CHILLVENTA

Chillventa Specialist Forums 2022
Chillventa Fachforen 2022

CONNECTING EXPERTS.

New Uses for Modeling & Simulation

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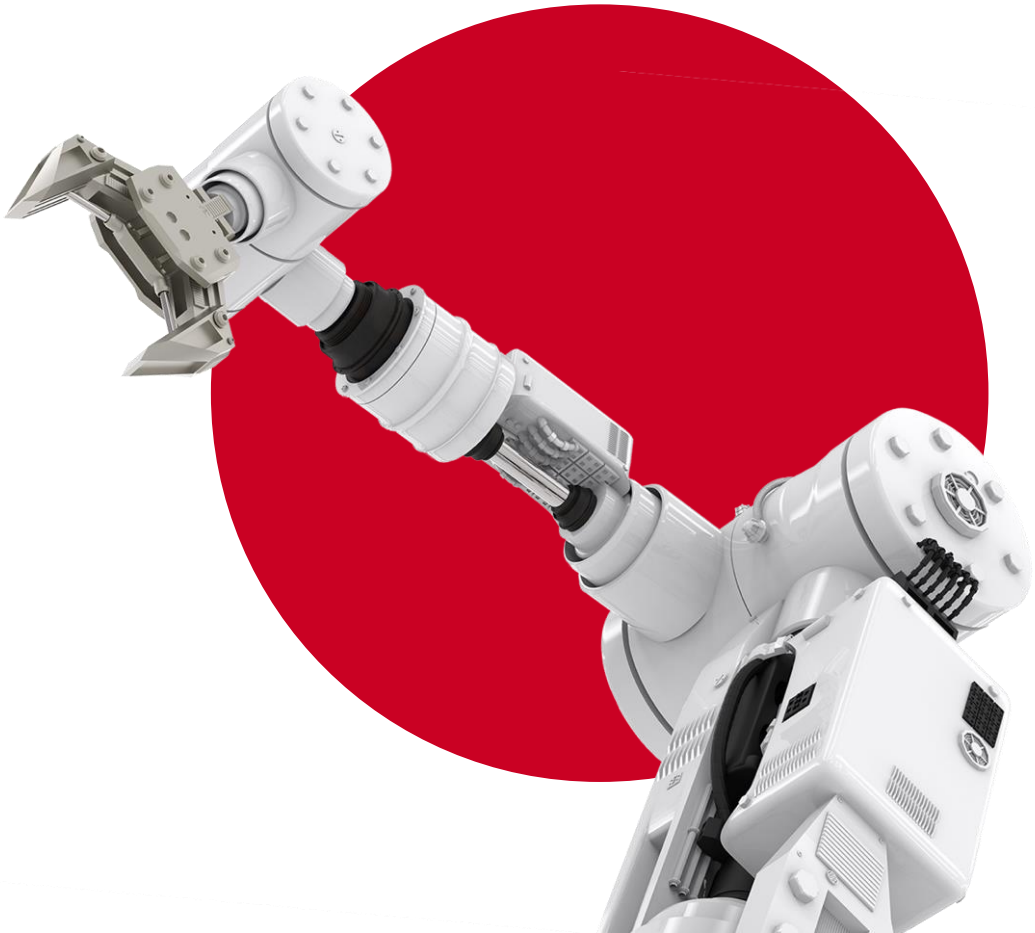
Oct. 12, 2022

