New defect classification methodology with regard to causal modeling, supervised by engineers (SME)

A Day in the Life of an Engineer

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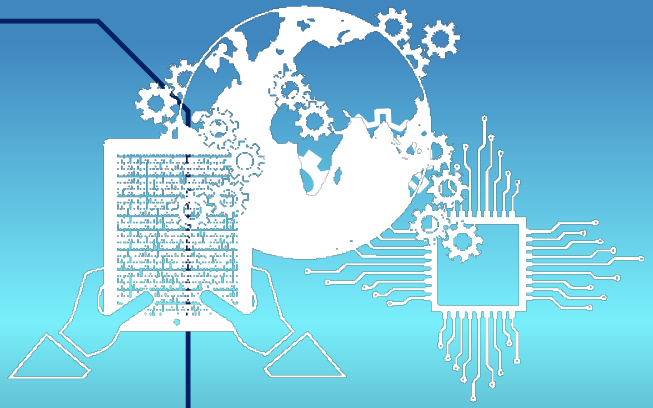


The project iDev40 is co-funded by the ECSEL Joint Undertaking, grants from Austria, Belgium, Germany and Spain as well as the European Structural and Investment Funds. It is coordinated by Infineon Technologies Austria AG.

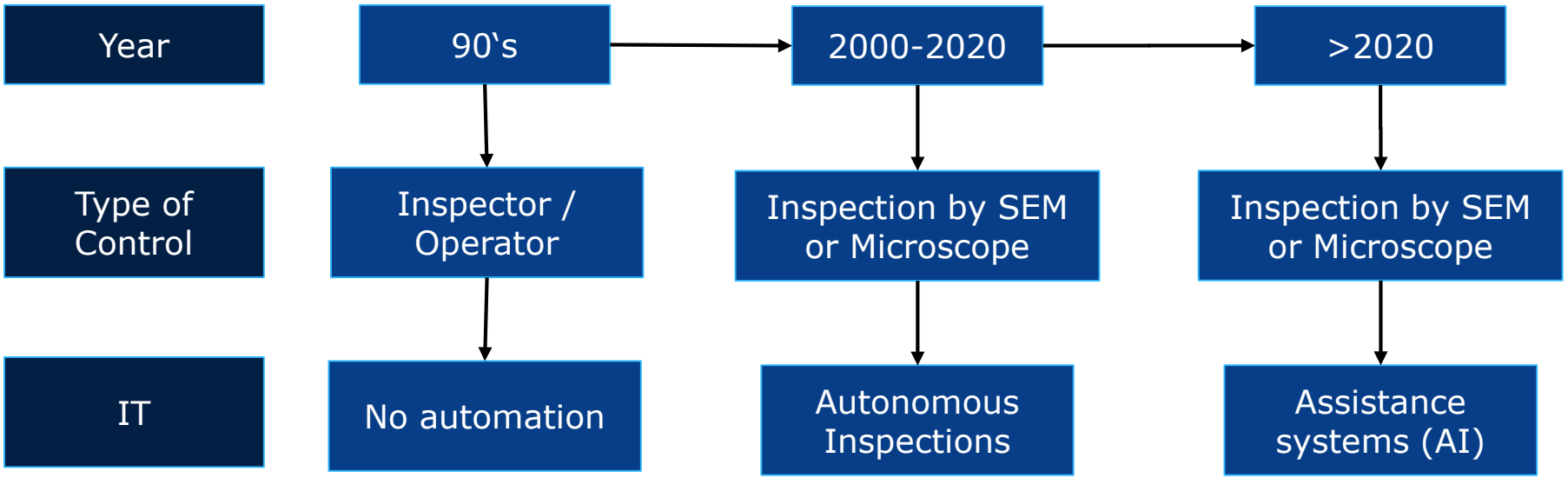
iDev40

Agenda

- Motivation, where does DE (defect engineering) comes from
- A day in the life of an engineer
- New kind of defects
- Causal source / causal model
- Adaptation of causal model / training
- AI validation
- Conclusion / open questions

