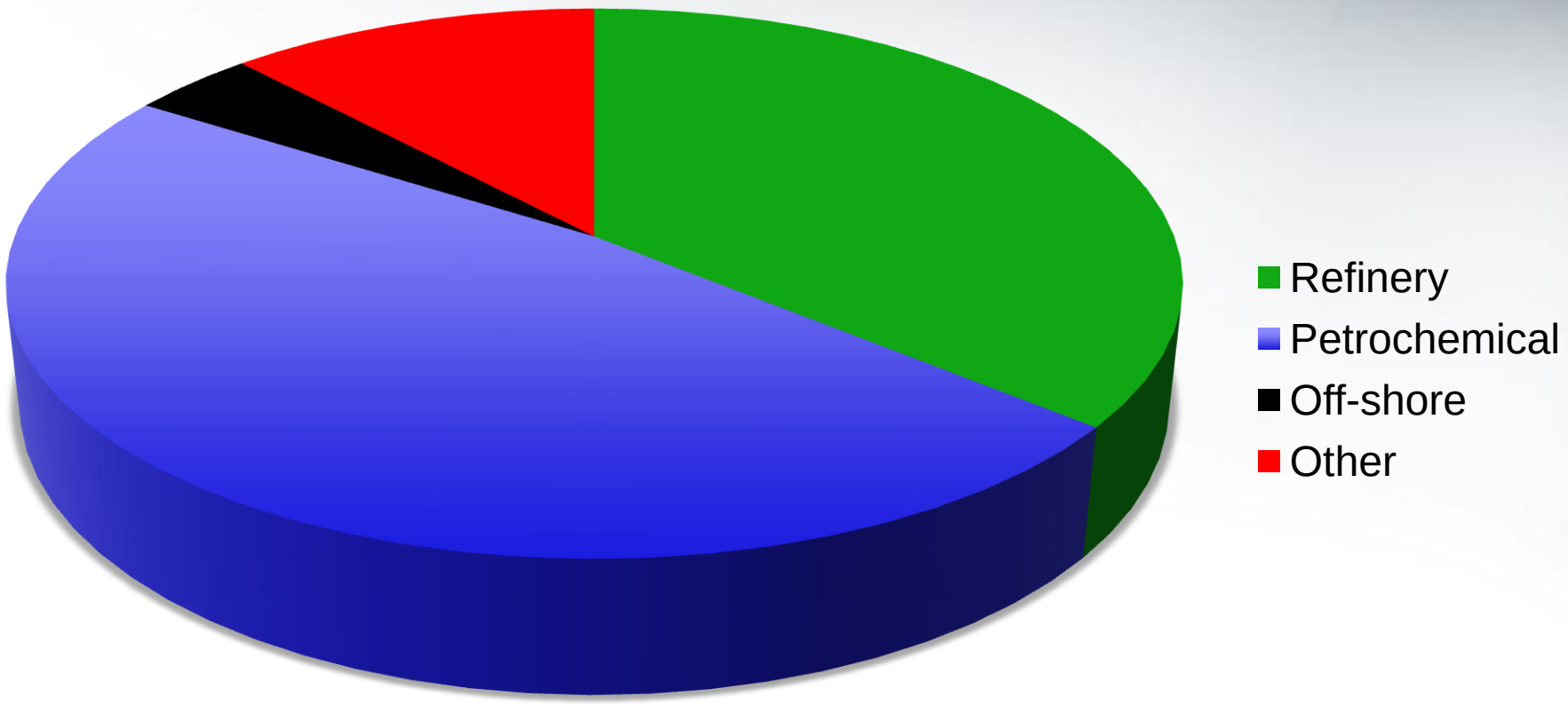
- But First…….

  ……..Do we have anything against which we can “gauge” our current performance??

