ELECTRICAL WIRE PROCESSING TECHNOLOGY EXPO 2025

CONFERENCE: MAY 6-8 | EXHIBITION: MAY 7-8

BAIRD CENTER ■ MILWAUKEE, WI

HARNESS CONNECTIONS

FAULT ANALYSIS & INVESTIGATION IN ELECTRICAL WIRE HARNESS TESTING

PRESENTED BY:

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INTRODUCTIONS

Nick Baker
New Product Development Manager
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Regional Director
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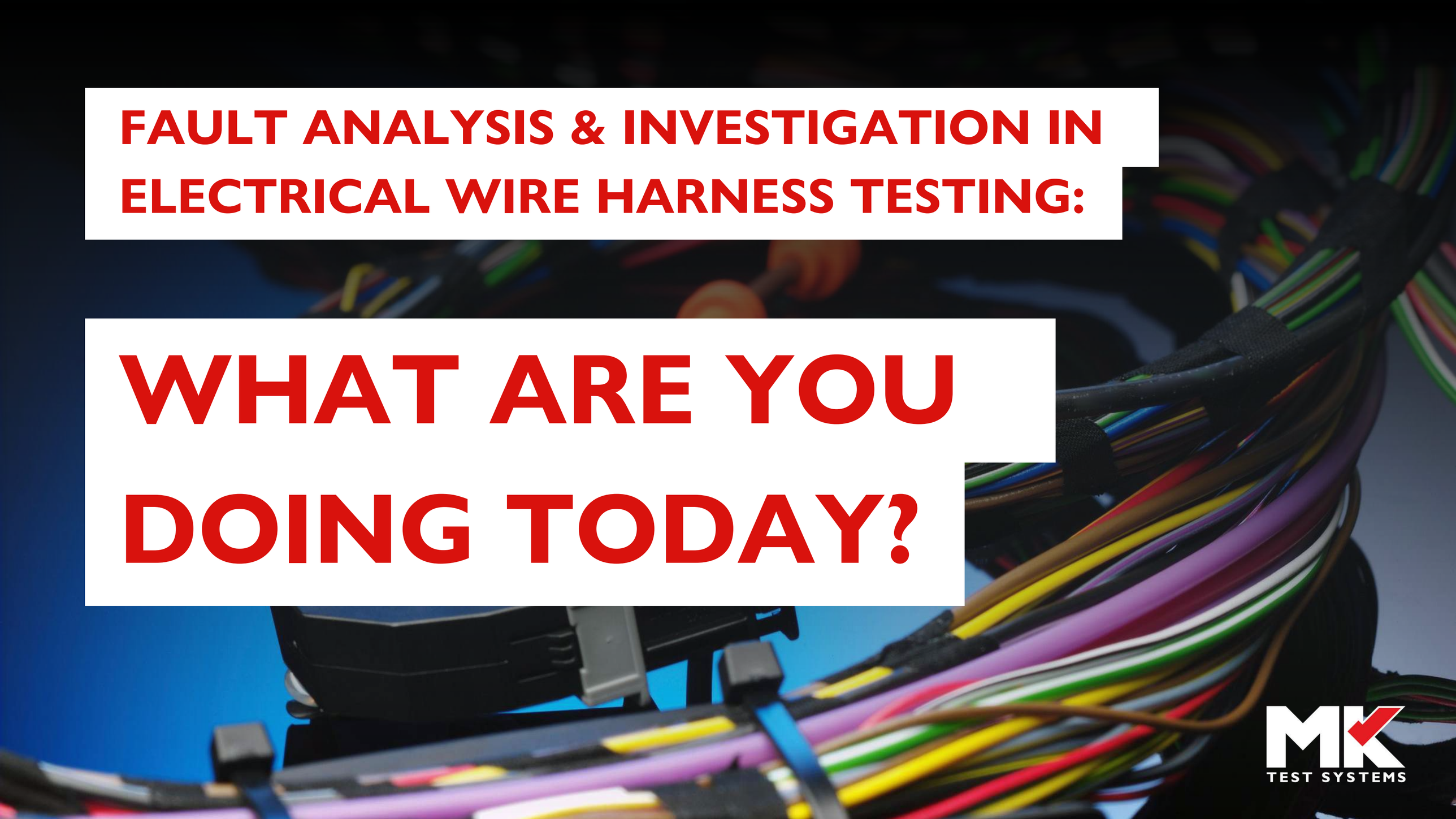
TOPICS COVERED

- ✓ What **are** you doing with the tech today?
  - Unlocking future analysis by generating and recording data
  - Recording data in computer readable formats
  - Use the real benefits of automation
  - Understand the whole test process and identify optimisation

- ✓ What **could** you be doing with the tech today?
  - Knowledge sharing from different industries
  - Think bigger! Pool data from repeat testing across all types and locations
  - Label data ready for AI applications

- ✓ What **should** you be thinking about in the future?



FAULT ANALYSIS & INVESTIGATION IN ELECTRICAL WIRE HARNESS TESTING:

WHAT ARE YOU DOING TODAY?

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WHAT ARE YOU DOING TODAY?

TEST DESIGN DECISIONS

- ✓ Automated test systems all provide the tools for recording measurements and validating these against a set of requirements.
- ✓ The choice to save each measurement result is up to the test designer.
- ✓ Some methods today come from historical design constraints.
- ✓ Classical systems had limited memory and test reports were printed.
- ✓ Only the pass result is saved with a quality stamp or signature.

WHAT ARE YOU DOING TODAY?

