w3.1- Maintenance Programs (4:35)

w3.1- Maintenance Programs (4:35).mp4

Maintenance

- Breakdown maintenance
- Preventative maintenance
  - Lubrication
  - Cleaning
  - Adjustment
  - Inspection
  - Replacement of worn parts
- Trade off's required

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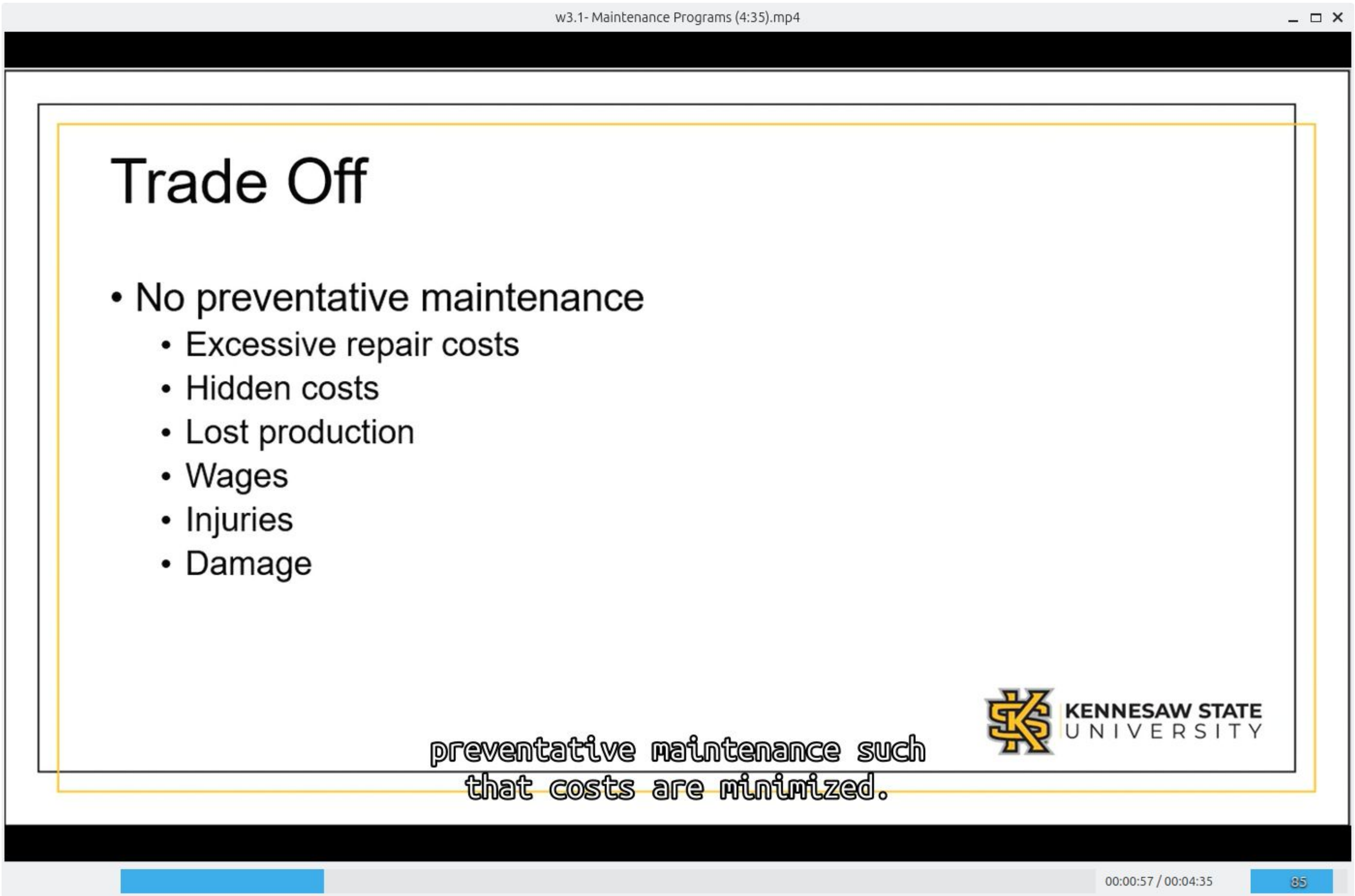
00:00:26 / 00:04:35