Example: health care vs. semiconductor

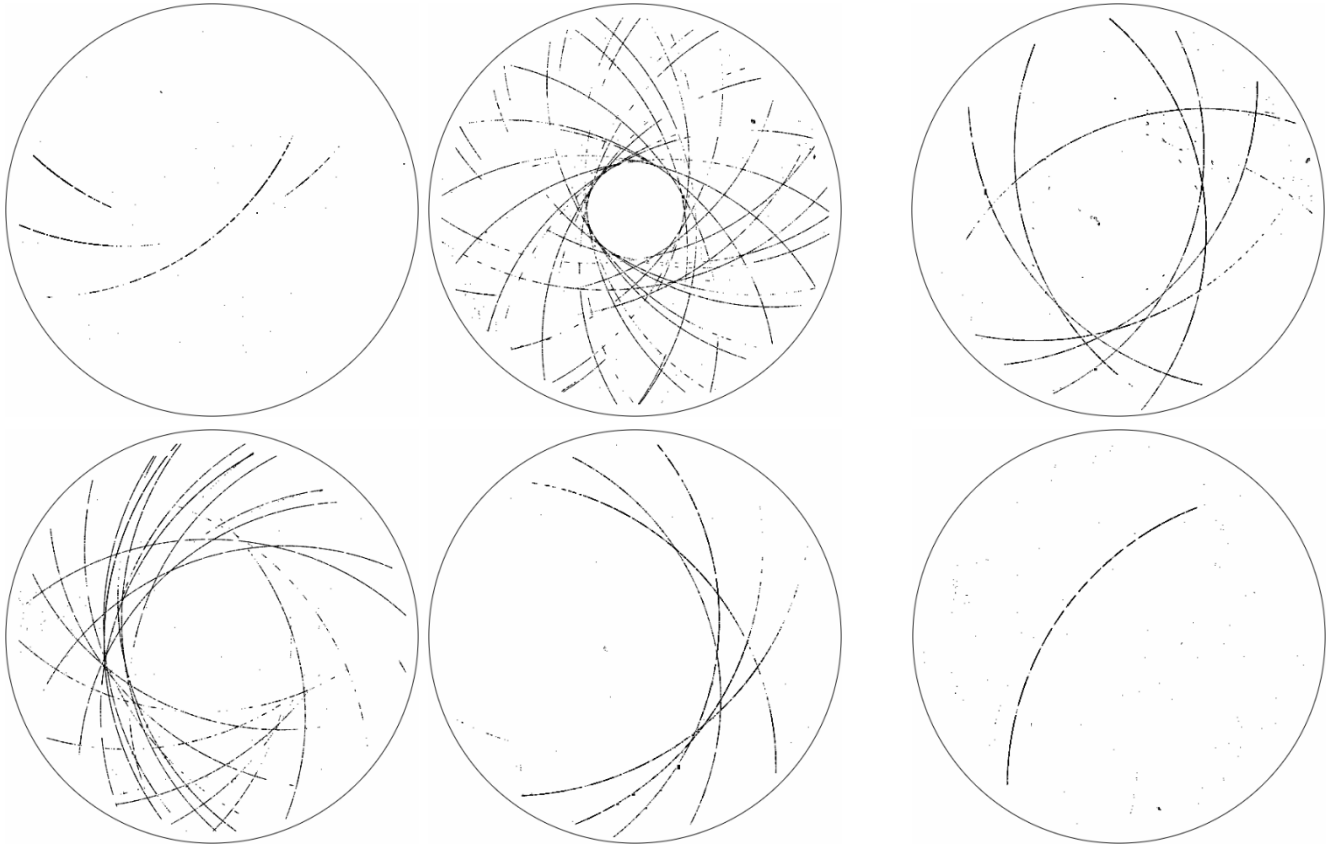
The evolution of DDE automation



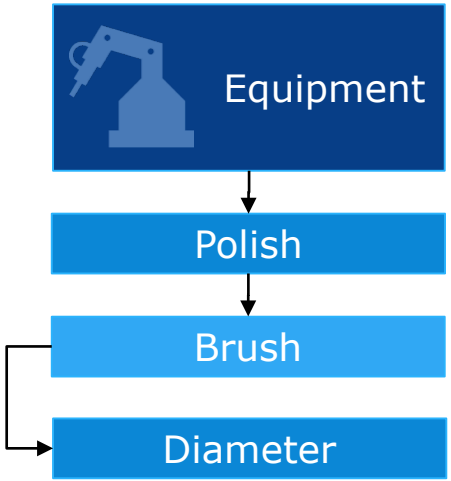
9:00AM – A Normal Day

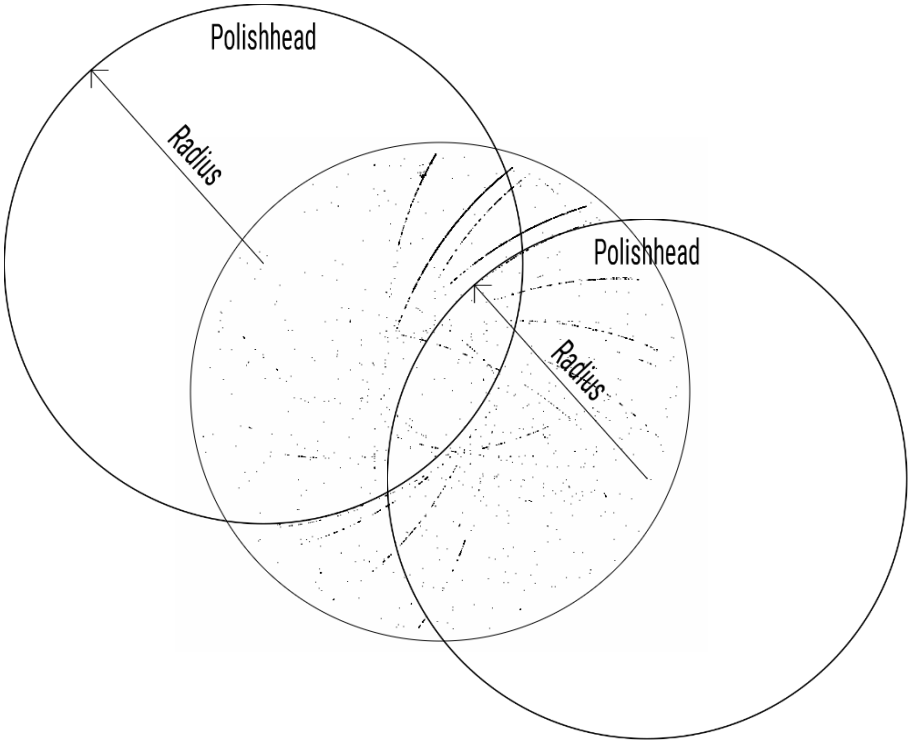
- Engineer begins work
- Checks Mail
- Recieves notification of a problem in production with a polisher tool
- Operator attached a list of wafers
- Engineer lookups polisher tool in a database
- Production operation lookup