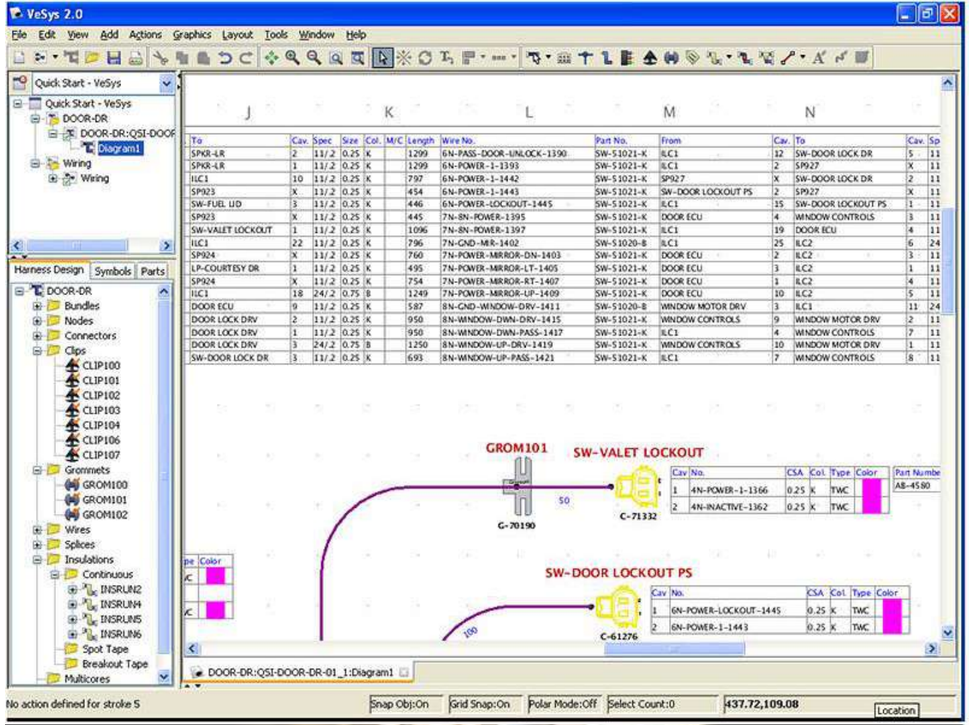
COMPUTER READABLE FORMATS

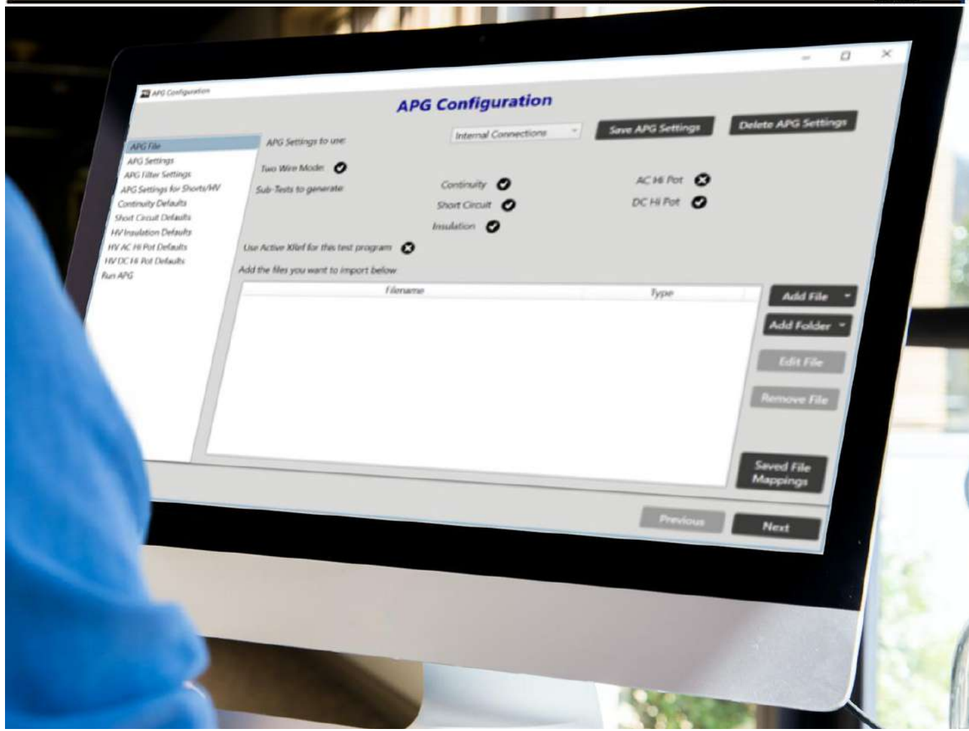
- ✓ Always record the results in a computer readable format (XML, JSON etc.)
- ✓ Much more data is available in these formats for traceability and analysis
- ✓ Meta-data can show much more info about why repeat failures occur such as:
  - Conditions during the test
  - Serial numbers of equipment used
  - Setup and timestamp for each measurement
- ✓ Results can still be transformed into human readable reports

WHAT ARE YOU DOING TODAY?

