

Industry

NAVIGATOR

SUSTAINABLE DEVELOPMENT
STRATEGIES FOR T&D

CONFERENCE 2025

AI and Digitalization as Enablers for Sustainable Development

Dr. Mauricio Soto

10 April 2025

Sustainability is the practice of using resources in a way that meets the needs of the present without compromising the future.



Environmental

Social

Economic



Environmental: conserving natural resources

Social: humans are cared for, protected, and valued

Economic: long term prosperity through efficiency and process optimization



Environmental



Design Optimization, Manufacturing and Monitoring of EconiQ Transformers



Develop environmentally friendly fluids



Production, Manufacturing and Monitoring of EconiQ Transformers



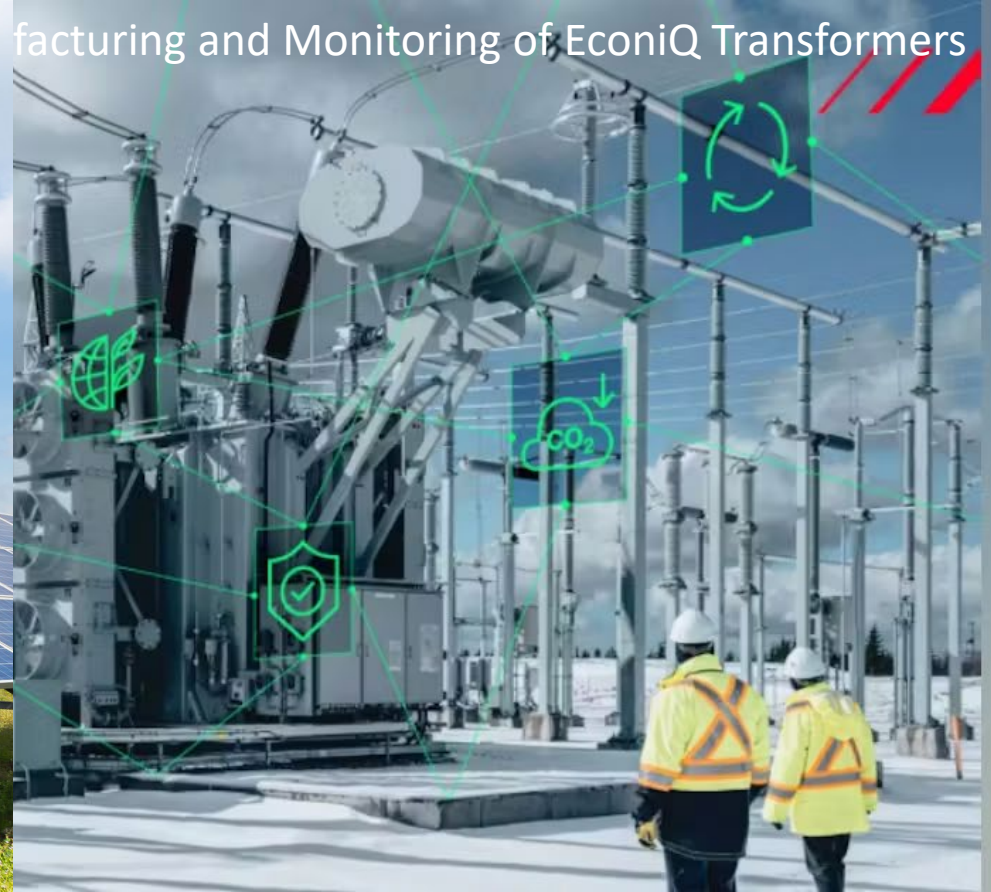
Develop environmentally friendly fluids



Predict renewable generation



Manufacturing and Monitoring of EconiQ Transformers



Develop environmentally friendly fluids



Predict renewable generation



Optimize carbon footprint management by identify main influencing factors and emission reduction opportunities



Environmental: conserving natural resources

Social: humans are cared for, protected, and valued

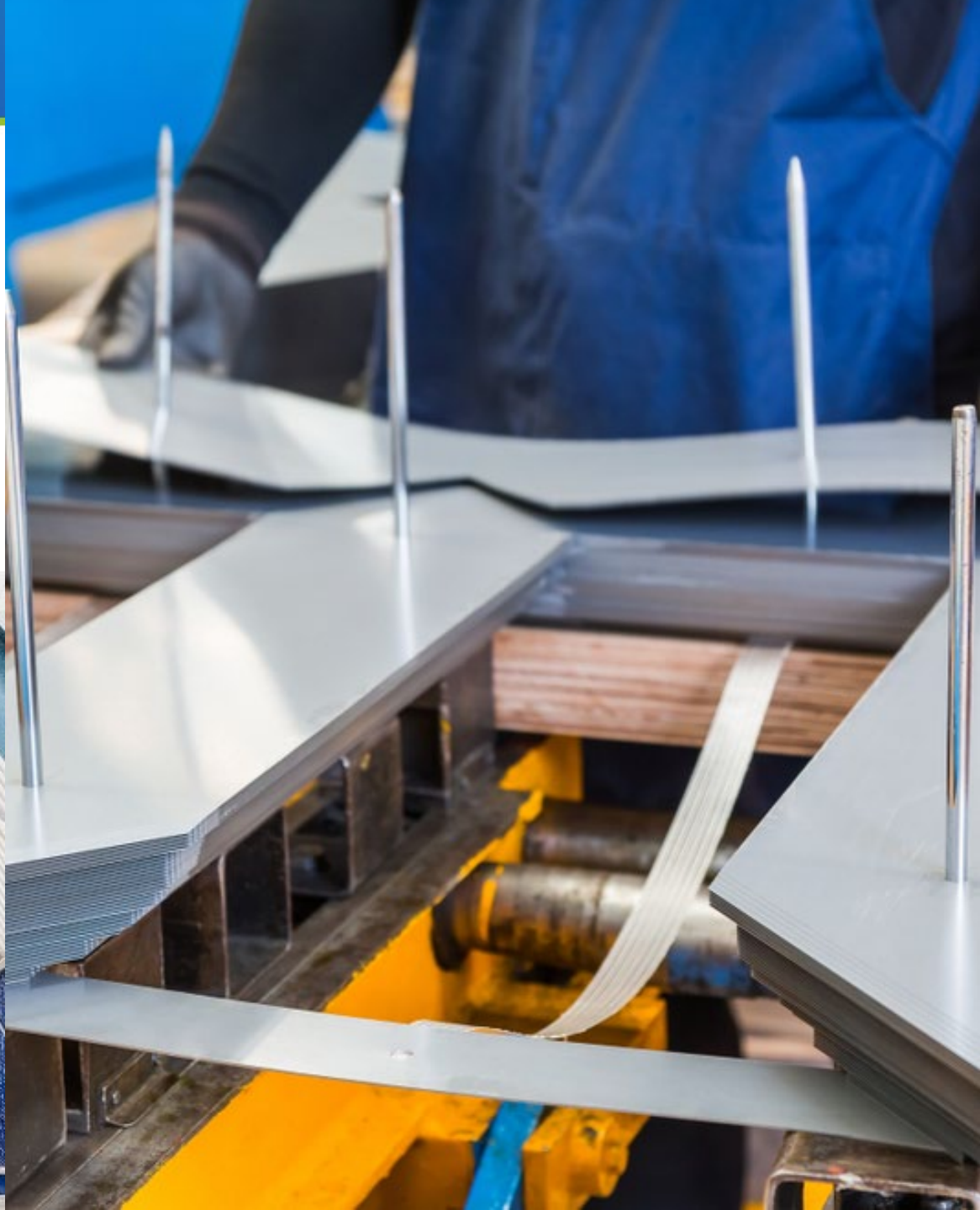
Economic: long term prosperity through efficiency and process optimization