Safety. Science. Transformation.™

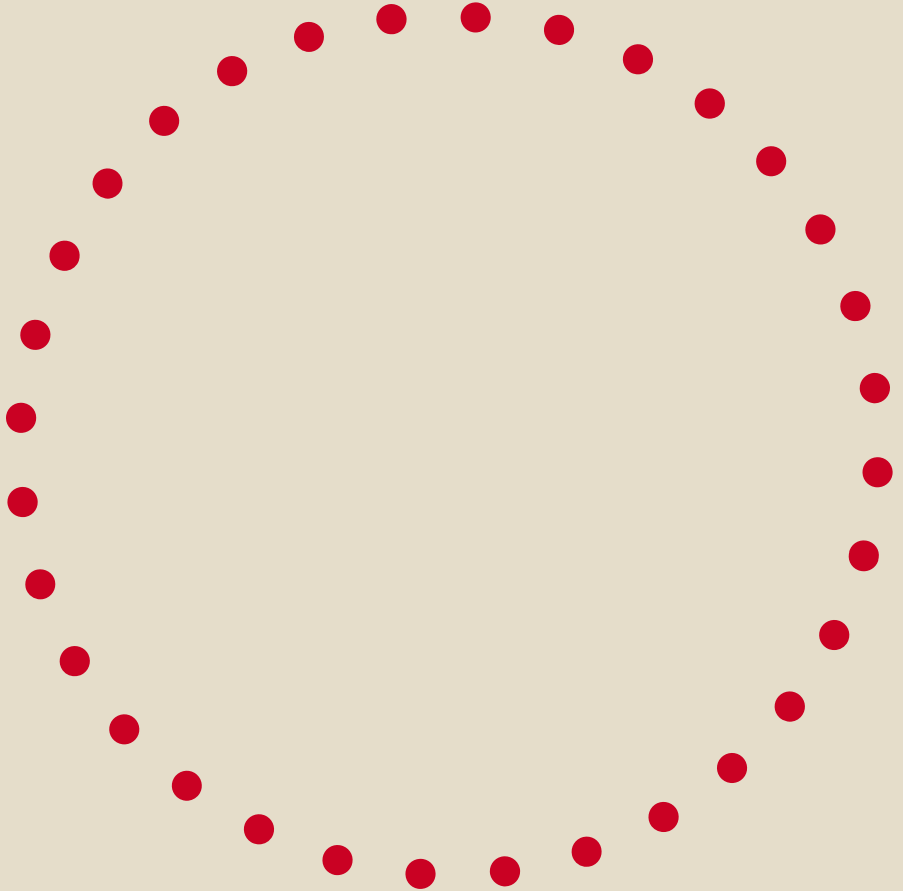
We are now UL Solutions

New brand. Same mission.

Evolving safety science, exploring the world’s pressing challenges and continuing to empower our customers to innovate with confidence.



Why modeling and simulation for compliance?



Why modeling and simulation for compliance

Digitize the supply chain

End-product manufacturers are increasingly inquiring about models of their component suppliers.

Small and mid-size companies have not been investing in the simulation with the purpose of saving time and cost during product development.

Electronic products

The requirements for innovative electronics are growing.

Prevailing miniaturization.

Growing complexity.

Shorter development cycles.

Permanently changing modifications.

Safety and performance

The demand for robust insights early in product development is increasing.

Temperature behavior.

Spacing Measurements.

EMC/F.

And more.

Time and cost

Each change in the design process later on is associated with substantial cost.

Start with the modeling and simulation for compliance to reduce the number of prototypes and tests.

Accelerate time to market.

Why modeling and simulation for compliance?

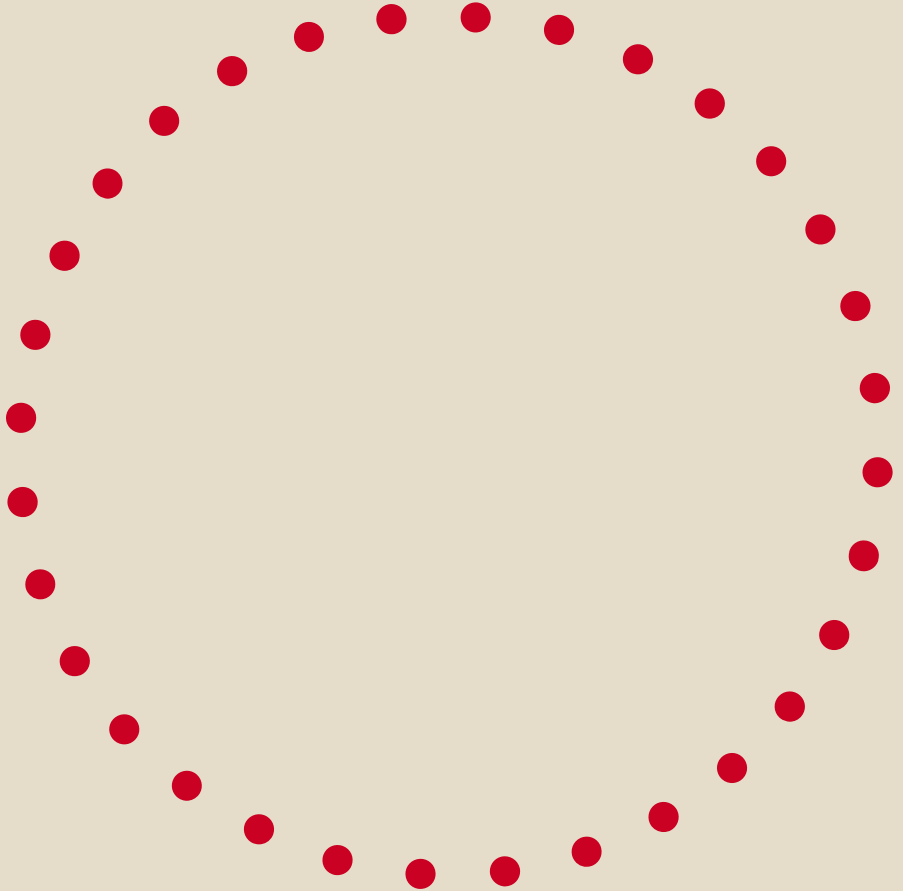
Simulation is nothing new. Established for decades in R&D.