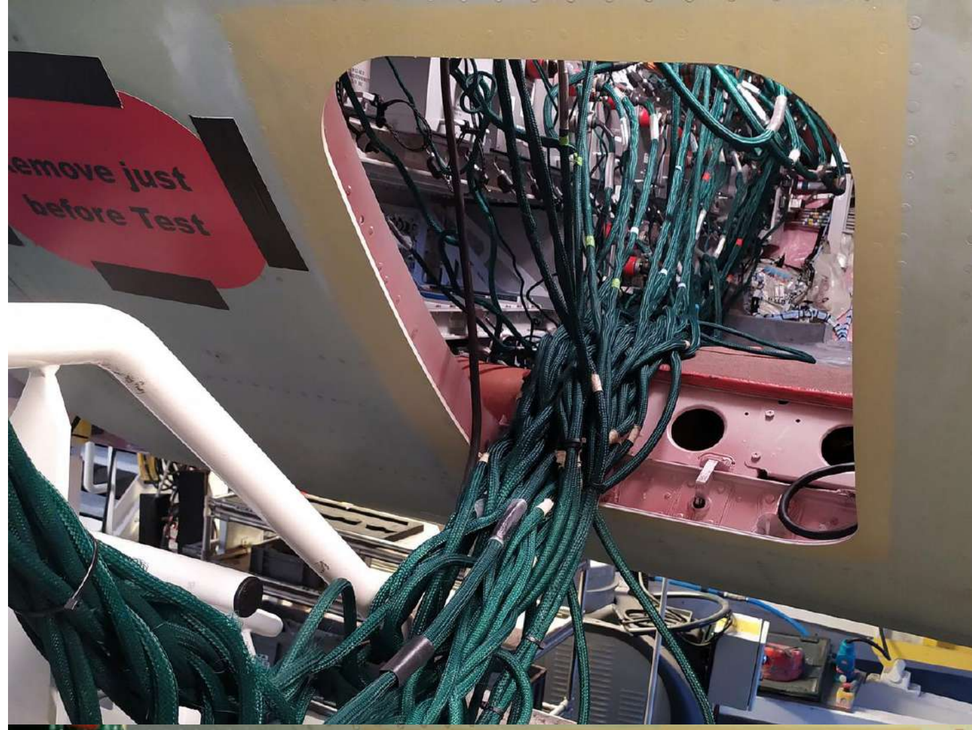
AUTOMATIC PROGRAM GENERATION

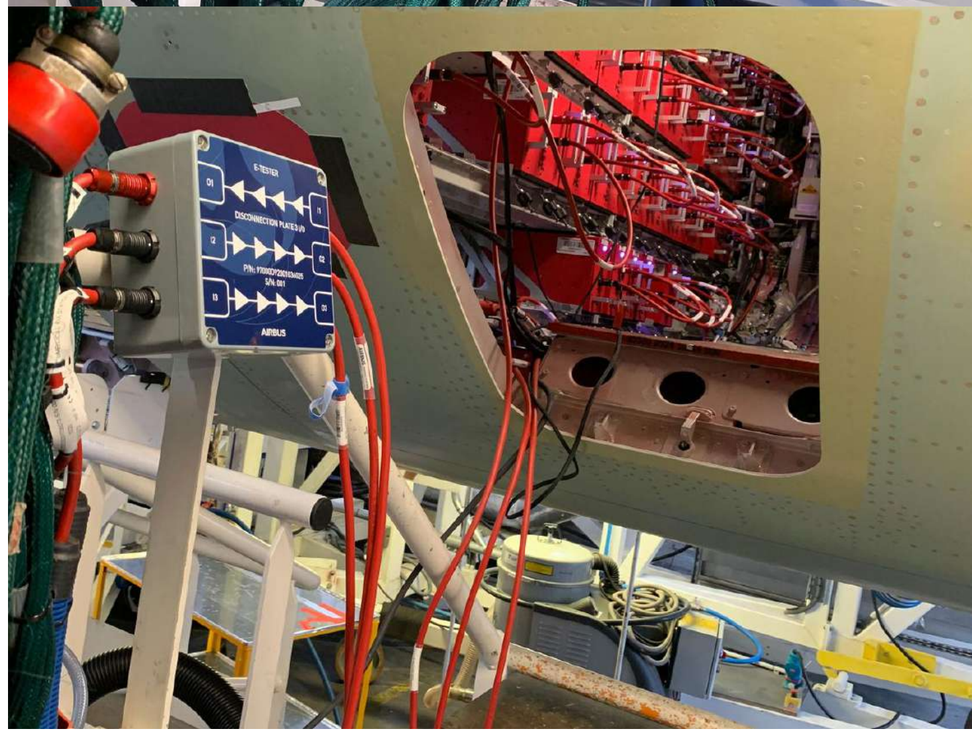
- ✓ Automatic Program Generator (APG) tools can create test programs directly from engineering data
- ✓ Even if program is fully defined, APG can show issues such as:
  - Missing pins from test interface leads
  - Human error in transcription
- ✓ Programs can force export of results automatically for every test





WHAT ARE YOU DOING TODAY?