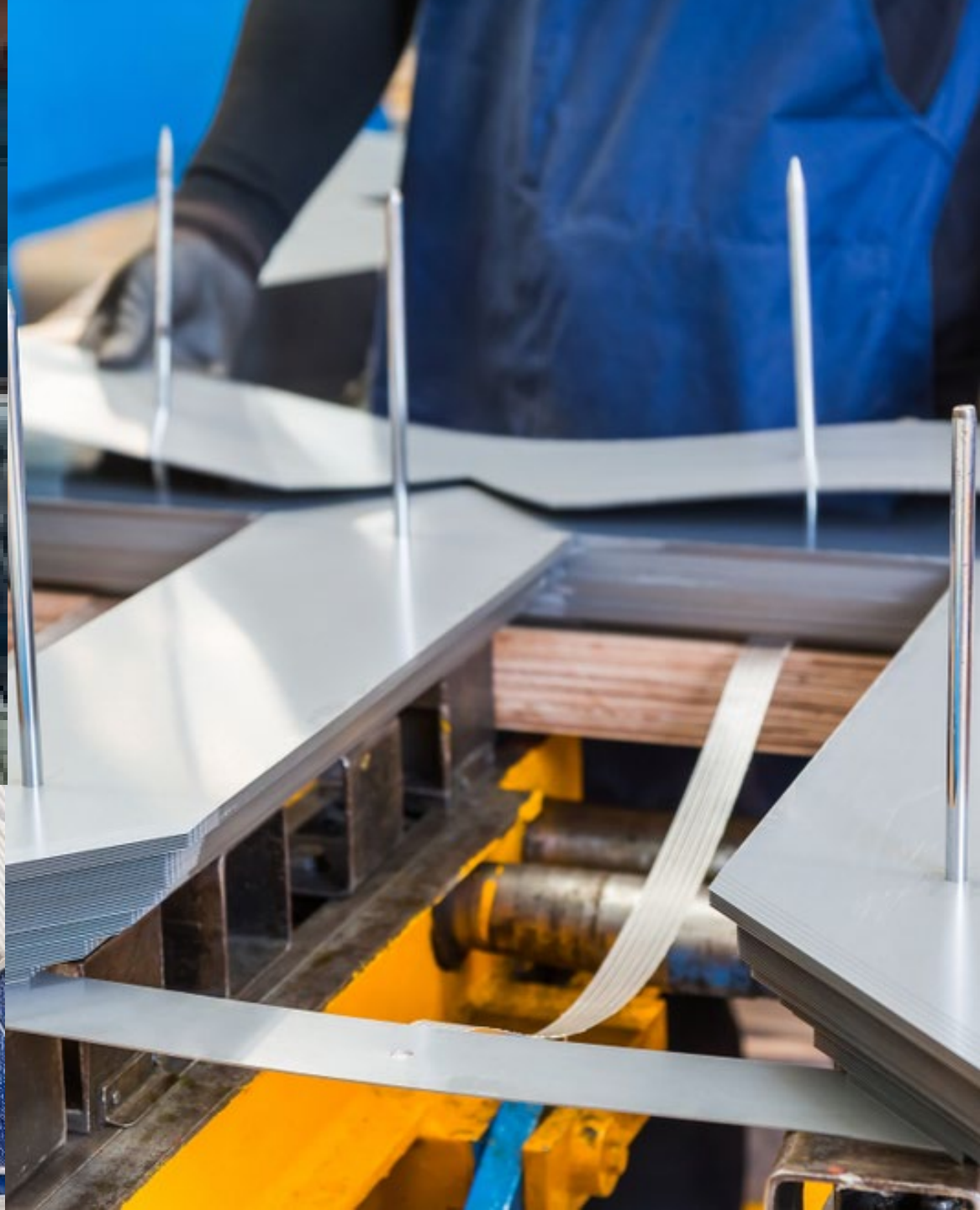


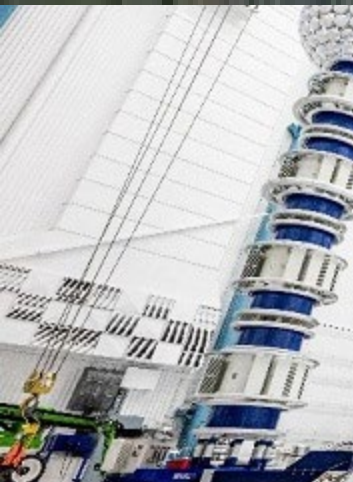
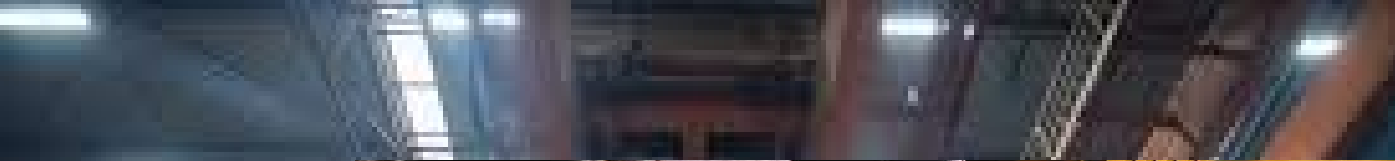
Social: Safety