9:30AM – Defect Image Analysis

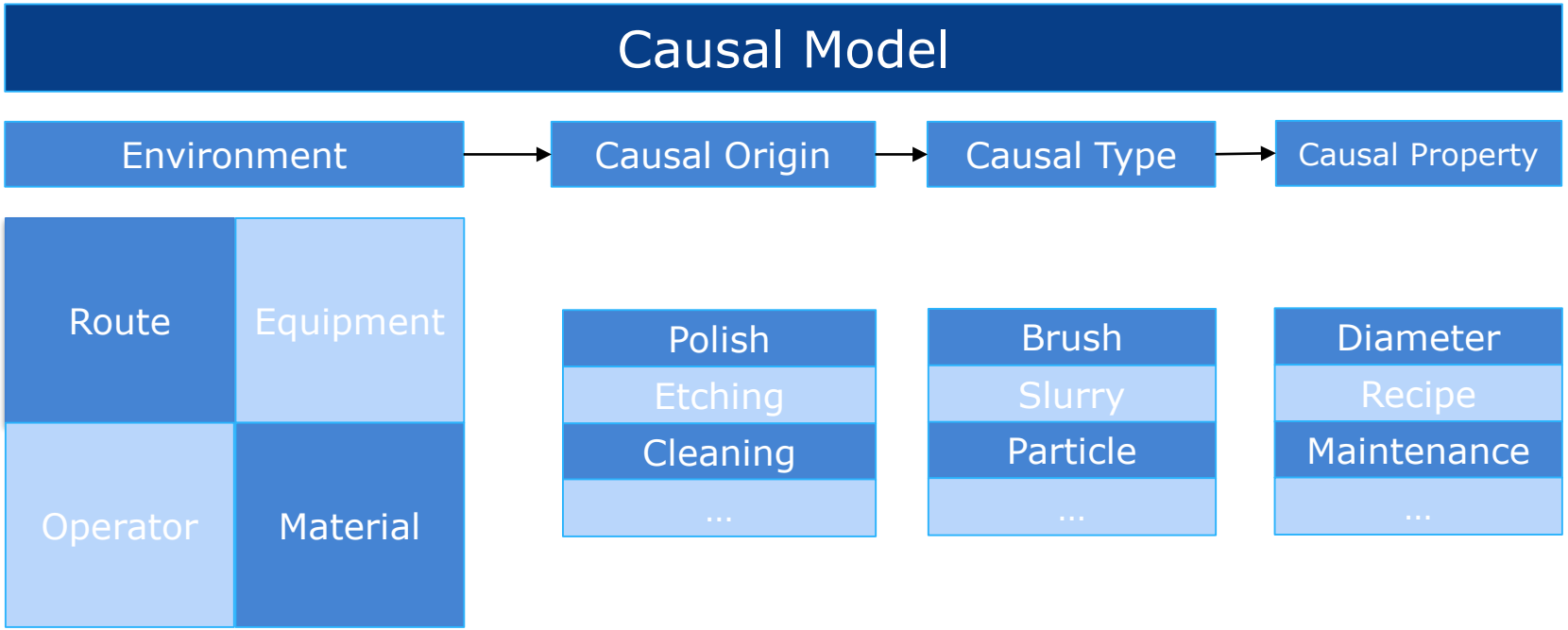


Causal Source





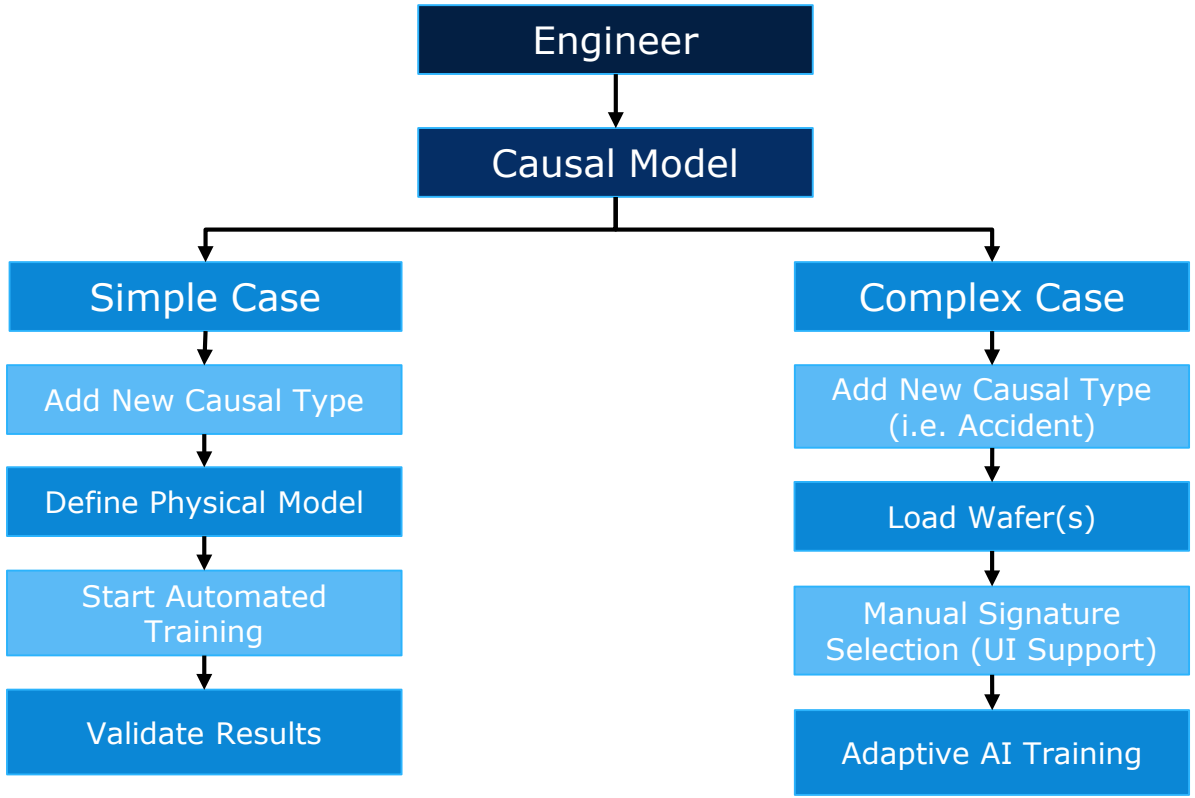
Causal Model Definition



10:30AM Root Cause Analysis

- Engineer understands the problem
- Knowledge of which operation / range causes the signatures
- Opens the cause modeling / training suite
- Lookups existing causal model types
- Starts creation of new causal model type
  - Polisher tool with 300mm diameter