85


w3.1- Maintenance Programs (4:35).mp4
Trade Off
• No preventative maintenance
• Excessive repair costs
• Hidden costs
• Lost production
• Wages
• Injuries
• Damage
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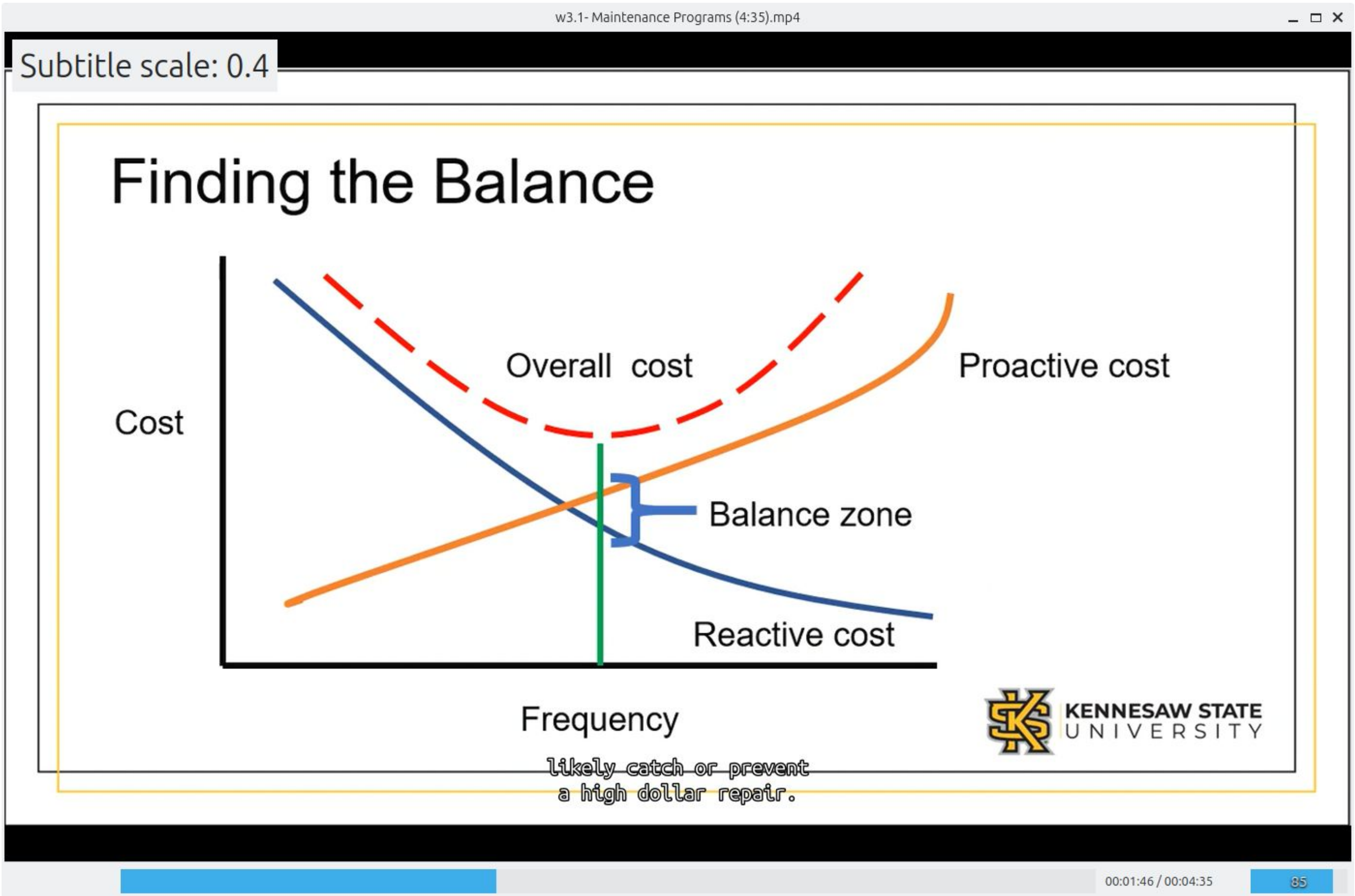
preventative maintenance such
that costs are minimized.
00:00:57 / 00:04:35
85