Tools have become more user-friendly and computing power has increased over the last decades.

Pressure for reduced R&D time is constantly increasing. Physical testing requires physical samples. Risk of redesign is late in the R&D process.

Pressure for reduced R&D cost ($$$) is constantly increasing. Physical testing requires physical samples. Those prototypes are extremely expensive and come late in the R&D cycle. Risk of redesign is late in the R&D process.

Model trustworthiness and governance



Model trustworthiness

To support any sort of decision, whether it is for product design, failure analysis or certification and compliance, a case must be built to demonstrate that a model and its predictions are **trustworthy**:

IT IS NOT JUST ABOUT THE RESULTS
Transparency for entire model building process

EXPLAINABLE RESULTS
An understanding of the underlying phenomenon being modeled by the mathematics

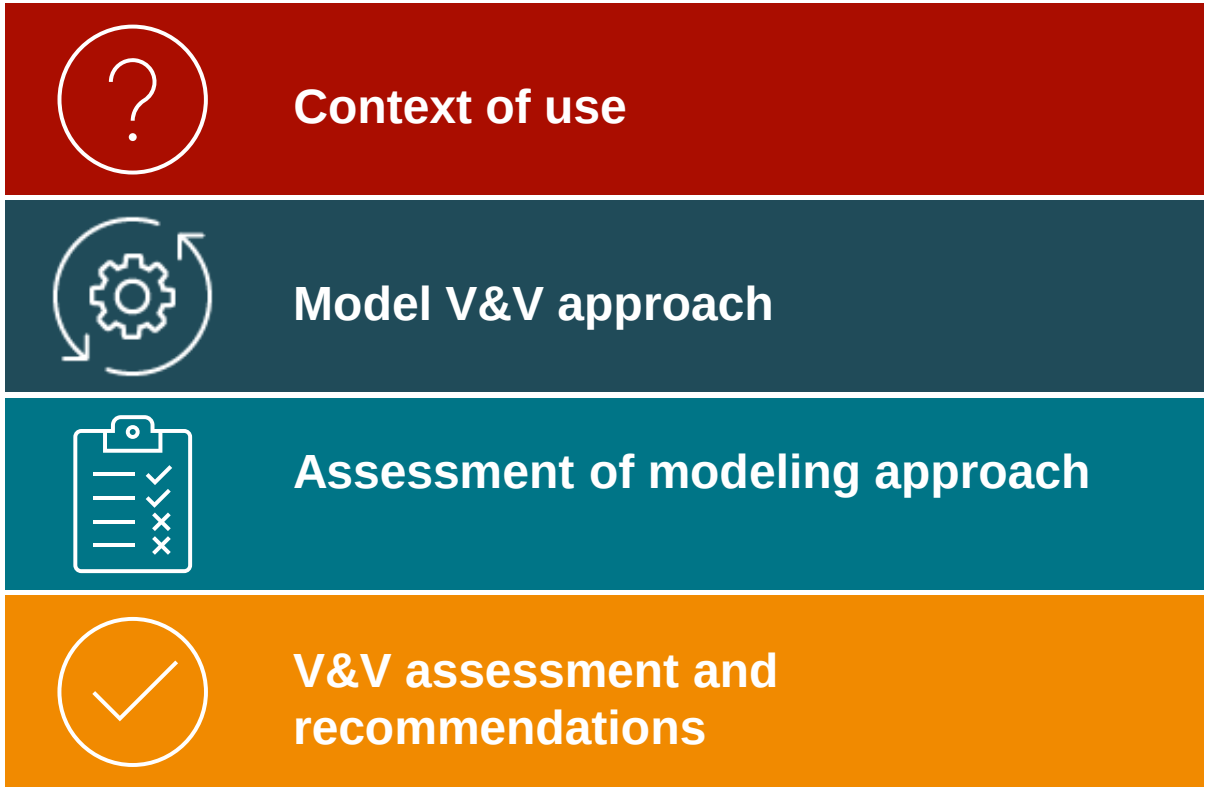
CONTEXT OF USE
Is this the right model and modeling approach for the question of interest?