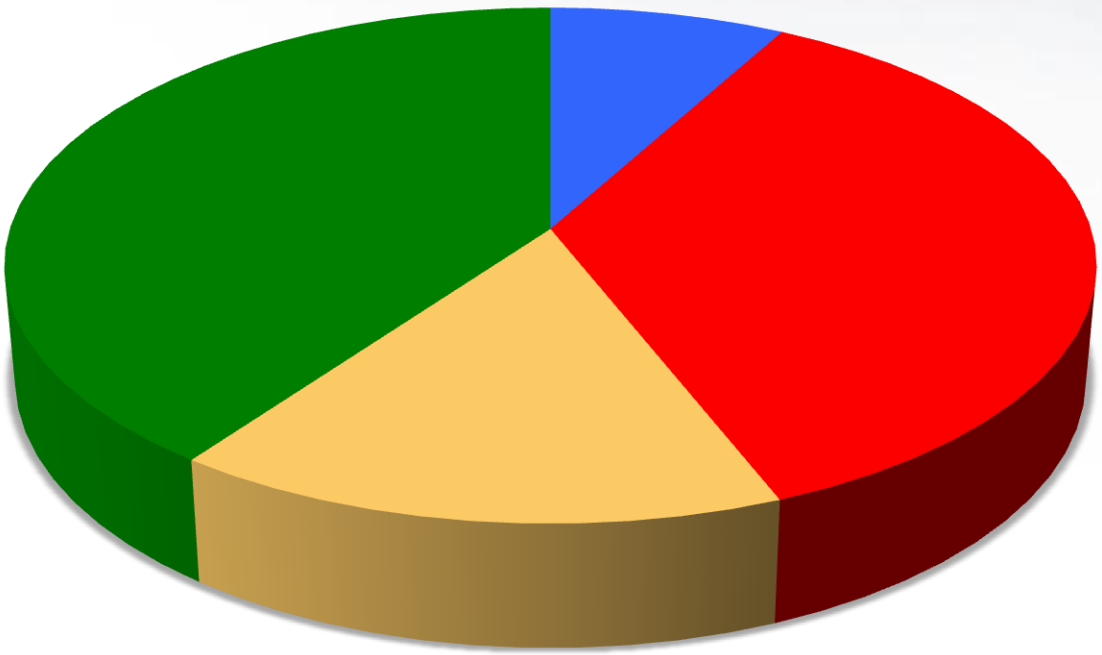
Materials Technology Institute (MTI)

- World Class Performance from MTI 2003-2004
  - Maintenance $ spent vs. Replacement Asset Base
    - Target: <3% overall equipment
  - Instrument Work Orders closed as “no problem found”
    - Target: <5%
  - Percent of Instrument Overdue Work Orders
    - Target: 0%
  - Percent overtime spent by Instrument Mechanic
    - Target: 5-10%
  - Percent time spent by Instrument Mechanic in training
    - Target: 7-10%