w3.1- Maintenance Programs (4:35).mp4
Subtitle scale: 0.4
Finding the Balance
Overall cost
Proactive cost
Cost
Balance zone
Reactive cost
Frequency
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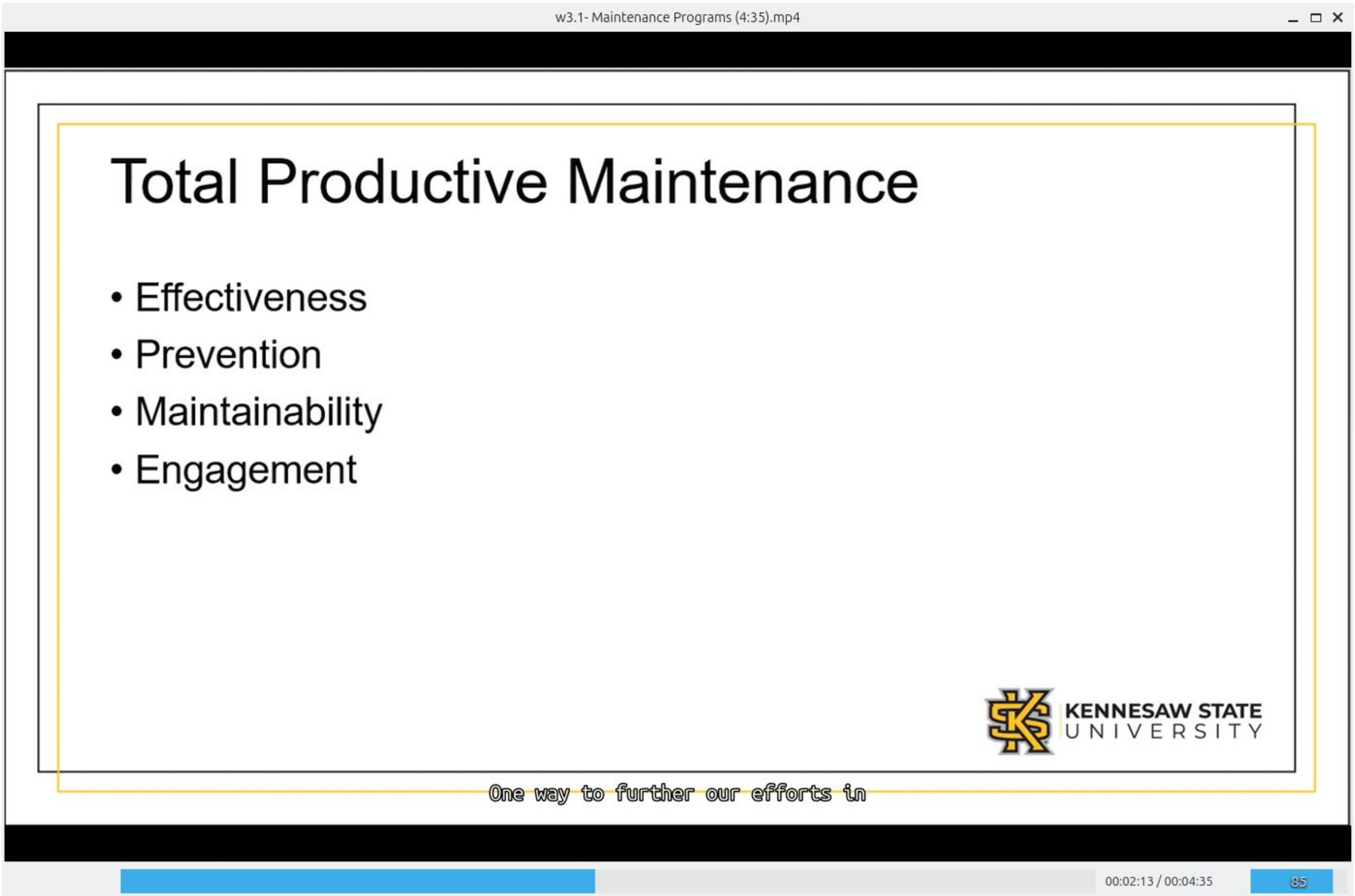
likely catch or prevent
a high dollar repair.
00:01:46 / 00:04:35
85

Breakdown of the Cost Curves

The graph shows how cost fluctuates based on the **frequency** of monitoring or proactive action:

- **Reactive Cost (Blue Line):** This represents the cost of failures, defects, or repairs. As frequency of monitoring increases, these costs drop because problems are caught early.
- **Proactive Cost (Orange Line):** This represents the "burden" mentioned in the transcript—the cost of testing, oversight, and operator time. As you monitor more frequently, this cost rises linearly.
- **Overall Cost (Red Dashed Line):** This is the sum of proactive and reactive costs. It creates a U-shaped curve, indicating that there is an optimal point for monitoring.


w3.1- Maintenance Programs (4:35).mp4
Total Productive Maintenance
• Effectiveness
• Prevention
• Maintainability
• Engagement
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UNIVERSITY
One way to further our efforts in
00:02:13 / 00:04:35
85

w3.1- Maintenance Programs (4:35).mp4

Benefits of TPM

- Seeks to maximize equipment effectiveness
- Involvement at all levels of the organization
- Planning for the life of the equipment
- Routine maintenance performed at operator level
- Facilitated through small groups

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TPM has many organizational
and systemic benefits.