Establishing trustworthiness

Establishing trust in model predictions is not simply about the results. It is also about the process.

Well-designed physical tests can help support model verification and validation (V&V).

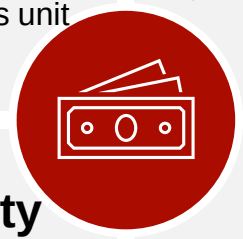
Independent model V&V assessment



Enabling ingredients to succeed with simulation in certification…

…a model design **cookbook** — how to model for a certain physical/technical domain, business unit and product topology

… a **suitable tool** that guides and facilitates the workflow. A more holistic workflow support in the future is preferred and validated part models from suppliers ready to use can further improve the efficiency and result accuracy

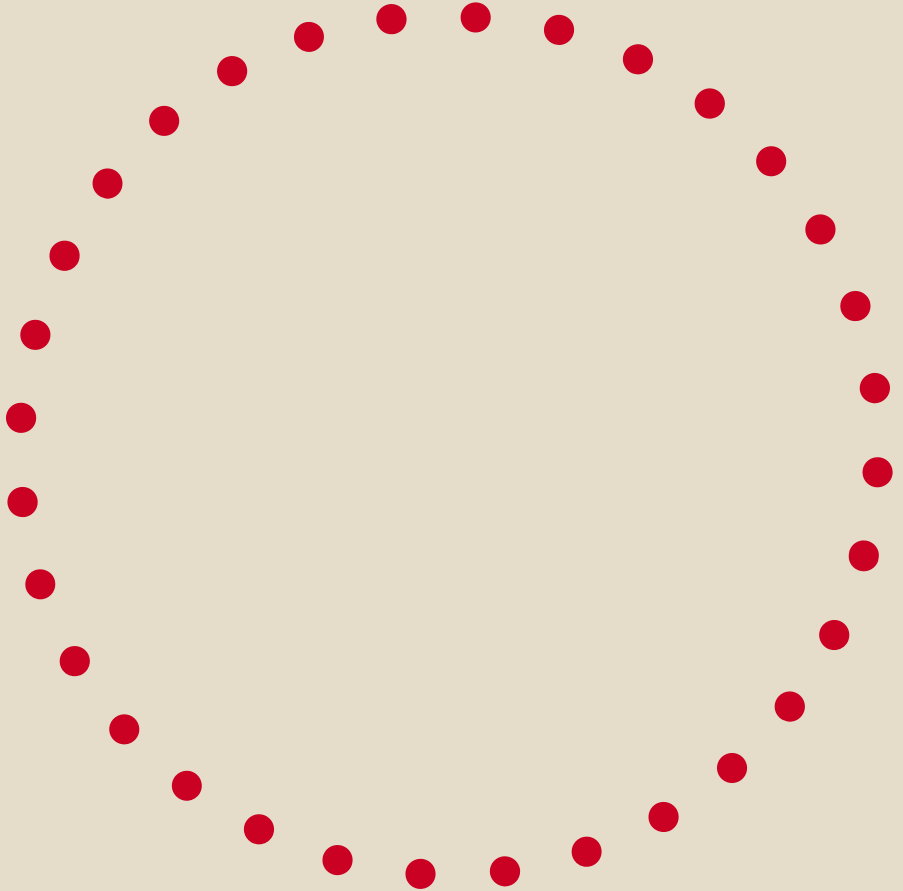


… an **independent party** which facilitates to prove and confirm the trustworthiness by limiting the effort with focus onto the relevant characters in the model design