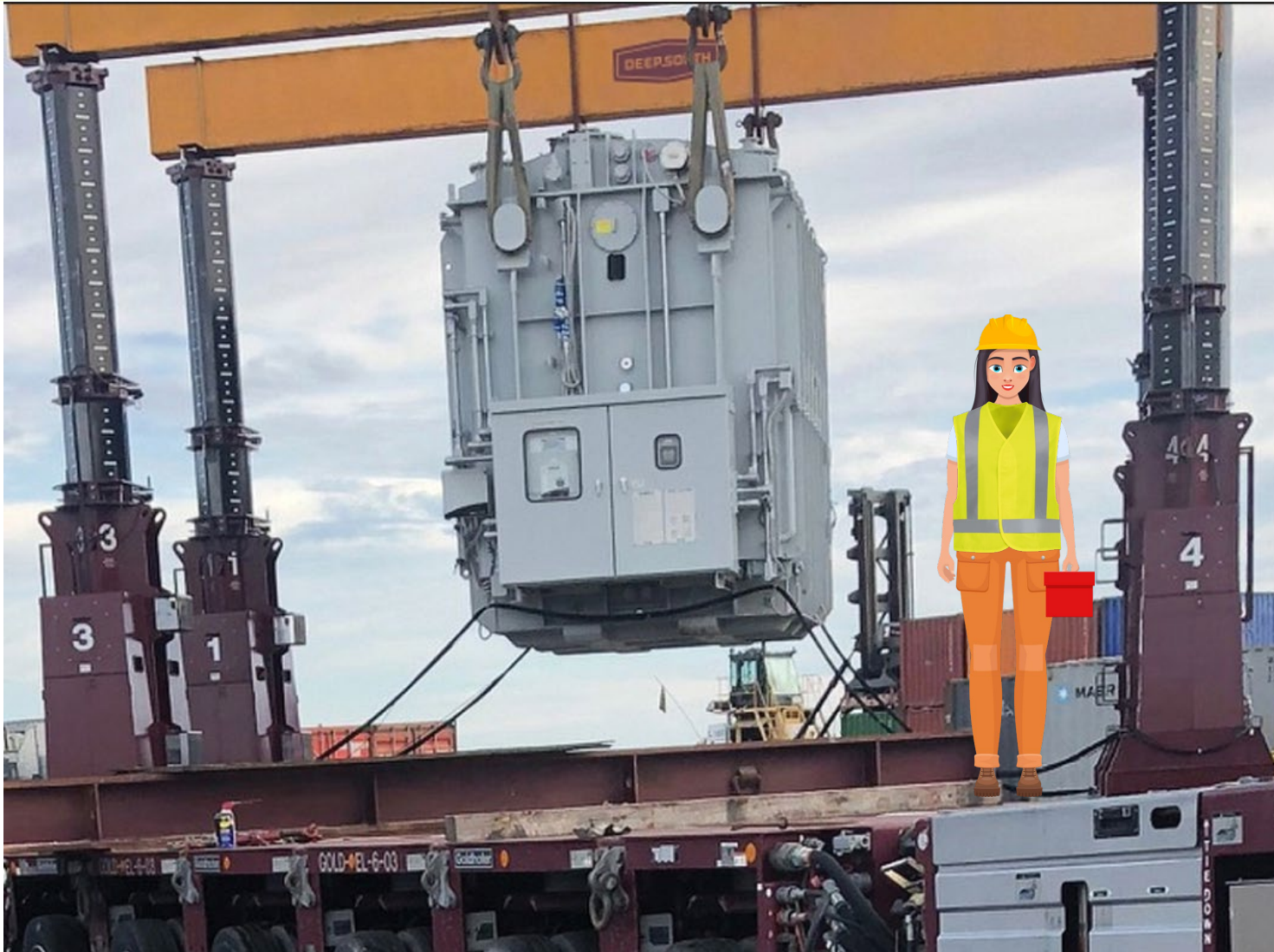






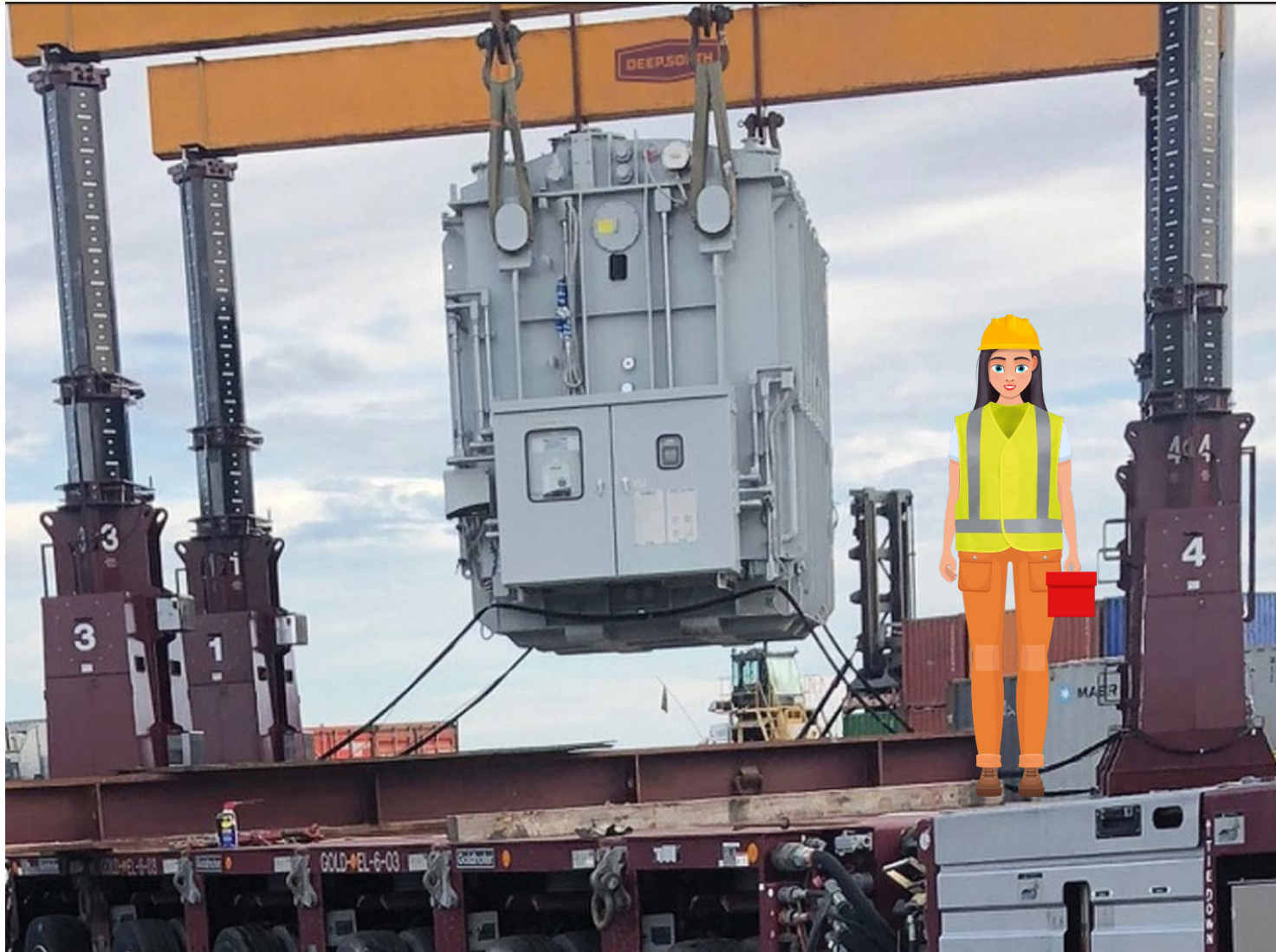






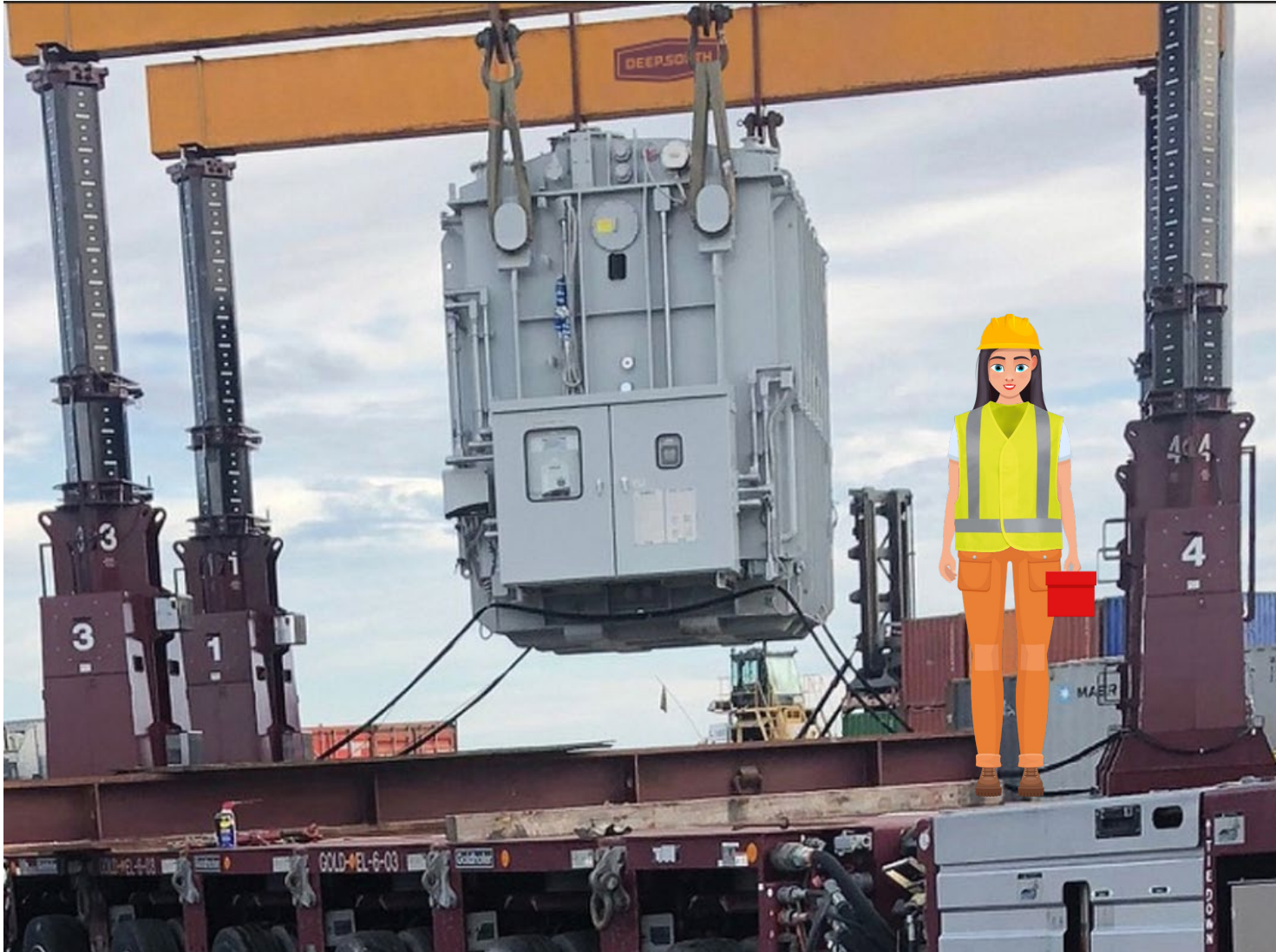