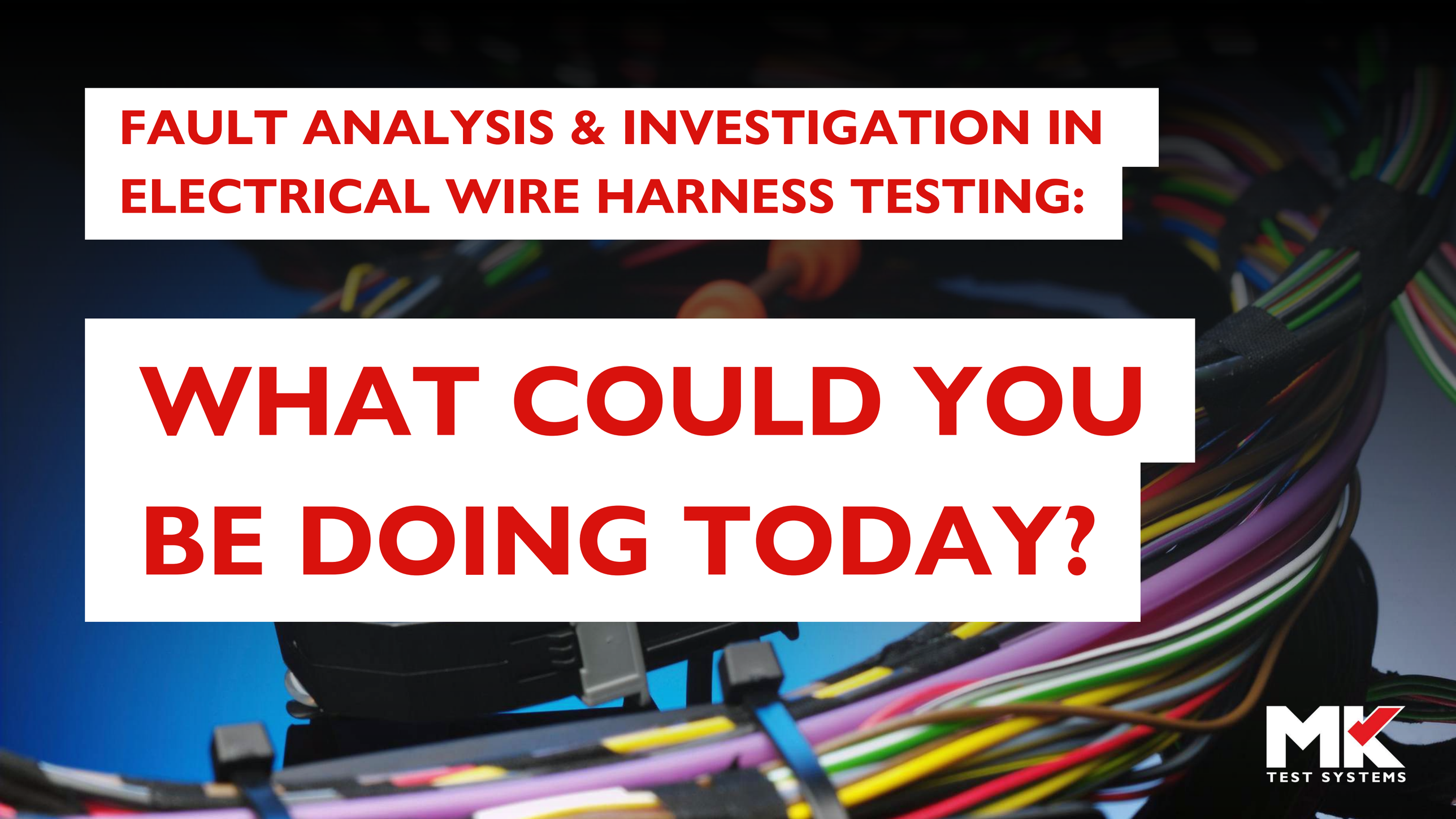
FAILURES DUE TO HOOK-UP

- ✓ Operators can stop and restart a test at any time. This is common if there is an obvious test setup problem
- ✓ Obviously, this is faster, but no failure is recorded!
- ✓ Knowing the cause of restart can help improve process:
  - Colour code leads
  - Remove the ability to make a mistake (poka-yoke)
  - Fix software or test program issues
  - Re-order test process to be more efficient

WHAT ARE YOU DOING TODAY?

HIDDEN DATA

- ✓ Modern ATE can take lots of measurements but only provide an average result.
- ✓ The average can hide outliers that could be important.
- ✓ Recording Min/Max is a good start, but a full sample set tells a much bigger story



FAULT ANALYSIS & INVESTIGATION IN ELECTRICAL WIRE HARNESS TESTING:

WHAT COULD YOU BE DOING TODAY?

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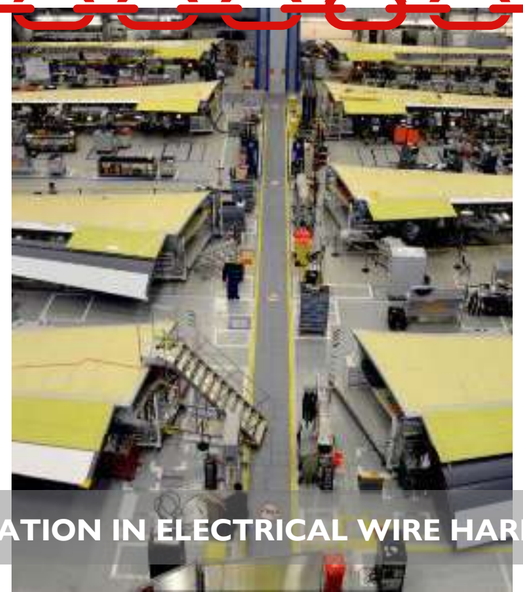
WHAT COULD YOU BE DOING TODAY?

BIGGER PICTURE

Wiring is often tested multiple times in the supply chain. Joining up results from each test can show lots of issues such as:

- ✓ Design for manufacture issues
- ✓ Tooling problems
- ✓ Test overstress in areas
- ✓ Manufacturing process overview



WHAT COULD YOU BE DOING TODAY?