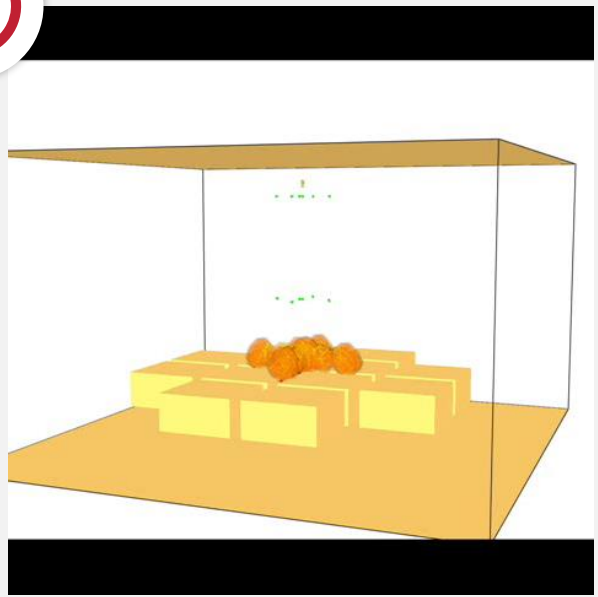
… a **suitable product** (family) with a significant number of EUT* or a modular concept, which promises a good reuse of the modeling approach

* Equipment under test

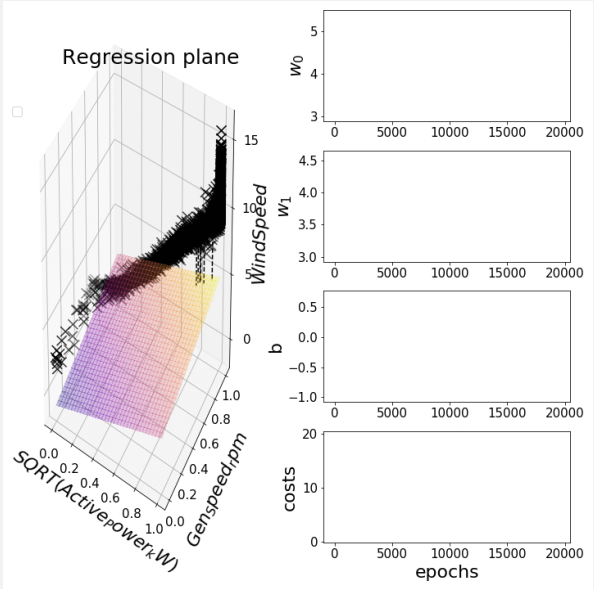
The deployment of modeling and simulation for certification