Edge Face
Blurring





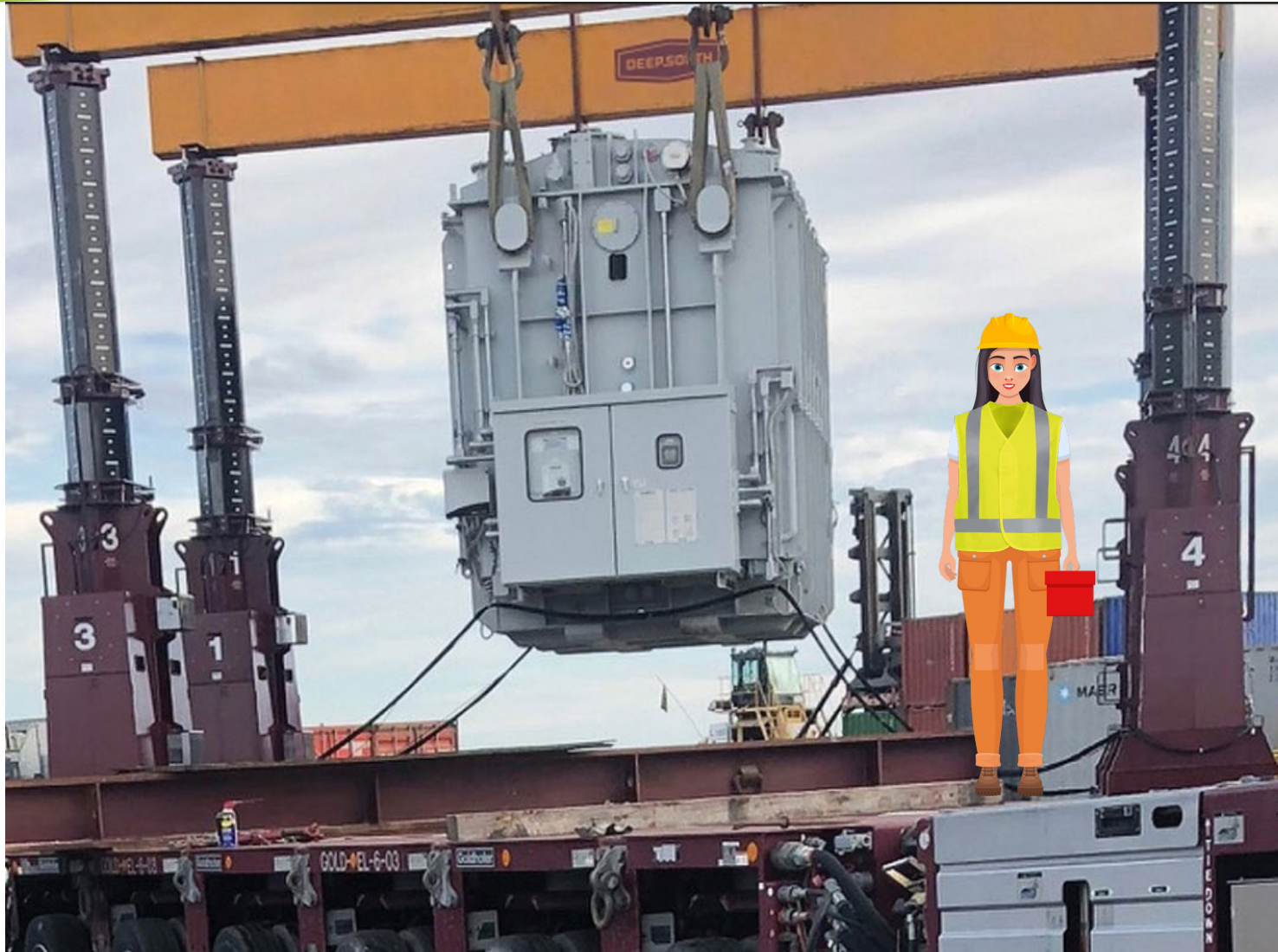
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Edge Face Blurring