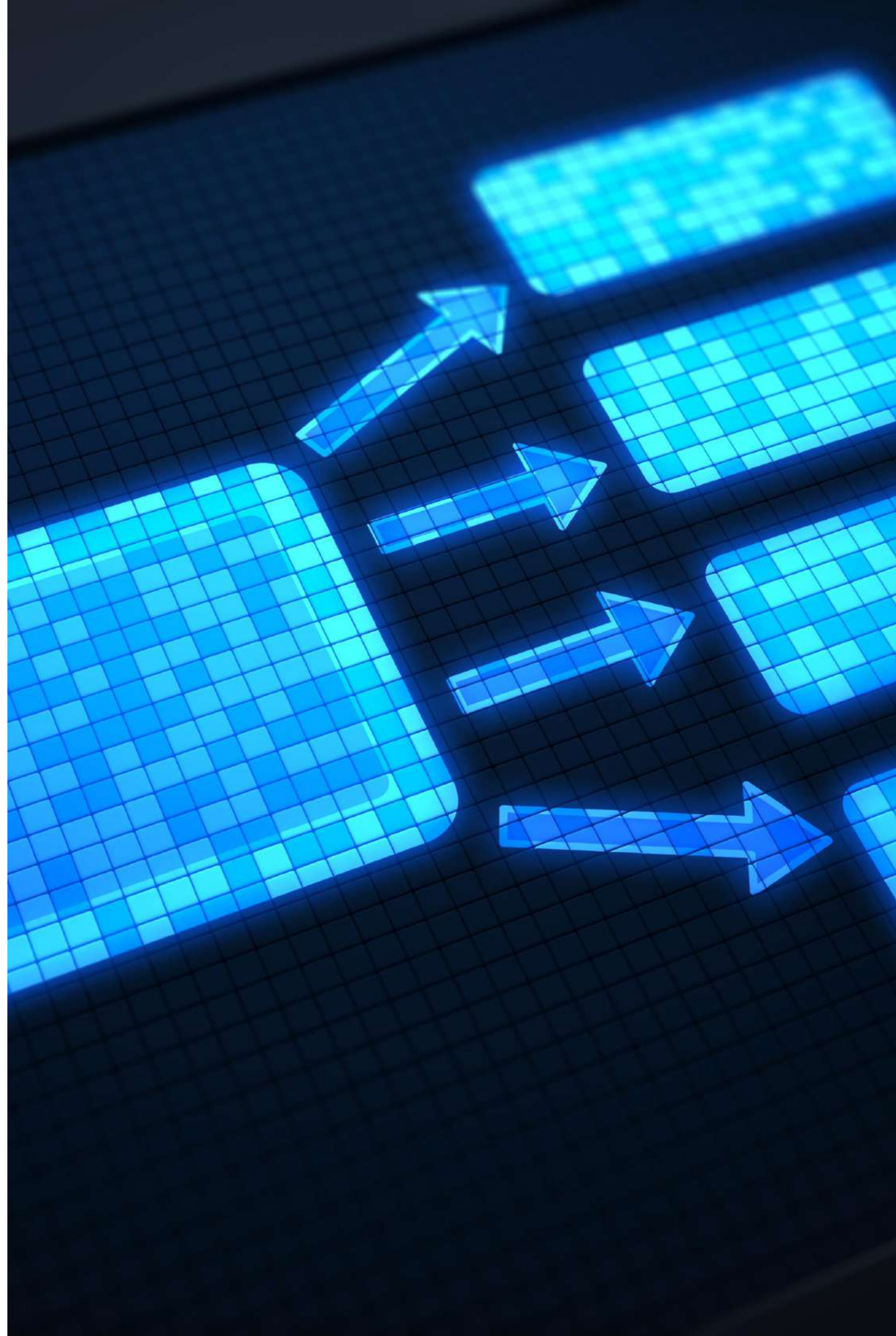
CONSOLIDATED DATA

- ✓ As we move into the next age of AI the consolidation of data is very important
- ✓ Most systems are networked so results from different tests can be aggregated and consolidated
- ✓ Data can be analyzed for patterns using ML & AI

WHAT COULD YOU BE DOING TODAY?

DATA LABELLING

- ✓ Data labelling is the first step to more analysis.
- ✓ Having categorized data rather than operator text inputs allows for filtering and statistics.
- ✓ Define some categories and only allow “other” as a last resort.
- ✓ AI categorization algorithms work well with labelled data



WHAT COULD YOU BE DOING TODAY?

AUTOMATED KITTING

- ✓ Failure analysis can show hook-up issues
- ✓ Usually, the kitting for the test is done by requirements document
- ✓ ATE programs contain the information about the required kit
- ✓ Automated kitting can remove operator mistakes

FAULT ANALYSIS & INVESTIGATION IN ELECTRICAL WIRE HARNESS TESTING:

WHAT SHOULD YOU BE THINKING ABOUT FOR THE FUTURE?

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WHAT SHOULD YOU THINK ABOUT FOR THE FUTURE?

LIVE TEST MODE (REAL TIME SCANNING)