Types of predictive models



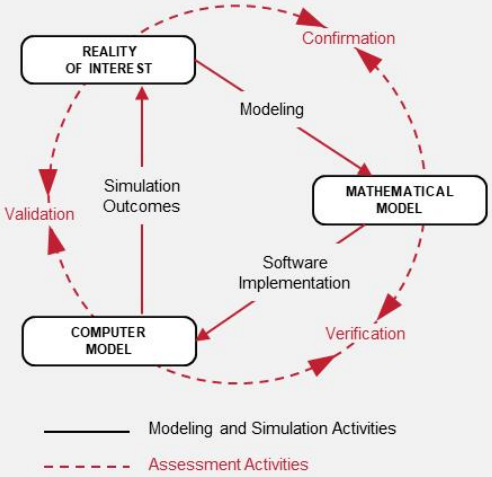
Computational multi-physics



Statistical/machine learning

Verification and validation (V&V) for computational physics

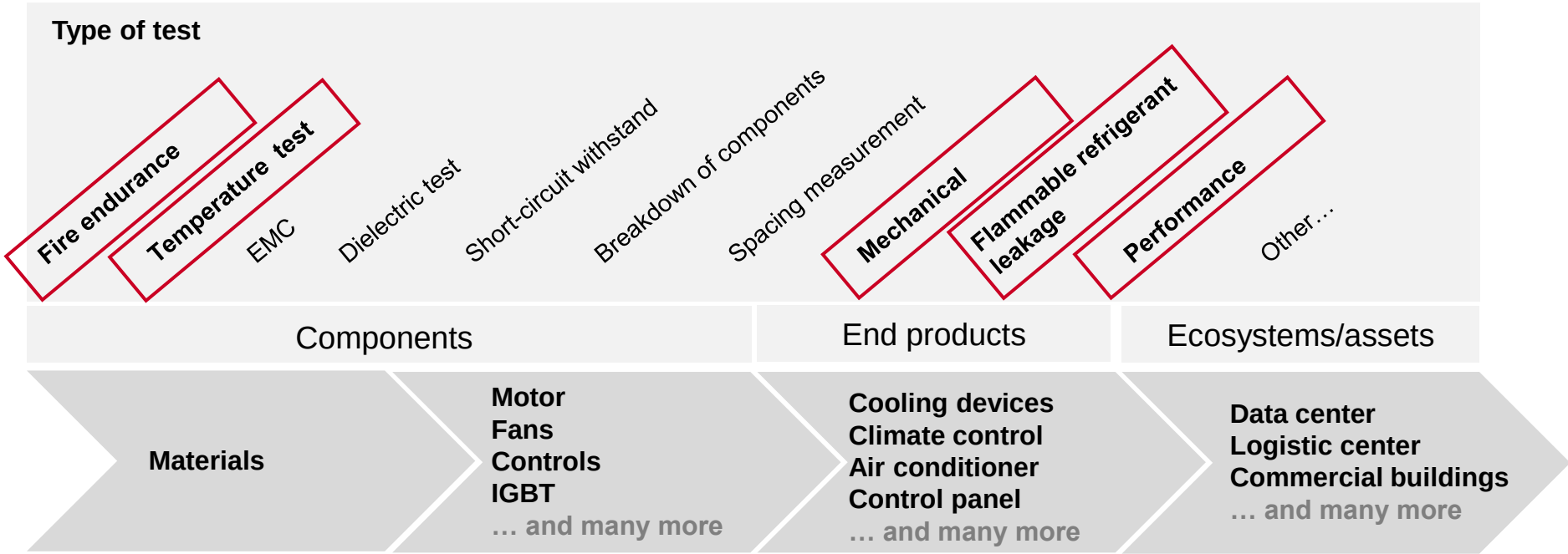
Overview



Standards/Handbooks

UL Solutions unique knolwledge-base in creating trustworthy regulatory frameworks

Prioritize the type of test based on the impact [time/cost]



Modelling and simulation for compliance

Predictive models themselves are generally not acceptable as sole evidence of conformance with mandatory test requirements in standards being used as the basis for a UL Mark certification or any other third-party certification.

The physics-based predictive model for a specific product design/test needs to go through a defined model verification and validation (MV&V) process by UL Solutions to get accepted as the basis for a UL Mark certification.

To establish the trustworthiness of a predictive model, it is necessary to have a process of determining the degree to which a mathematical model is an actual representation of the real world as it relates to the intended uses of the model and the accuracy of the model. This process is known as model verification and validation (MV&V).

Predictive models not validated and verified by UL Solutions may be used as a tool similar to thermography or data from non-calibrated test equipment during the R&D process.

Comparing simulation with physical tests

Physical test are accepted for certification if those test methods are based on a standard used for certification and the test laboratory meets the requirement of the certification body like UL Solutions. Components used in a product need to be traceable.

The physics-based predictive model for a specific product design/test needs to go through a defined MV&V process by UL Solutions for being able to get accepted as the basis for a certification.

Input parameters for a thermal model include power losses that need to be traceable.

In both cases:

- The selection of a product to be tested/simulated needs to be representative for the family to be certified.
- Positions of measuring devices like thermocouples need to be selected carefully.
- The verification needs to take place with the proper ratings/boundary conditions.
- Testing and simulation both require a level of rigor to provide confidence to the users of a certification.

The requirements of the appropriate schemes need to be considered in all cases.

Simulation to support engineering judgement

To determine which test can be waived for a family of products based on worst case.

Non-standard test methods like thermography to reduce the number of thermocouples during temperature rise tests.

Calculation, e.g., to determine max power losses (I^2R) based on common formulas, of a series of products to select the worst-case conditions used for testing.

Data from comparative measurements outside DAP to fine-tune test programs that will become the foundation for a certification.

Thermography can give additional insights and can therefore be used to support engineering judgment to reduce tests. The same approach applies to simulation. Simulation gives significantly more insight into the factors contributing to the results than thermography.

Those insights allow a certain reduction of a test program in both new certification but especially for alternate components and alternate ratings.

Benefits of a validated simulation model

Reduced risks in the product development process by early assessment of the standards compliance in the accuracy and granularity of a physical certification test → **time to market**

Reduced effort by less requirement of expensive test units, test facilities, infrastructure. Future: less manpower when tools support automated modeling and validated and ready-to-use component models are available → **saves costs**

Extended testability: Independence of the availability of test facilities, defined and reproducible test boundaries, deeper insights to reduce design margins, quick root cause finding and problem-solving, **source for innovative ideas**…

Questions?

For more information regarding modeling and simulation for compliance:

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Thank you

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