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Edge Face Blurring

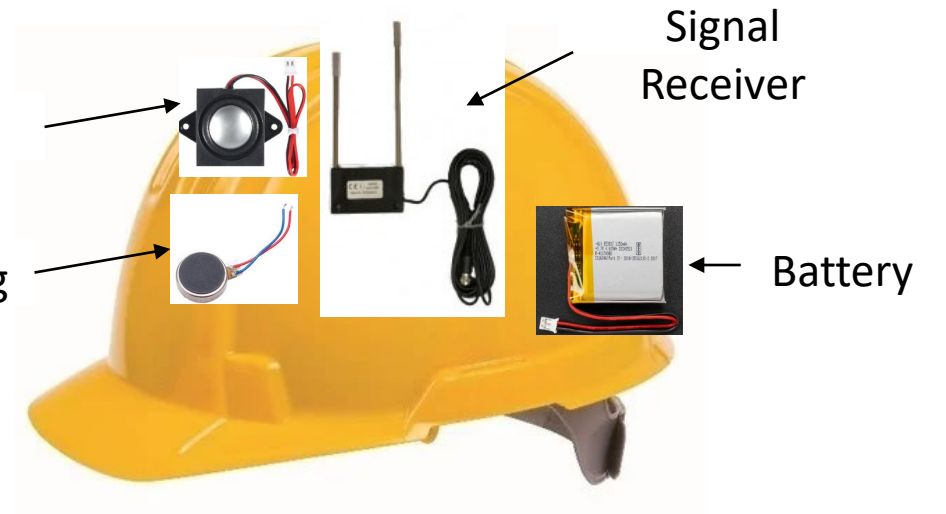


Redundancies of same QR Code



Speaker

Vibrating Motor



Cameras



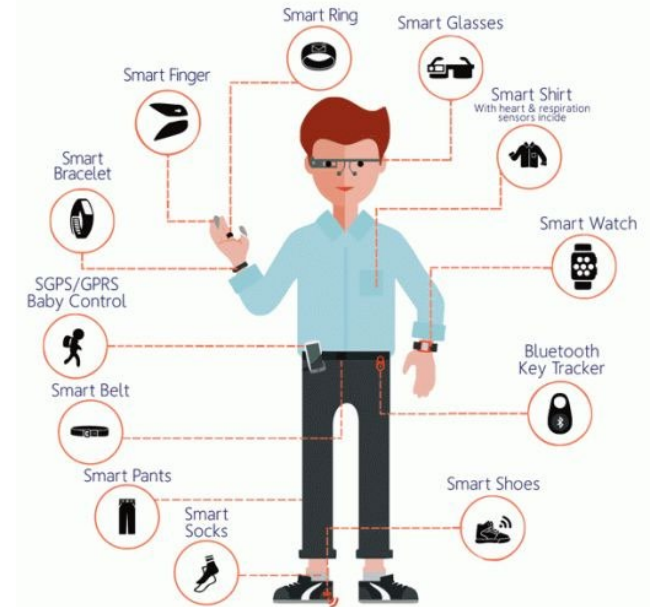
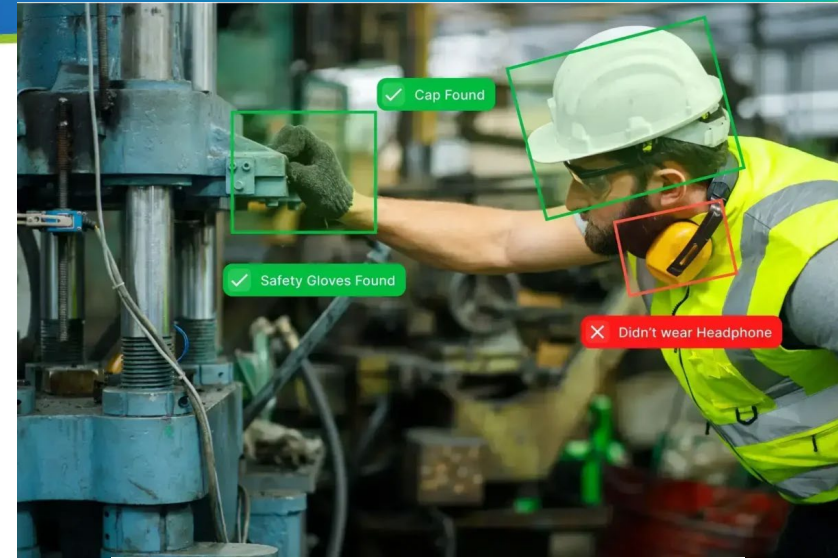
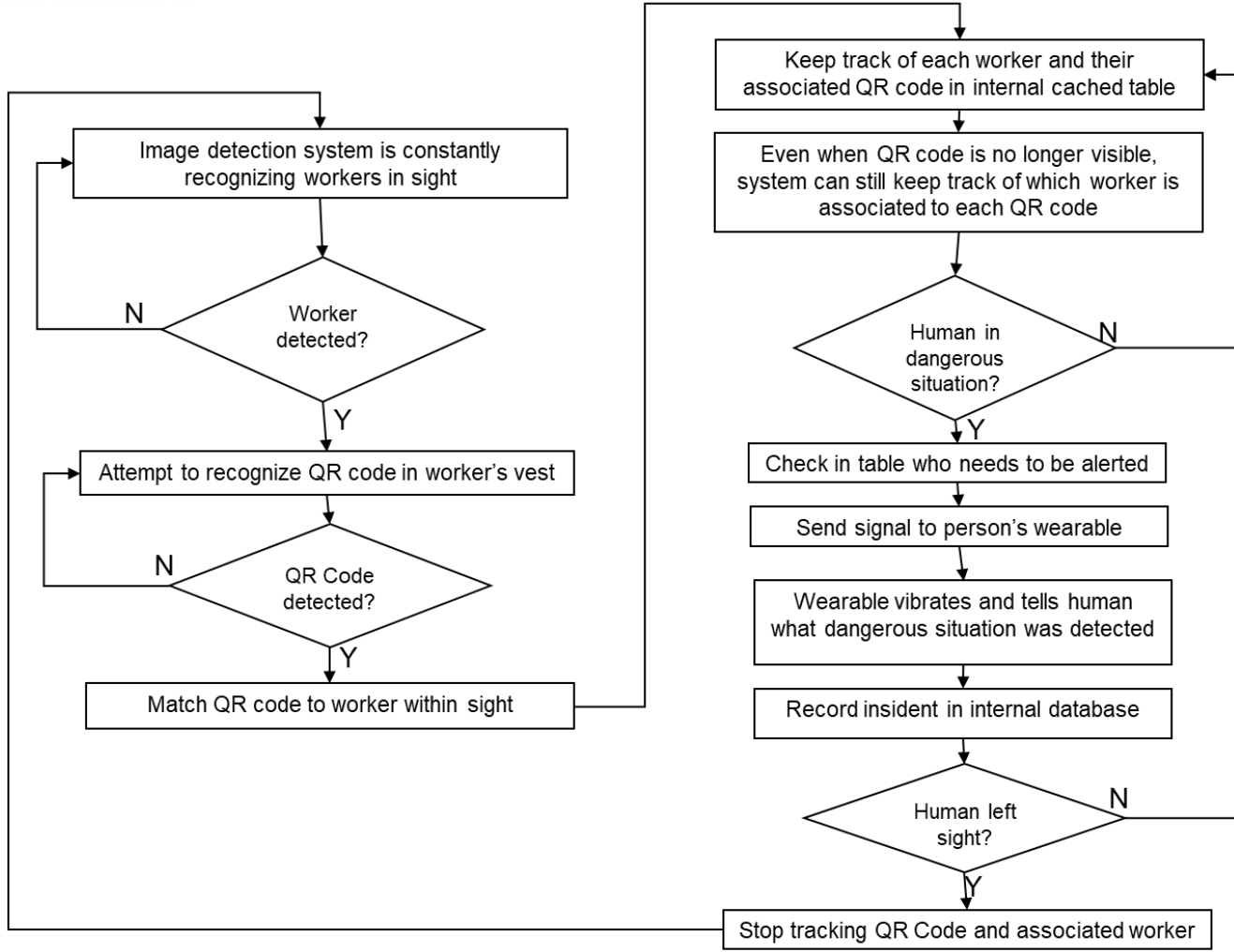
Edge Face Blurring