Training Modes

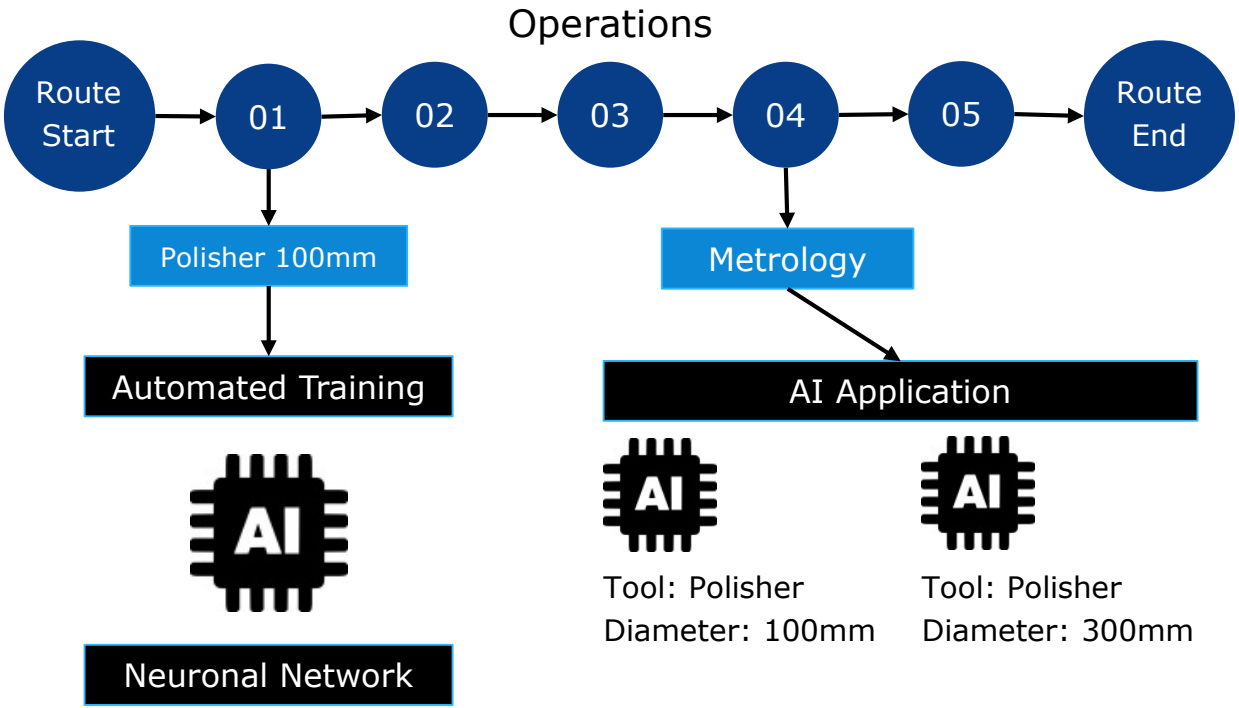


1:00PM Causal Model Adapted

- Engineer adapted the causal model
- Created a new causal model type for polish tool 300mm diameter
- Defined parameters for the training environment
- Assigned the new causal model type to the specific operation
- Started the training phase

Production Flow

Production Route



3:00PM AI Training finished

- The AI toolkit reports that the training is finished
- Engineer loads validation data (100s / 1000s of wafers)
- Start of validation / QA process
- AI is tested against the mass data before production ready

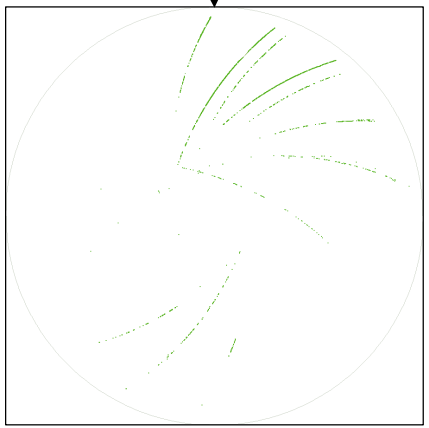
Causal Model Application

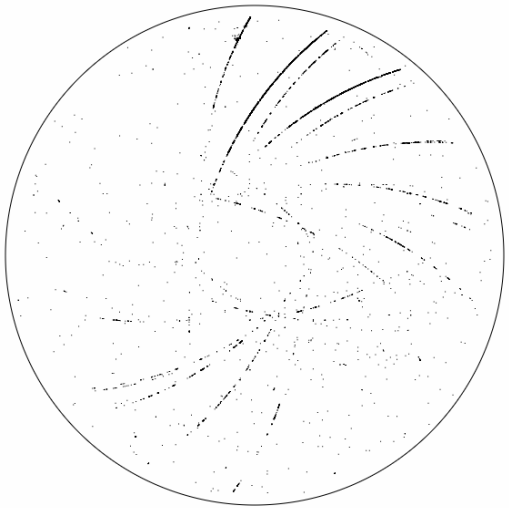
Causal Model → Apply Causal Model ← Defect Data

Equipment

- Polish
- Brush
- Diameter
- Recipe

Universal Signature Engine





4:30PM AI Validation finished

- The AI found 85% of signatures
- Engineer adding missing signatures by manual signature selection within modelling toolkit
- Adaptive AI training with the expert knowledge of the engineer
- Starting AI validation

5:30PM AI Validation finished

- AI now has 90% accuracy rate
- Accuracy rate is defined by QM
- AI is now certified for production
- AI is assigned to the specific metrology operation where the signatures occured
- AI is moved to production and supports the signature detection

Conclusion

- Engineers‘ expertise is still required
- As humans are producing errors so can AI system
- AI system is meant to support the production process
- Easy to use user interfaces
- Elimination of complex alogorithms with loads of parameters
- Elimination of undefined behaviour of statistical algorithms
- Faster and error reduced detection setup

Known Problems

- Back side scans with large defect densities can cause fuzzy signature recognition
- Solution: Application of density reduction with specialized reduction algorithm
- -> Loss of information
- -> Only parts of signatures can be detected

Thank You!

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