Survey Responses - Distribution

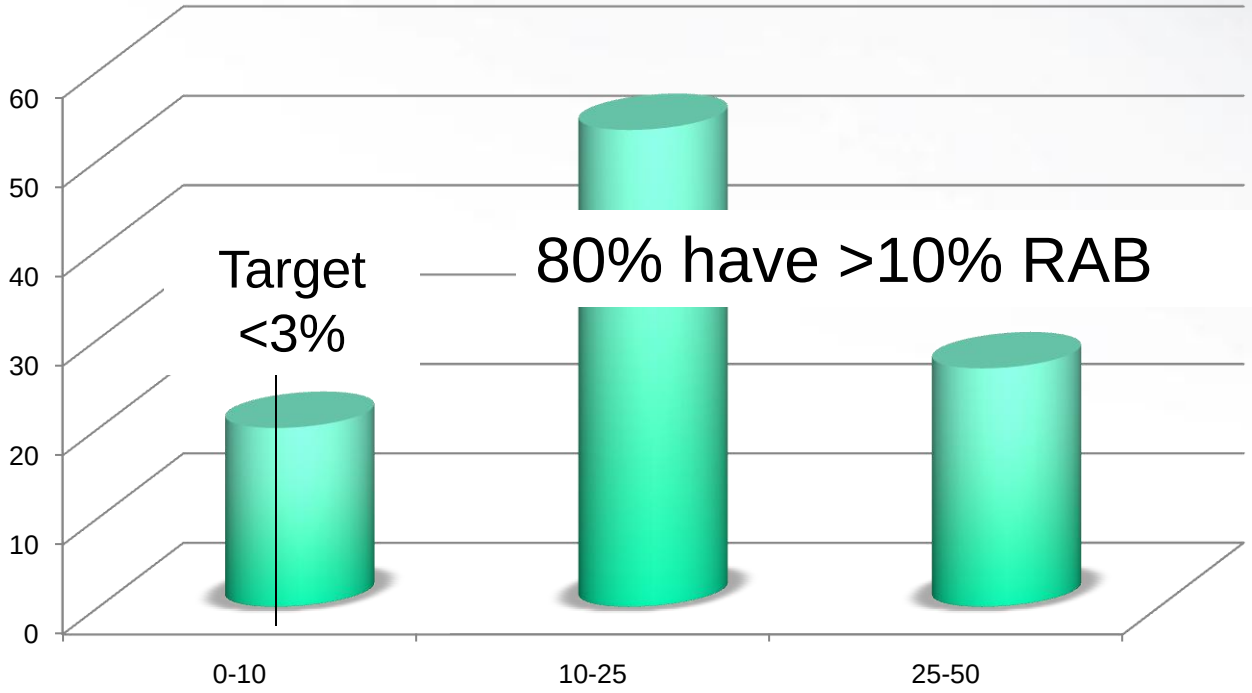


Survey Responses - Disciplines



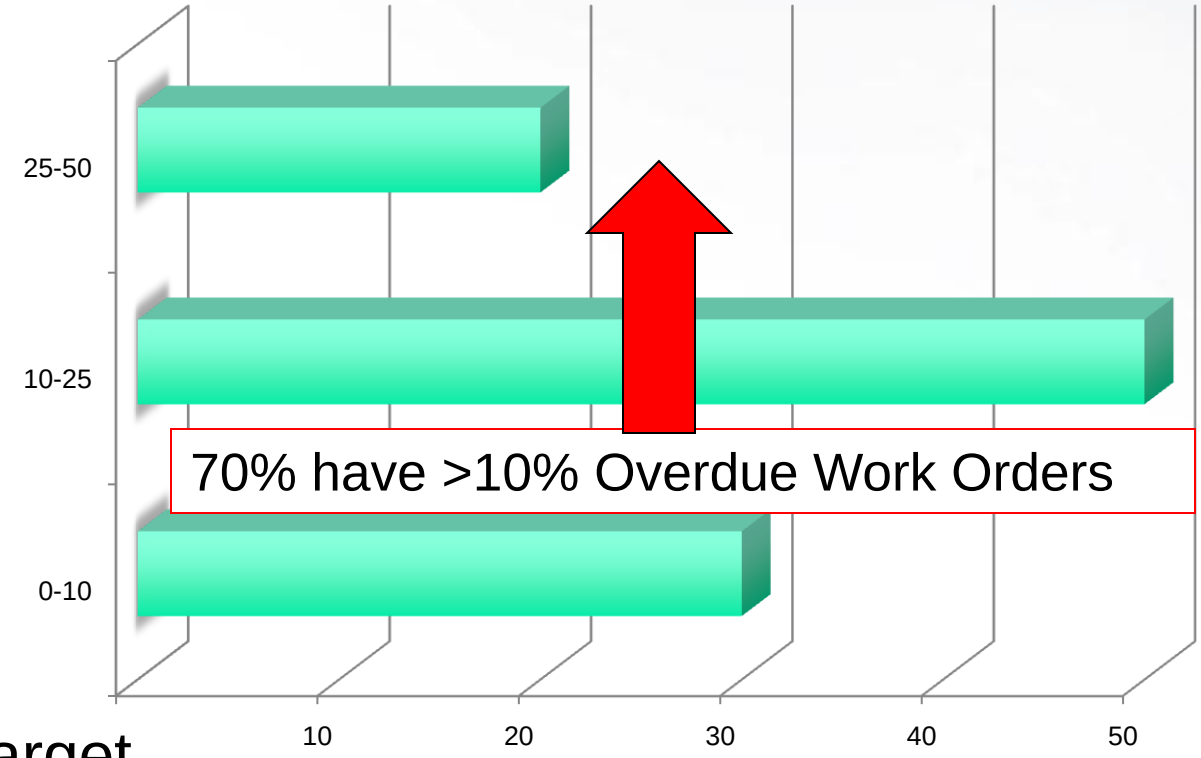
Maintenance $ Spent vs RAB

- Indicates maintenance cost is high relative to asset value