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Processing Unit

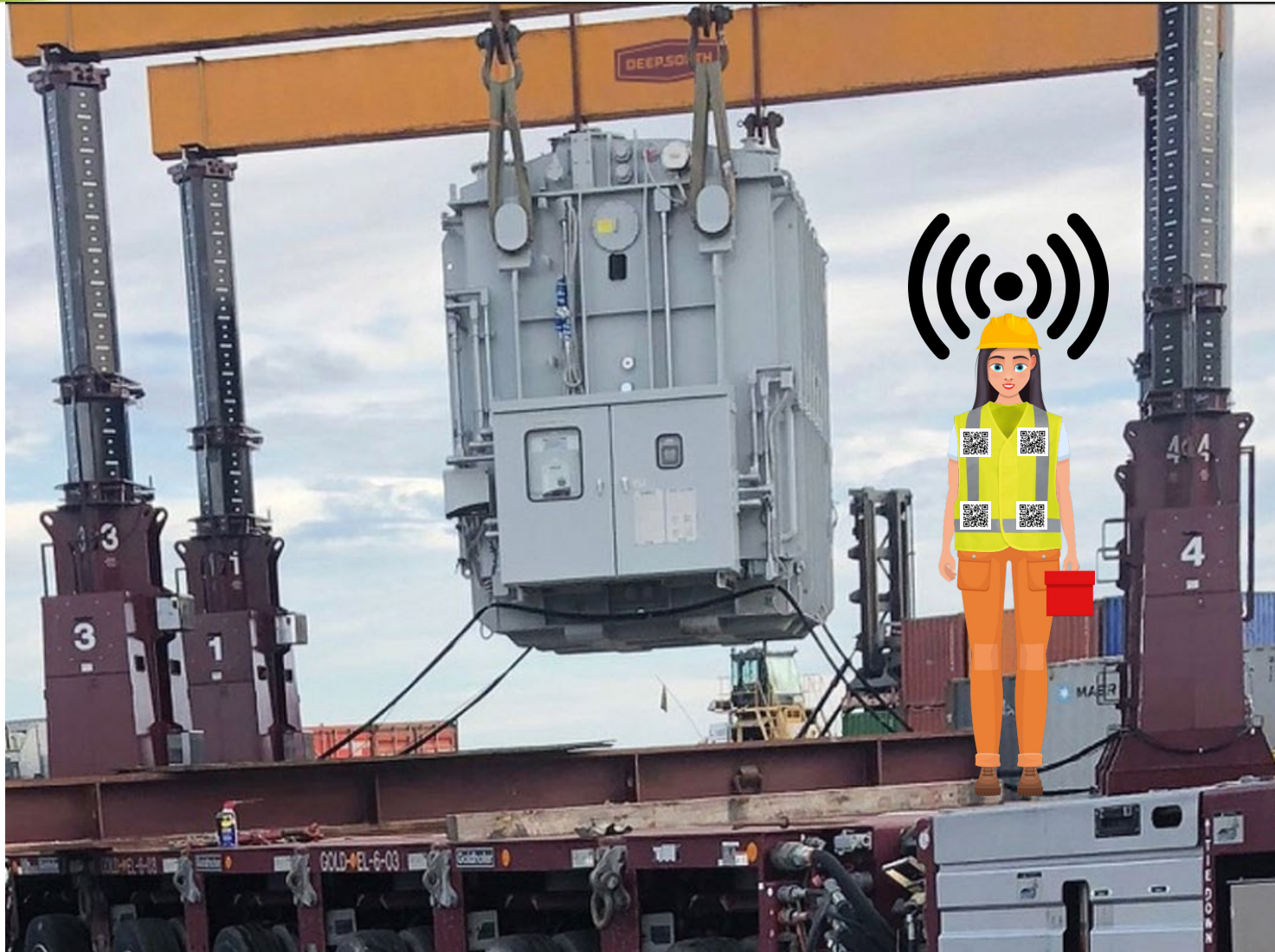
Signal Transmitter





| Dangerous situation | Workers targeted |
|---|---|
| Craine transporting transformer part near worker | <ol style="list-style-type: none"> 1. Worker near suspended load 2. Craine operator |
| Workers located in places they should not be (e.g. testing room during impulse testing) | <ol style="list-style-type: none"> 1. Workers in dangerous place 2. Test room operators |
| Workers in the production floor not wearing PPE | <ol style="list-style-type: none"> 1. Workers not wearing PPE |
| Fire detection in testing room | <ol style="list-style-type: none"> 1. Test room operators |
| Worker not moving in testing room | <ol style="list-style-type: none"> 1. Test room operators 2. Unresponsive worker |
| Factory visitors away from the visitor path | <ol style="list-style-type: none"> 1. Visitors 2. Guide |





Edge Face Blurring



Social: Training

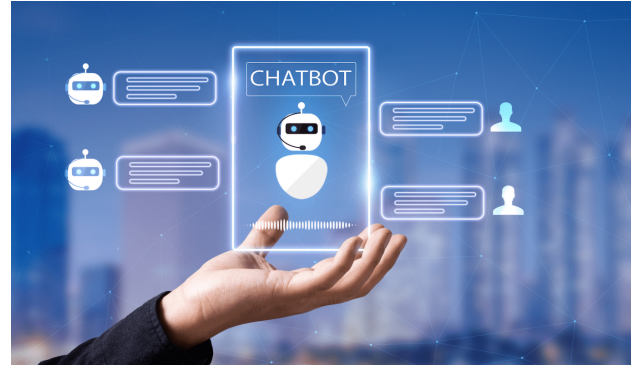


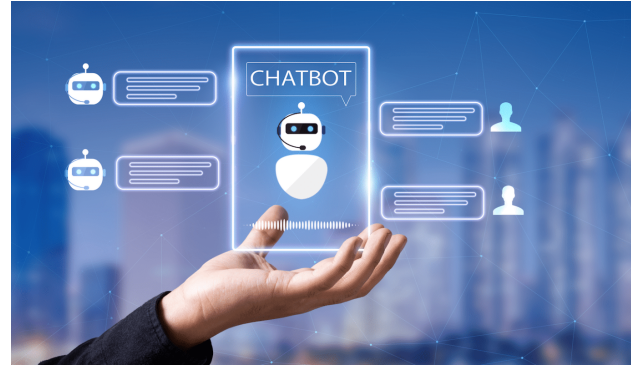
Industry

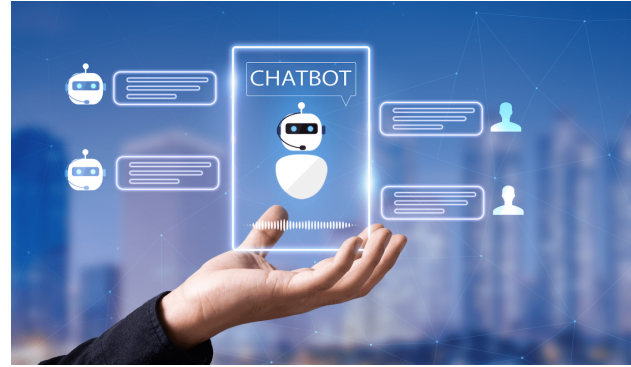
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Engineer Question (Samples)

LLM Answer

For a Seismic design, base enhancement, how many gussets shall be welded?

For a seismic design, base anchoring should be done on 16 points

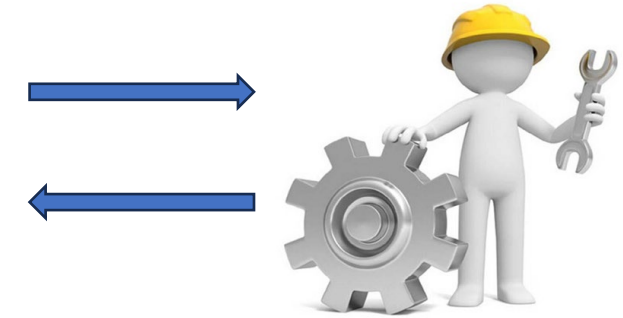
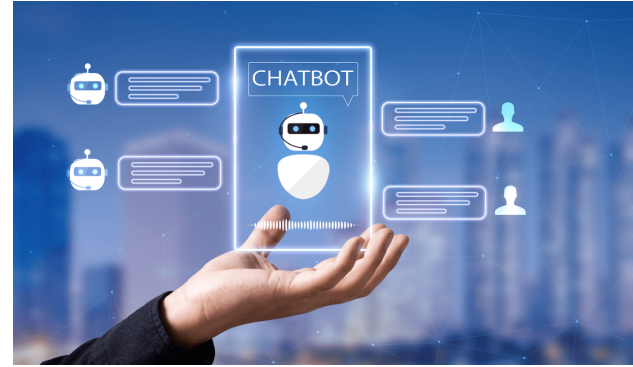
In the case 34k V & 170 BIL and conductor thickness is 0.005 inch, which type of inner insulation should be applied?

For a transformer with a voltage of 34 kV, a BIL of 170 kV, and a conductor thickness of 0.005 inches, the type of inner insulation to be applied is Type 4

What is the recommended LV coil height for a 1170 mm HV electrical height with 30 mm end fill and BIL 170 kV in IEC?