00:02:53 / 00:04:35

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w3.1- Maintenance Programs (4:35).mp4

TPM Objectives

- Failure
- Reduced yield
- Defects
- Set up
- Adjustment
- Stoppages
- Slow down

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There are many areas that can offset these goals.

00:03:38 / 00:04:35

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This transcript from Course 7, Module 3, covers the strategic approaches to **Maintenance Controls**, focusing on the delicate balance between cost and equipment reliability.

1. Maintenance Strategies: Reactive vs. Proactive

The text identifies two primary ways organizations handle equipment upkeep:

- **Breakdown Maintenance (Reactive):** Machines are only repaired after they fail. While this saves on immediate labor and parts, it often leads to "toxic" costs like lost production time, wages for idle workers, and safety risks.
- **Preventative Maintenance (Proactive):** Involves routine cleaning, lubrication, and inspection to prevent failure. The goal is to catch issues before they cause a shutdown.

The Cost Trade-off

Management must find the "sweet spot" where total costs are minimized.

- **Too little maintenance:** High repair and downtime costs.
- **Too much maintenance:** The cost of the preventative measures eventually exceeds the value of the repairs they prevent.

2. Total Productive Maintenance (TPM)

TPM is a Six Sigma and Lean pillar that seeks to maximize equipment effectiveness by involving **all employees**, especially operators.

Core Ideals of TPM

1. **Efficiency:** Focus on cost reduction and effectiveness.
2. **Failure Prevention:** Designing a system where breakdowns are eliminated.
3. **Maintainability:** Ensuring equipment is easy to keep in working order.
4. **100% Engagement:** Shifting routine maintenance (like daily checks) from specialized mechanics to the machine operators themselves.

> **Key Concept:** In TPM, major repairs remain with specialists, but daily "autonomous maintenance" is handled by the people running the machines. This empowers the workforce and identifies issues earlier.

3. Objectives and Obstacles

The ultimate goal of TPM is **Zero Breakdowns and Zero Defects**. To reach this, organizations must combat "losses" caused by:

- **Loss Time:** Scrap, quality issues, and lower productivity due to failure.
- **Setup Times:** The goal is to perform setups in parallel with operation (SMED principles) to keep the machine running.
- **Stoppages/Slowdowns:** Often caused by material flow issues or operating equipment outside of its intended parameters.

w3.2- Assessing Total Productive Maintenance (6:50)

w3.2- Assessing Total Productive Maintenance (6:50).mp4

Measuring TPM

$$(OEE) = (\text{Availability}) \text{ x } (PE) \text{ x } (Rate)$$

$$\text{Availability} = \frac{\text{Loading time} - \text{Downtime}}{\text{Loading time}}$$

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OEE, or overall
equipment effectiveness,

00:00:19 / 00:06:50

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w3.2- Assessing Total Productive Maintenance (6:50).mp4

TPM Metric Example 1

Suppose we have the following time frames:

Available time: 480 minutes

Set up time: 25 minutes

Planned downtime: 20 minutes

Unplanned downtime: 40 minutes

What is the loading time and the availability?

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Time frames are given for the total time for the shift,

00:01:04 / 00:06:50

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w3.2- Assessing Total Productive Maintenance (6:50).mp4

TPM Metric Example 1

Loading time = Available time per shift – Planned downtime

Loading time = 480 – 20 = 460 minutes

$$\text{Availability} = \frac{460-(40+25))}{460} = 0.857 = \boxed{85.7\%}$$

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The loading time is 460 minutes,

00:01:20 / 00:06:50

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w3.2- Assessing Total Productive Maintenance (6:50).mp4

TPM Metric Example 2

- Theoretical cycle time = 1.5 minutes per unit
- Actual cycle time = 2.5 minutes per unit
- Processed amount = 130 units
- 97% of products meet quality standards

Find

- Performance efficiency
- Net Operating Rate
- OEE

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The theoretical and actual cycle times