Percentage Overdue Work Orders

- Indicates scheduling deficiencies are widespread

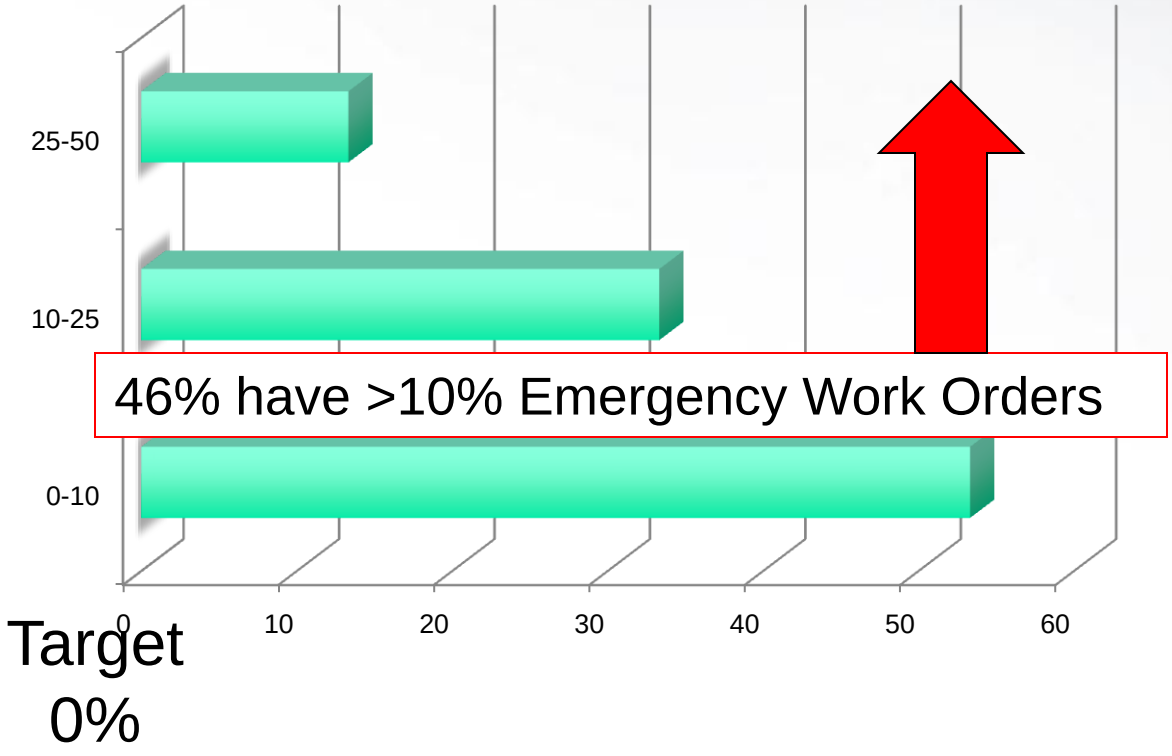


snowball rolling down hill

Target
0%

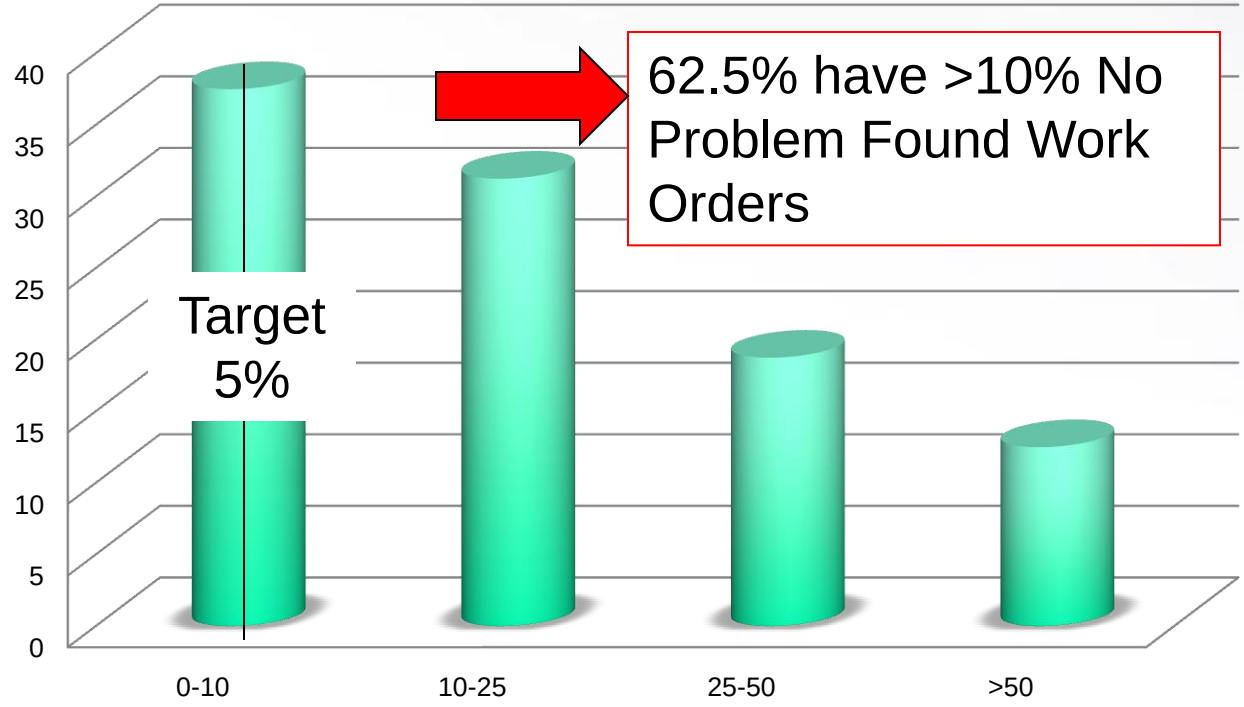
Percentage Emergency Work Orders

- Indicates maintenance deficiencies are widespread



Instrument Work Orders closed as “no problem found”

- Indicates problems with diagnostics, training, work processes and documentation