The recommended LV coil height for a 1170 mm HV electrical height with 30 mm end fill and BIL 170 kV in IEC is 1380 mm





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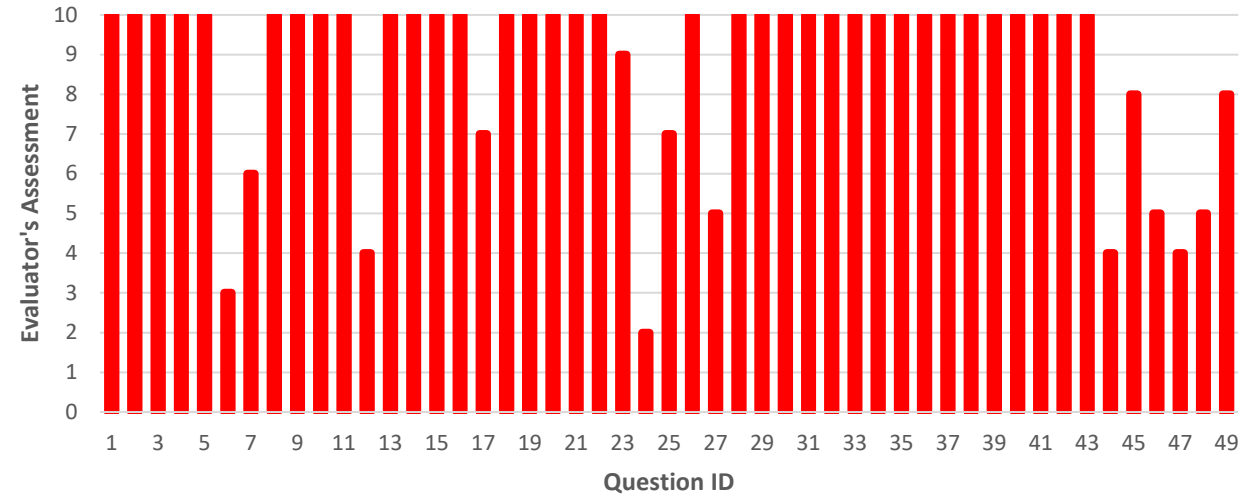
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Evaluator's Assessment



Economic: Extend Transformer Life



Motivation:

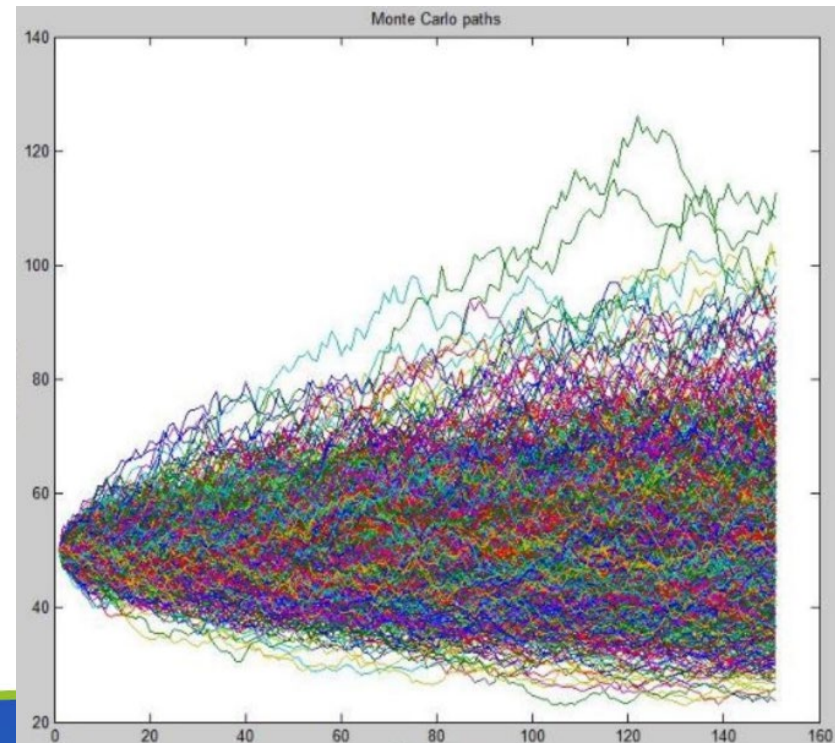
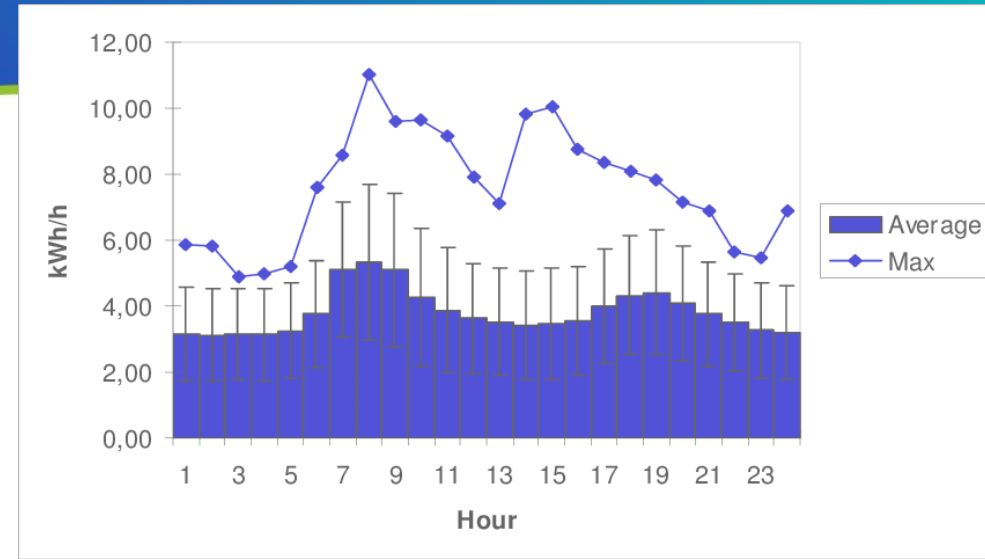
Life estimate is complex

Existing model is based on hot spot only

Solution:

We create an approach using hotspot, moisture and O₂ levels as suggested by IEC

Create thousands of simulations using a Monte Carlo approach to find expected end of life of a transformer



Economic: Optimize System Load



Motivation:

An improper balance between power generation and consumption leads to transformers overloading and diminishing their expected life

Solution:

Use artificial intelligence to predict and inform users of upcoming power demand, system load, power generation, and market pricing.

Better calculation of transformer loadability, and better usage of cooling and hotspot control, load shedding