00:01:41 / 00:06:50

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w3.2- Assessing Total Productive Maintenance (6:50).mp4

TPM Metric Example 2

$$\text{Operating Speed Rate} = \frac{\text{Theoretical cycle time}}{\text{Actual cycle time}} = \frac{1.5\ minute}{2.5\ minutes} = 60\%$$

$$\text{Net operating rate} =$$

$$\frac{\text{Actual processing time}}{\text{Operating time}} = \frac{\text{Processed amount x actual cycle time}}{\text{Operating time}}$$

$$\text{Net operating rate} = \frac{130\ x\ 2.5}{460 - (40 + 25))} = 82.3\%$$

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w3.2- Assessing Total Productive Maintenance (6:50).mp4

TPM Metric Example 2

PE = Operating speed rate x net operating rate

PE = 0.6 x 0.823 = 49.4%

OEE= Availability x PE x rate

OEE= 0.857 x 0.494 x 0.97 = 0.411 = 41.1%

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the product of availability,

00:02:37 / 00:06:50

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w3.2- Assessing Total Productive Maintenance (6:50).mp4

Steps to Implement TPM

- Introduce TPM to the organization
- Align functional areas with the aims of TPM
- Establish TPM policies and objectives
- Form teams and investigate
- Establish and distinguish maintenance programs
- Conduct training
- Establish protocols for the installation, operation and validation of equipment

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We should begin by orienting the organization to TPM.

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Total Productive Maintenance (TPM) is a proactive approach to equipment maintenance that blurs the lines between production and maintenance by involving all employees—especially operators—to achieve "perfect production". In a Six Sigma context, TPM is a vital tool in the **Control Phase** to ensure that improvements are sustainable and that equipment reliability doesn't become a bottleneck.

The ultimate goal of TPM is **Zero Losses**: zero breakdowns, zero defects, zero accidents, and zero waste.

w3.2- Assessing Total Productive Maintenance (6:50).mp4

Autonomous TPM Small Group Activities

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The core of effective TPM lies

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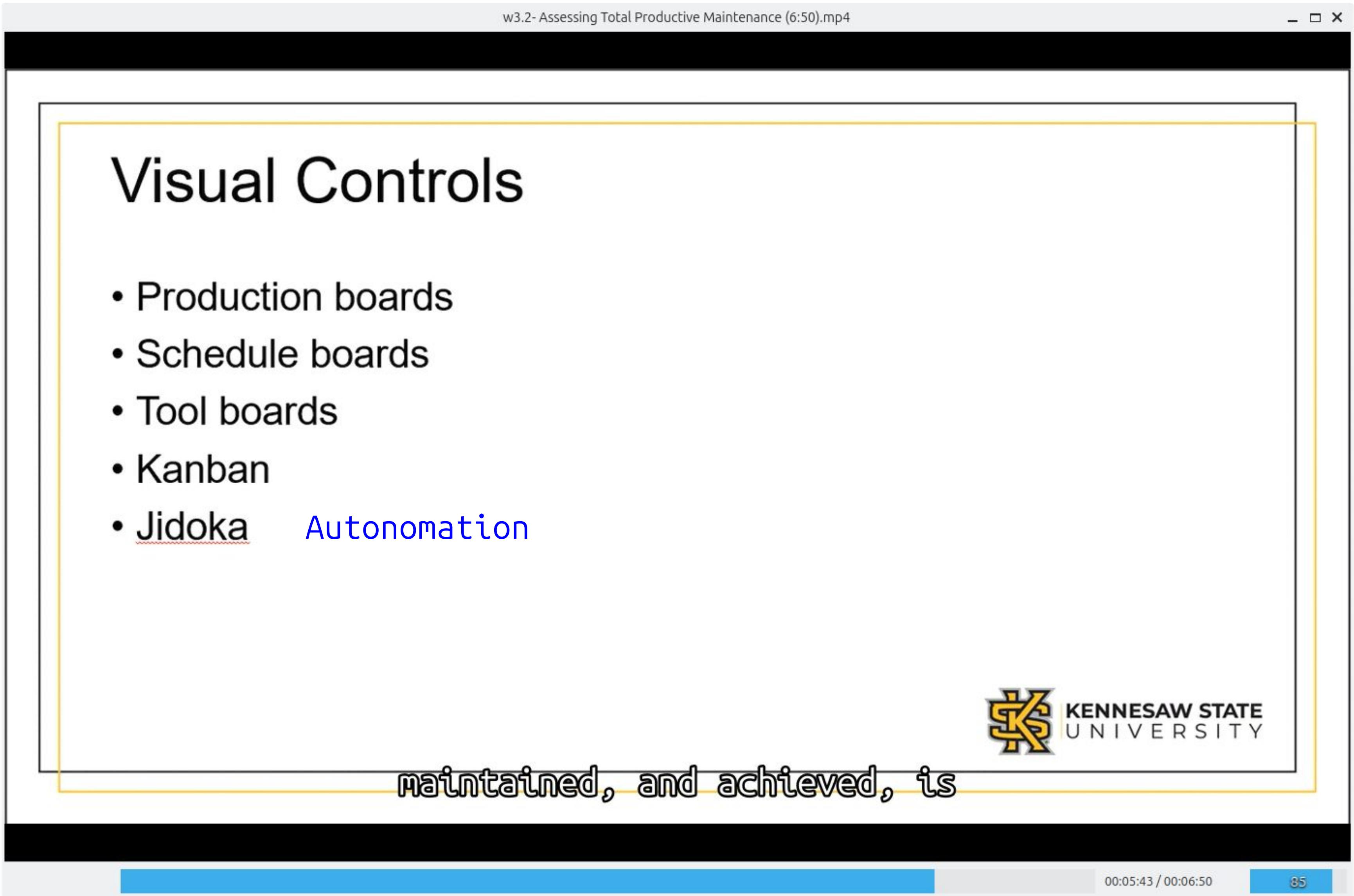
w3.2- Assessing Total Productive Maintenance (6:50).mp4
Visual Controls
• Production boards
• Schedule boards
• Tool boards
• Kanban
• Jidoka
Autonomation
KENNESAW STATE UNIVERSITY
maintained, and achieved, is
00:05:43 / 00:06:50
85