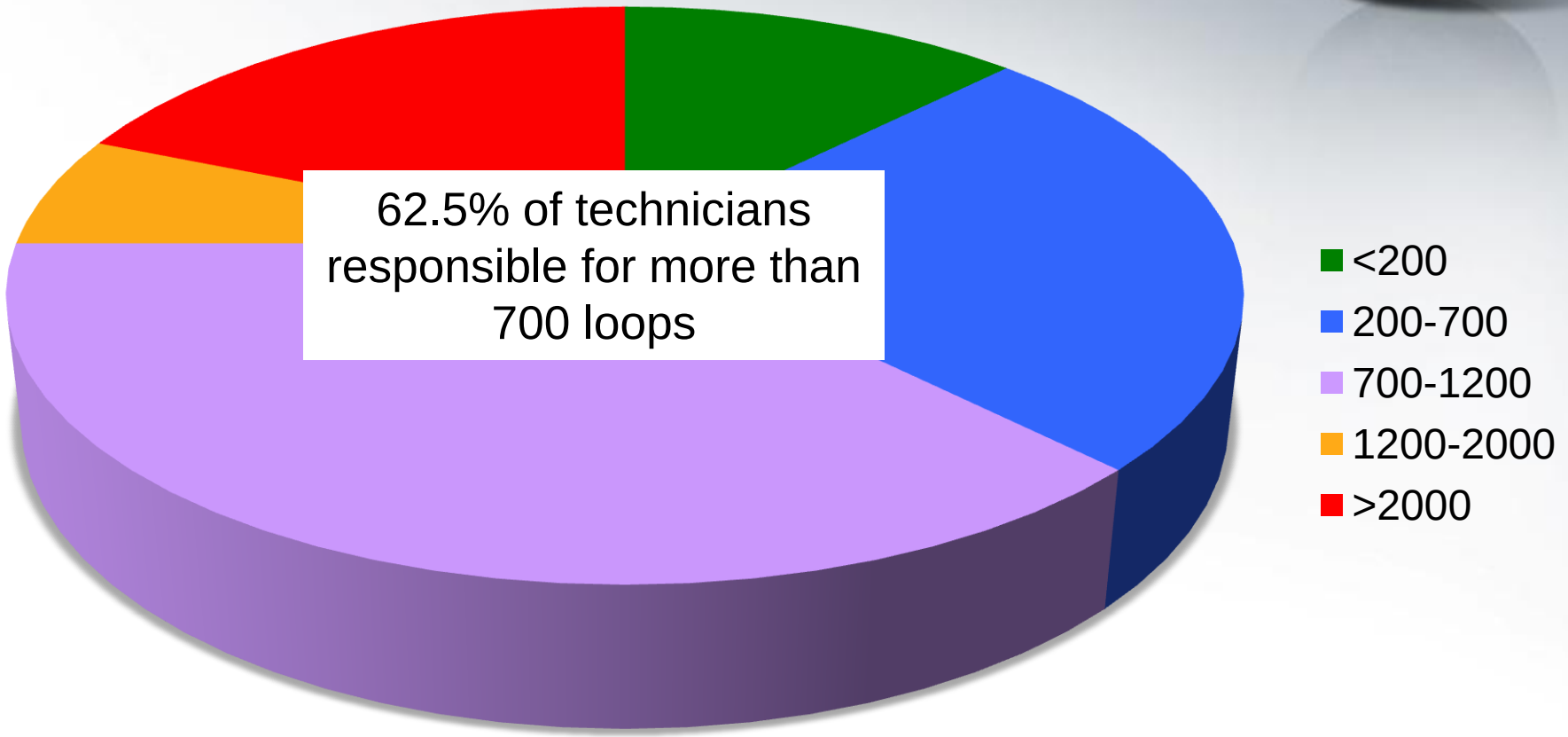


Boy wh

Will they ignore it when its real?