Economic: Failure Prevention



Probabilistic Fault Tree Using Bayesian Networks

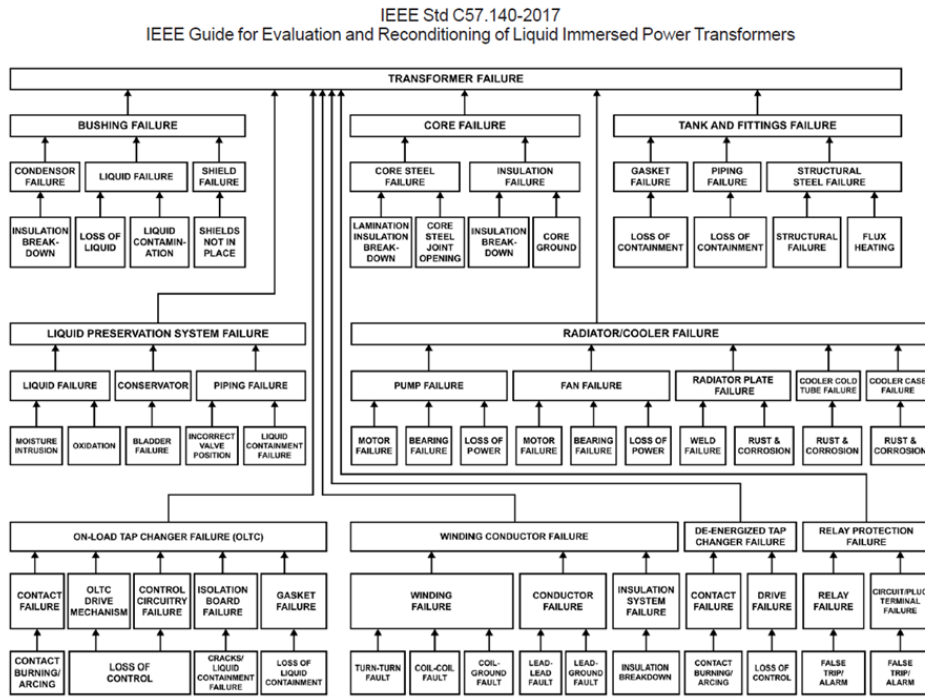
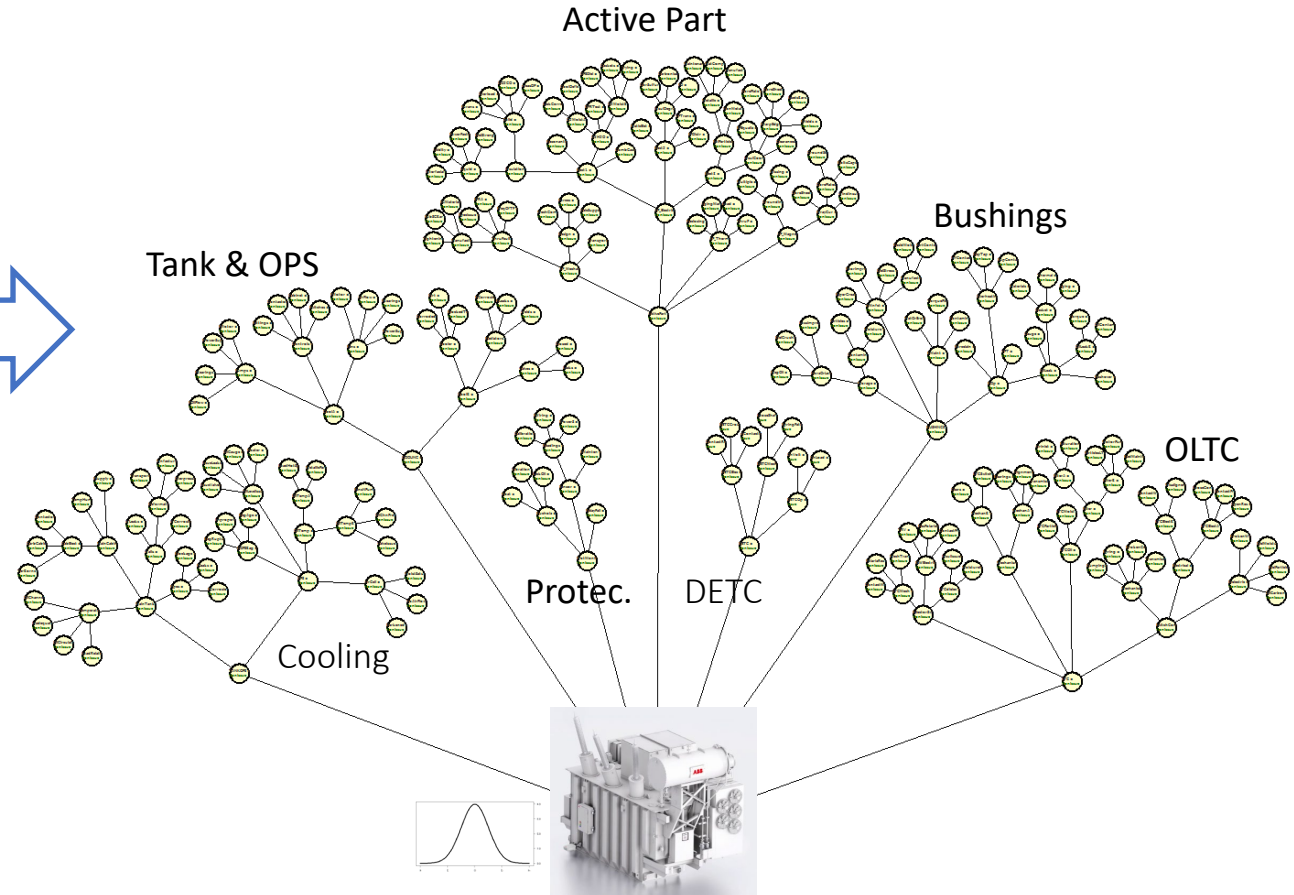
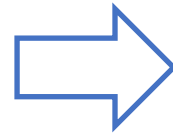


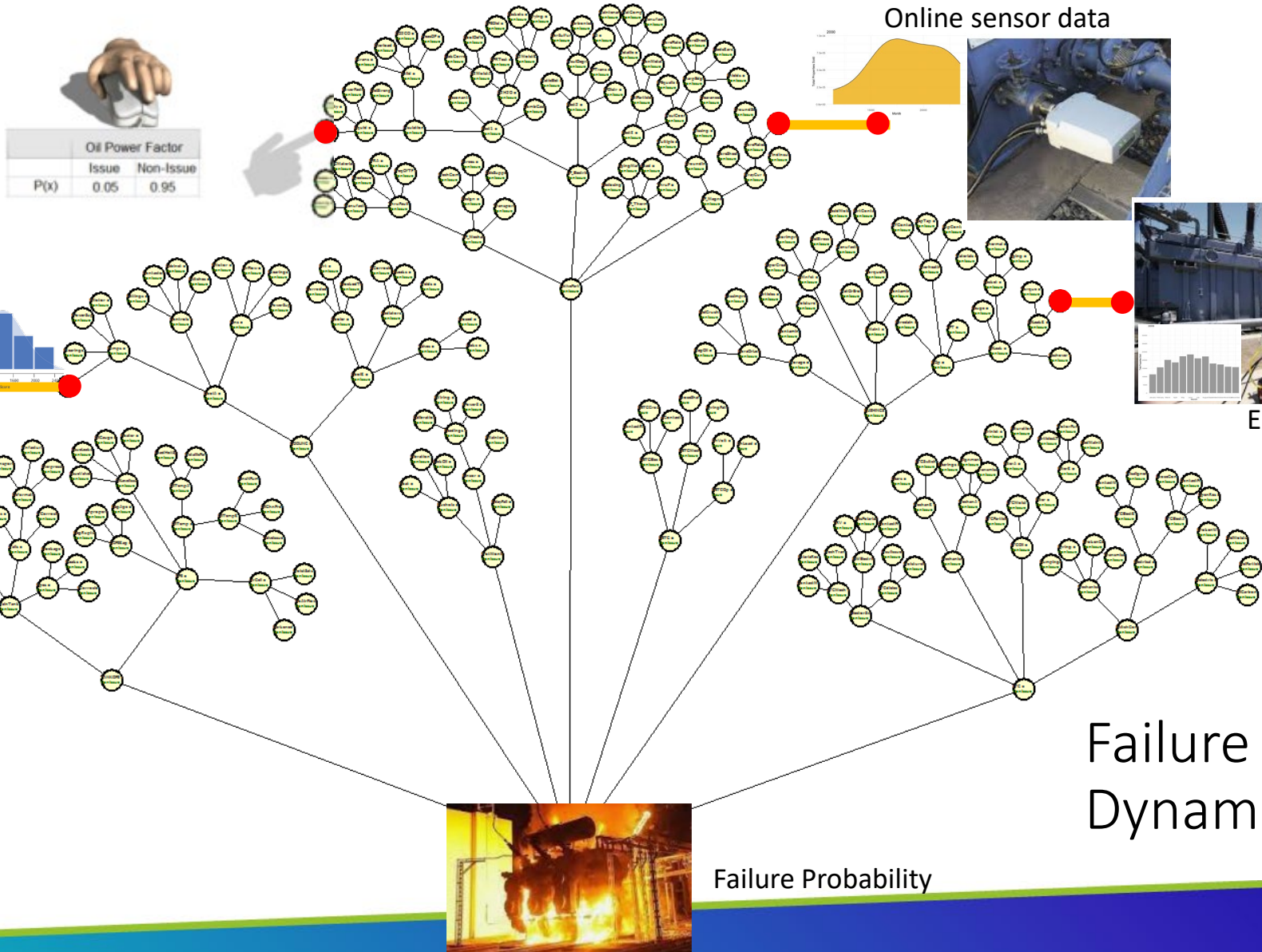
Figure 1—Transformer fault tree

79 Nodes



253 Nodes





Failure Probabilities
Dynamically Updated