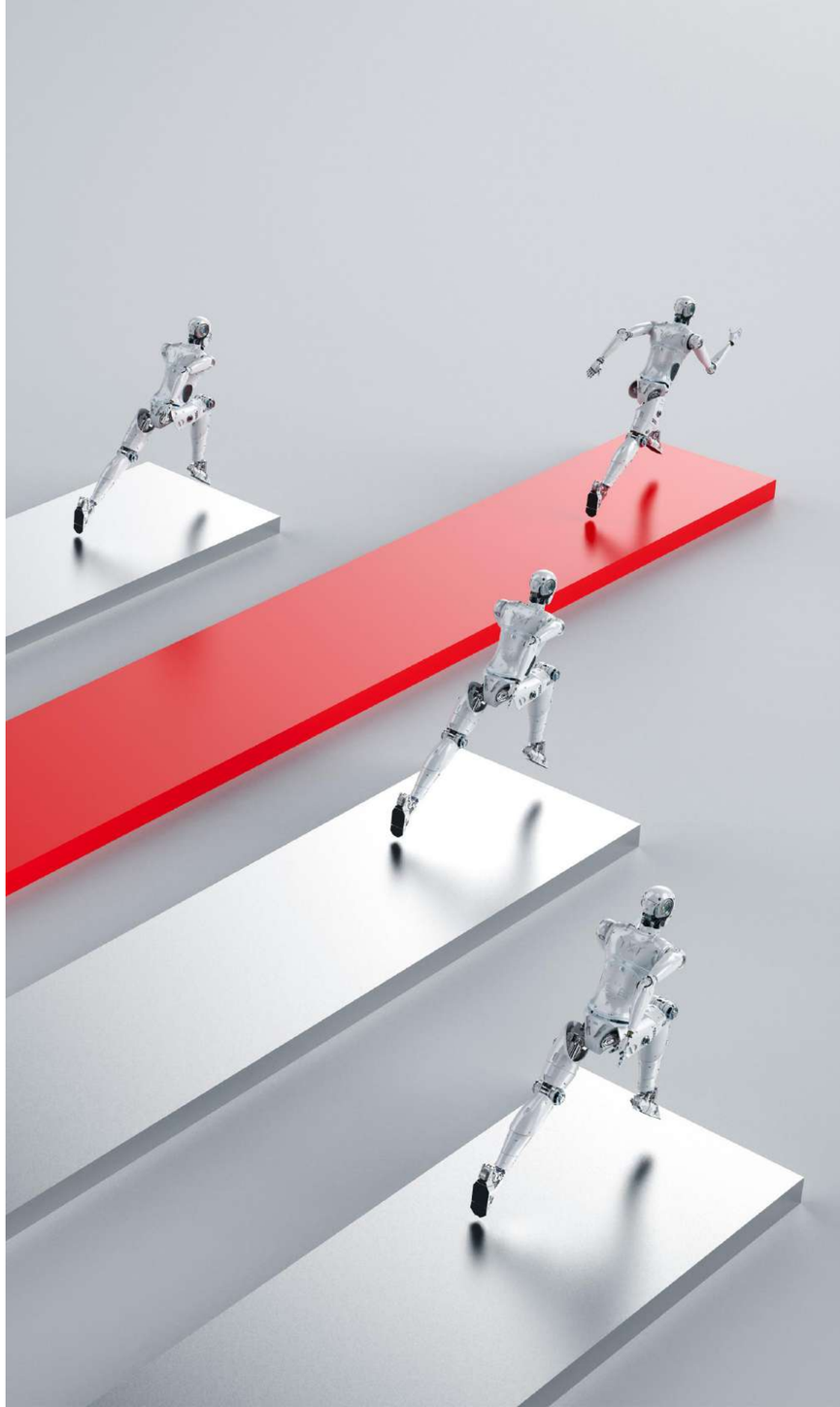
- ✓ With safe low voltage testing, the results are recorded from the start of hook-up and even during manufacture

- ✓ This shows a complete picture of the build process that could help with:
  - Test setup processes
  - Manufacturing/Assembly process
  - Tooling analysis
  - Repeat failure analysis
  - Intermittent faults

WHAT SHOULD YOU THINK ABOUT FOR THE FUTURE?

AUTOMATIC TEST OPTIMIZATION

- ✓ Re-ordering test run and sequences to help bring common issues to the start of programs.
- ✓ The faster the issue can be found the quicker it can be fixed!



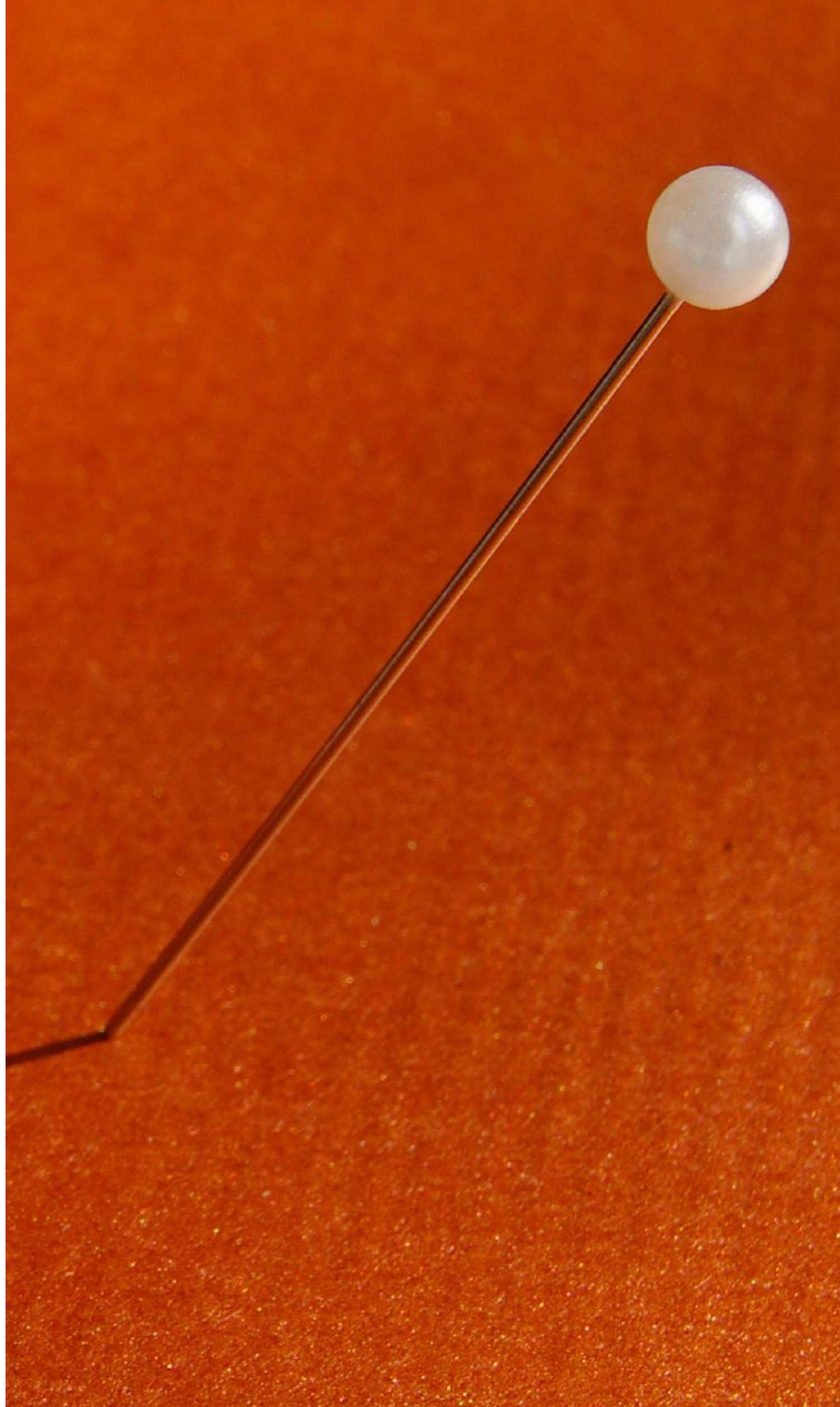
WHAT SHOULD YOU THINK ABOUT FOR THE FUTURE?