Instrument Technician Work Load

- Indicates high work load expectation

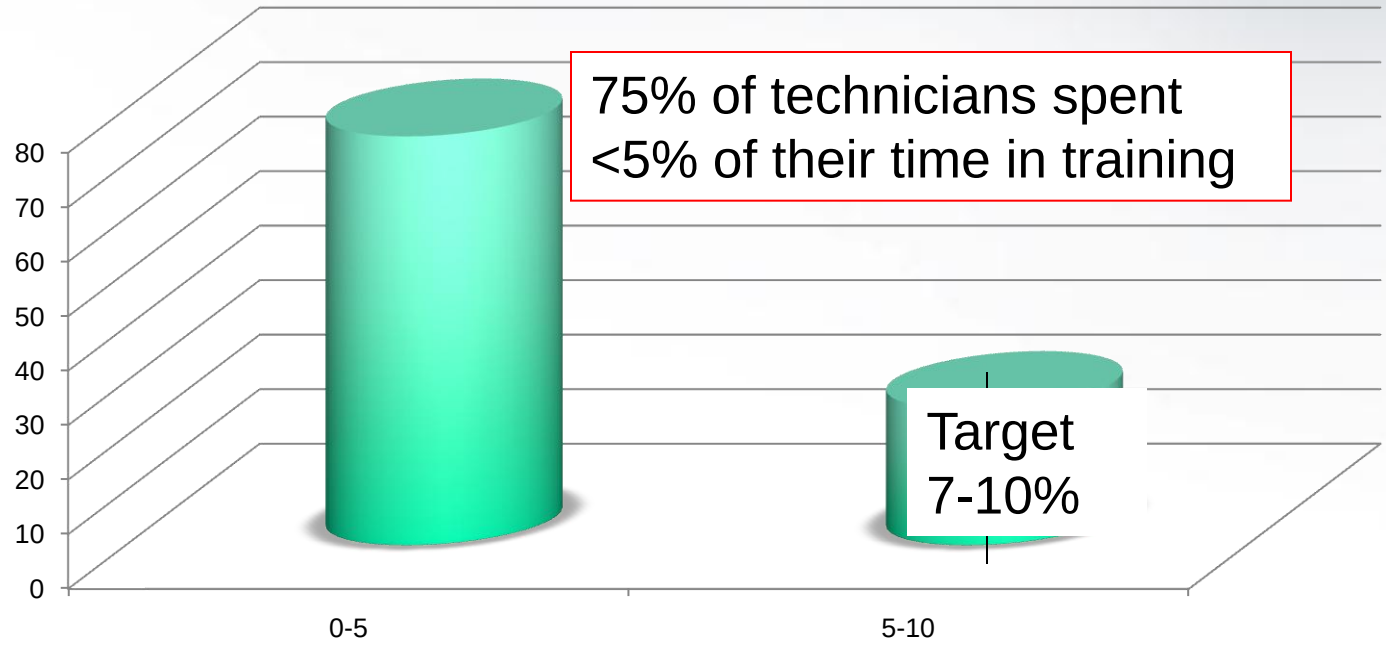


<10% overtime: 44%
>10% overtime: 56%

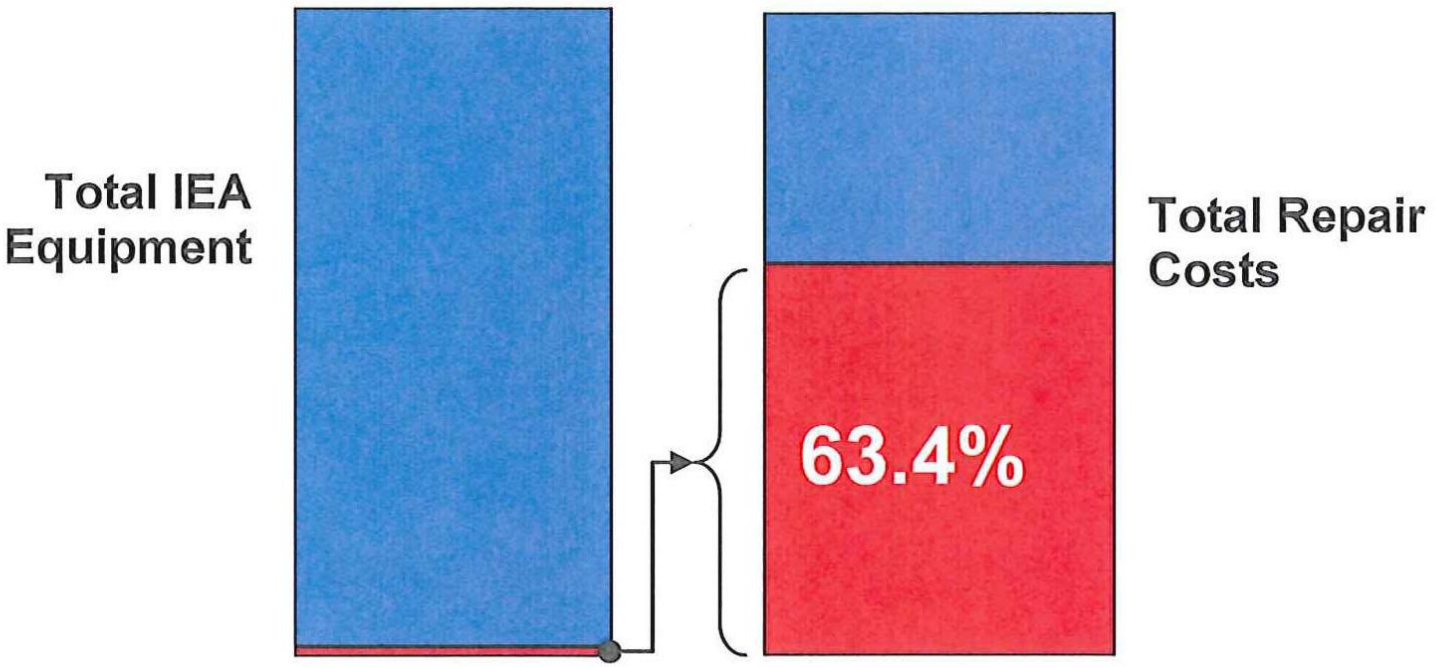
Small amount of overtime is generally expected and accepted, while high amounts have a negative effect

% Time Spent in Training

- Indicates inadequate training time



Impact of Repeat Offenders



1.3% Repeat Offenders Account for 63.4% of all IEA Repair Cost!