In the world of Lean and Six Sigma, **Jidoka** is often translated as "autonomation," or **automation with a human touch**. It is one of the two main pillars of the Toyota Production System, alongside Just-in-Time (JIT).

At its core, Jidoka gives machines and operators the ability to detect when an abnormal condition has occurred and **immediately stop work**. This prevents defects from being passed down the line, ensuring that quality is built into the process rather than inspected at the end.

Summary

This transcript details how to measure and implement **Total Productive Maintenance (TPM)**, focusing on the calculation of **OEE** and the use of **Visual Controls** to sustain equipment reliability.

1. OEE: The Primary TPM Metric

Overall Equipment Effectiveness (OEE) is the definitive measure of how well a manufacturing operation is utilized compared to its full potential. It is calculated by multiplying three factors:

$$OEE = \text{Availability} \times \text{Performance Efficiency} \times \text{Quality Rate}$$

Components Explained

- **Availability:** The ratio of actual operating time to planned loading time.
  - *Note:* Loading time excludes planned downtime (meetings, scheduled maintenance) but includes unplanned downtime (breakdowns, setups).
- **Performance Efficiency (PE):** A combination of **Operating Speed Rate** (theoretical vs. actual cycle time) and **Net Operating Rate** (time spent producing at the current speed).
- **Quality Rate:** The percentage of total products that meet quality standards (e.g., 97%).

The 85% Benchmark: In the transcript's example, the OEE was only **41.1%**. World-class TPM organizations aim for **85% or higher**. Because the factors are multiplied, even a "good" 95% in all three categories results in an OEE of only ~85.7%.

2. Implementation Steps for TPM

A successful TPM program follows a structured rollout:

1. **Orientation:** Formally introduce TPM and align it with business goals.
2. **Policy Establishment:** Document and communicate objectives regularly.
3. **Investigation:** Use teams to identify critical processes and current OEE gaps.
4. **Categorization:** Split tasks into **Autonomous Maintenance** (operator-led) and **Scheduled Maintenance** (maintenance-led).
5. **Training:** Ensure every employee understands their specific role and responsibility.
6. **Protocols:** Establish strict rules for the installation and validation of any new or modified equipment.

3. Visual Controls and Jidoka

To maintain stability without constant reporting, TPM relies on **Visual Controls**. These systems provide an "instantaneous" assessment of the process state.

Common Visual Tools

- **Production & Schedule Boards:** Track output against targets in real-time.
- **Tool Boards:** Ensure every tool has a place (often related to 5S).
- **Kanban:** Visual signals for material replenishment.
- **Jidoka (Autonomation):** A critical concept where a machine is designed to stop automatically if a defect is detected. This prevents the mass production of scrap and requires human intervention only when a problem exists.