ARTIFICIAL VS AUGMENTED

- ✓ Artificial Intelligence – the rise in machine learning and neural networks has created a buzz in all industries!
- ✓ Finding patterns that are hard for humans to spot
- ✓ Adding operator guidance to direct them to faults “Augmented Intelligence”
- ✓ AI optimization from failures and process suggestions

https://digitalreality.ieee.org/publications/what-is-augmented-intelligence

WHAT SHOULD YOU THINK ABOUT FOR THE FUTURE?



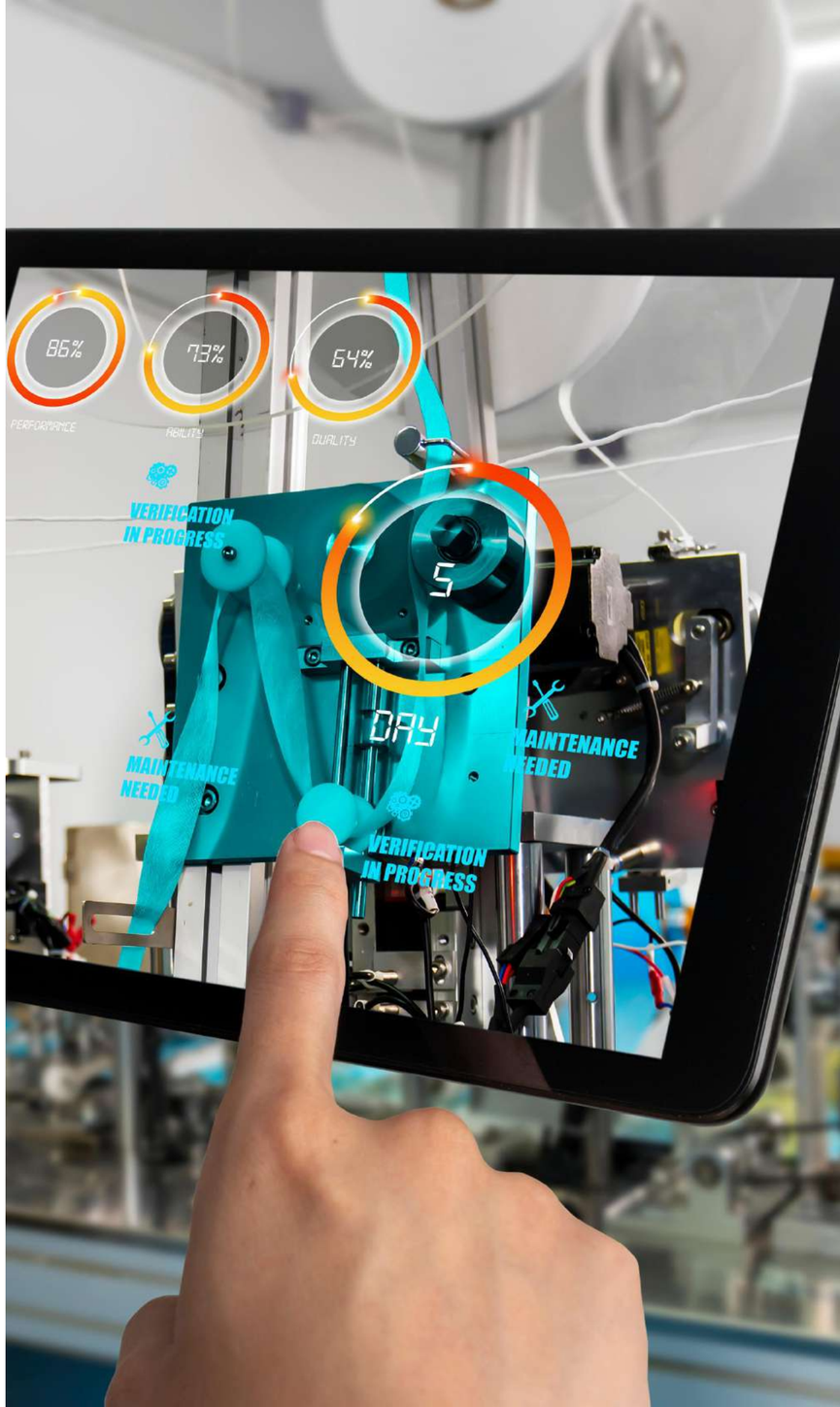
AUTOMATED FAULT LOCATION & ANALYSIS

- ✓ Failures in large UUTs can be hard to locate, only the From/To points are shown
- ✓ Adding distance to fault analysis as an automatic step on failure can enhance the speed to fix
- ✓ Another example of Augmented Intelligence and links closely to Augmented Reality (AR)

WHAT SHOULD YOU THINK ABOUT FOR THE FUTURE?

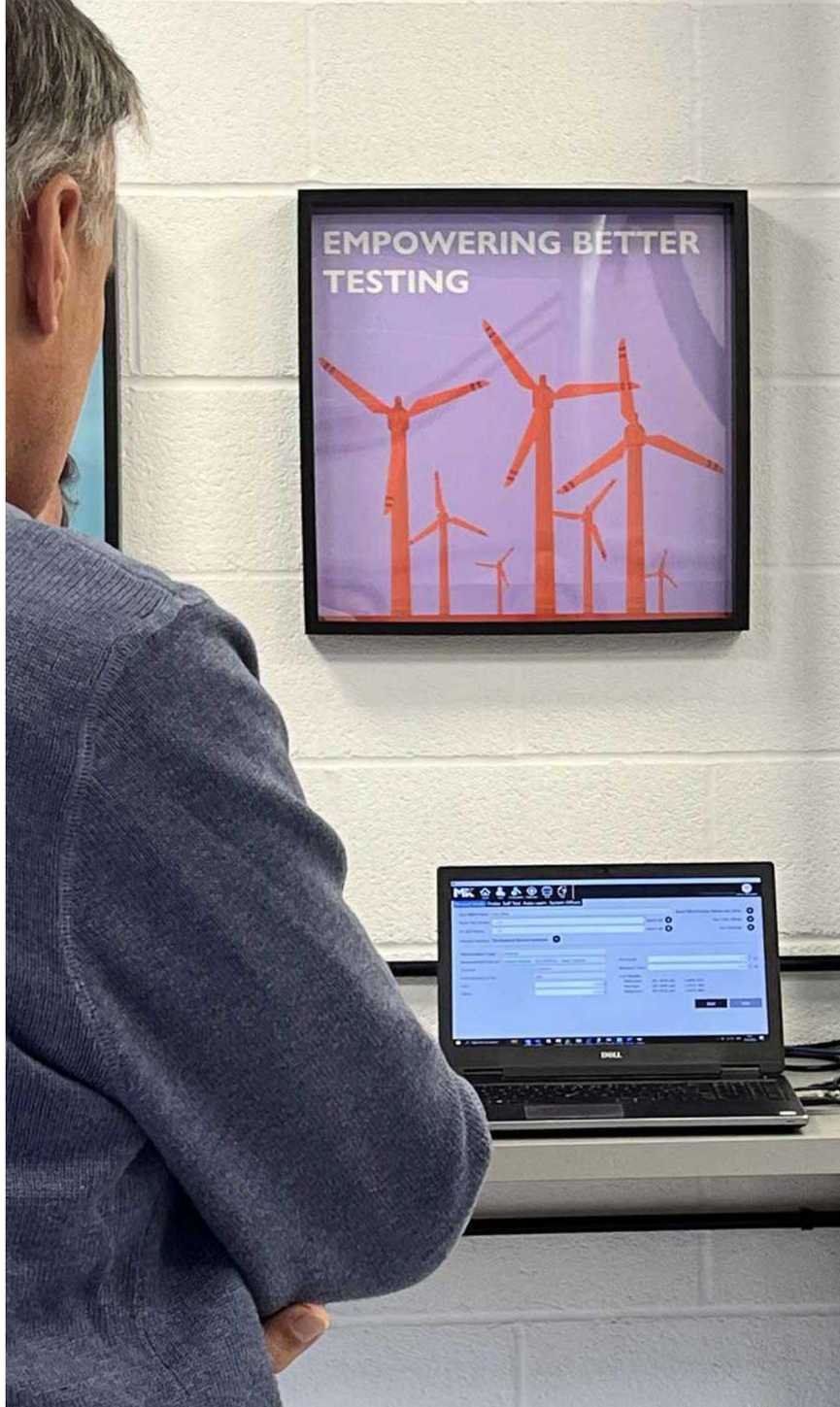
AUGMENTED REALITY (AR)

- ✓ Failure visualization using Augmented Reality
- ✓ Fast fault location within the UUT
- ✓ Can see behind panels! (X-Ray Specs)
- ✓ Adds layers of information such as:
  - Resistance measurement color gradient
  - Highlight intermittent faults
  - Animated instructions



IN SUMMARY

- ✓ Today's automated test technology is not always used to its full potential
- ✓ Some of today's methods are driven by yesterday's technical constraints
- ✓ Lots of information can be found by recording all failures including hook-up / tear-down mistakes
- ✓ More automation in all phases of testing can help track and avoid failures
- ✓ The AI age has arrived, but we need data sets labelled and ready!
- ✓ In safety critical applications the future will likely be augmented rather than artificial



QUESTIONS?

Access and download today's content here:

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