*From paper presented at the 2011 Texas A&M Instrument Symposium: How to Create an Instrument Reliability Program by John Thibodeaux and Marcus Rideaux of The Dow Chemical Company

What Keeps Us From Knowing

- Poor data integrity and quality
- Poor information availability and consistency
- Lack of broad understanding and consistency
- Poor or missing internal practices and procedures
- Poorly understood compliance expectations
- Inadequate revision control or notification of changes
- Lack of comprehensive training on data, information, procedures & documentation practices, and **ownership**

*CCPS IPS Book 2007

Key Elements of Instrument Reliability Program

- People - Accountabilities
  - Engineering
  - **Maintenance**
  - Operations
- Equipment - Tools
  - Engineering/Design Databases
  - Computerized Maintenance Management Systems
  - I/A Smart Asset Management
  - Approved equipment list
- Work Processes – Procedures
  - Engineering
  - Maintenance
  - Operations

Moving Toward Sustainability

- Develop Strategy and Plans
  - To Improve multi-discipline work process interaction and accountability
  - Enforce Life Cycle Documentation Integrity
  - To capture, categorize and analyze data

Moving Toward Sustainability

- Improve Equipment
  - **63% did not track infant mortality after installation**
  - 50% did not track Mean Time Between Work Orders or Mean Time Between Failure
  - **27% did not have a process for tracking bad actors**
  - **42% did not track production impact due to instrument failures**

You cannot improve what you don't monitor!

Moving Toward Sustainability

- Improve work practices
  - **53% had no defined process for transferring data from design to maintenance database**
  - **Who's the master? Do you know?**
    - 42% design database
    - 58% maintenance database
  - 21% used the same MI process for all equipment regardless of criticality

Gain efficiency through consistent work practices!

Moving Toward Sustainability

- Improve People Management
  - Training
    - 75% invested less than 5% in training yet expect to get the right information from people in the trenches (targeted/customized)
  - Failure Documentation
    - 48% do not use standard failure codes

Quality Assurance begins and ends with people!

This Is A Journey: Begin with fixing the obvious

- Capital Projects and Plant Improvements
  - Process parameters and ambient conditions
  - Incorporate maintenance strategy in design (IPA VIP?)
  - Who is watching your packaged equipment design and fabrication?
  - Storage prior to installation
  - Detailed commissioning plan

This Is A Journey—Begin with fixing the obvious

- Maintenance and operations
  - Find available sources of information
    - Work/repair notifications
    - Maintenance Tech notes/interviews (notes in the file drawer)
    - Asset management system records
    - Process Historian/Alarm Log
    - Emergency and overdue work orders
  - Are you closing this loop?

This Is A Journey—Begin with fixing the obvious

- Maintenance and Operations
  - Largest Technology Family Grouping of Work Orders
    - Probably Valves and/or Analyzers
      - Usually Systematic in Failure
      - Sizing process parameter “inflation”
      - Bug screens
      - Solenoid valve exhaust orientation
      - Painters
      - Insulators
      - Sample systems
      - Operator and other’s actions

This Is A Journey—Looking down the road

- Getting everyone on the same page comparing “apples” to “apples”
  - Failure type
  - Failure mode
  - Failure cause
  - Failure mechanism
  - Retiring records (CMMS)
  - Establishing the master documentation repository
    - Data transfer from design engineering to CMMS
    - Trusted information you can count during RCI, Audits
    - Records management

This Is A Journey—Looking down the road

- Growing an industry instrument reliability network—manufacturers, service providers and end users
- Start with individual components build toward system improvement and reliability growth
- Sharing data within industry—are you with the herd?

Conclusion

- Questions
- Discussion
- What’s Next