

# ITEA VMAP

A new Interface Standard for Integrated  
Virtual Material Modelling in Manufacturing Industry

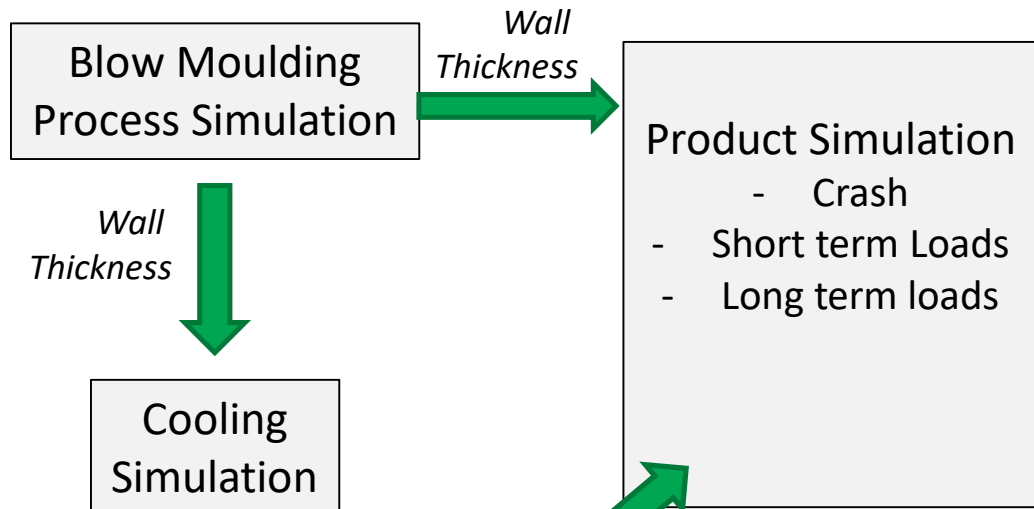
EMMC 2019

25-27 February 2019

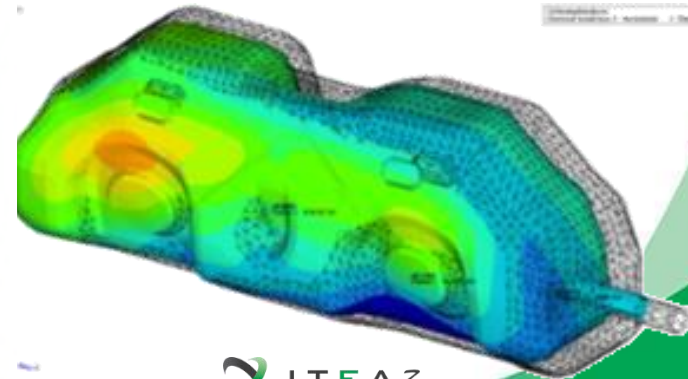


# Virtual Design and Engineering

## Example - Blow-Formed Containers



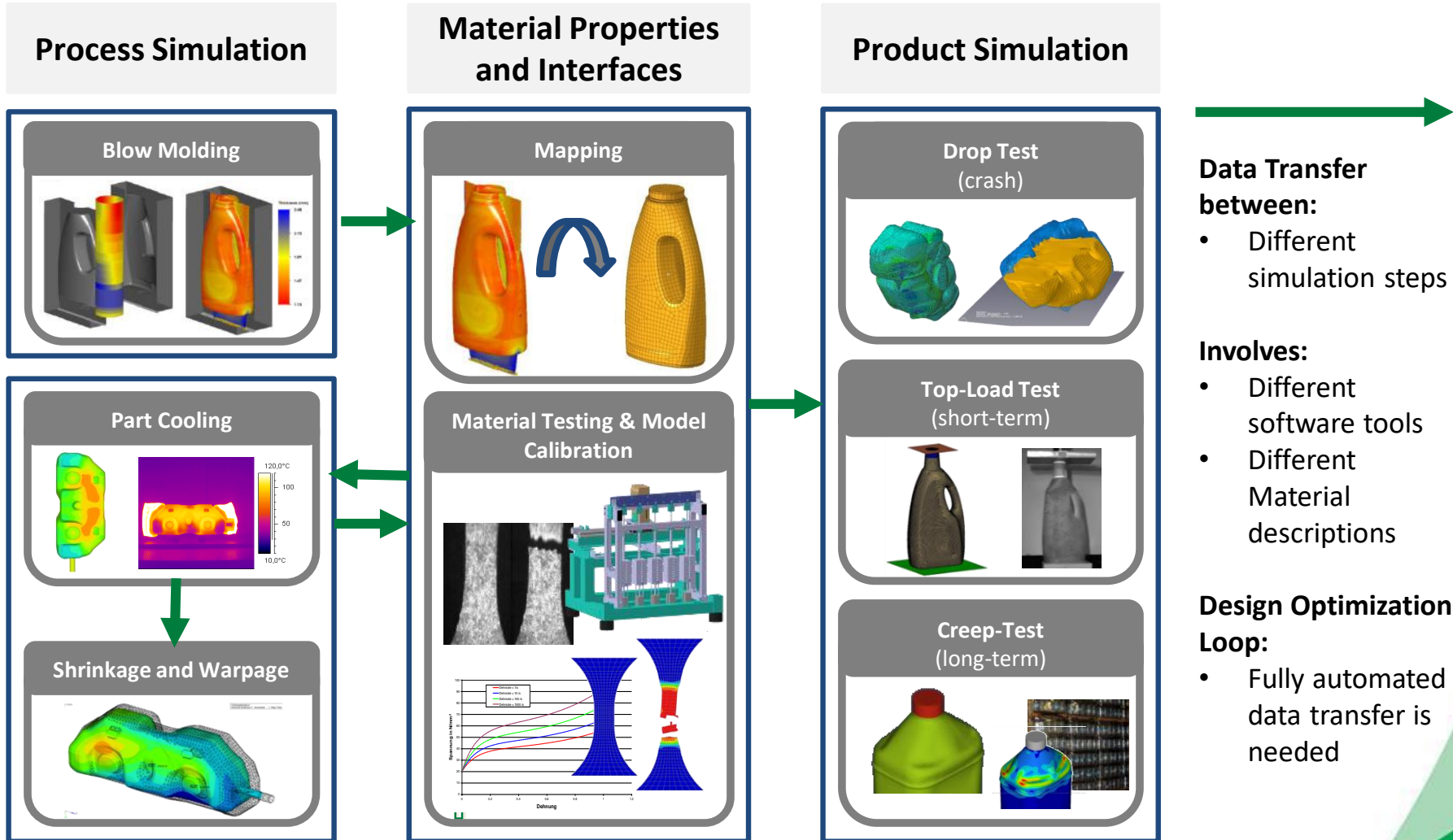
2018



February 7, 20

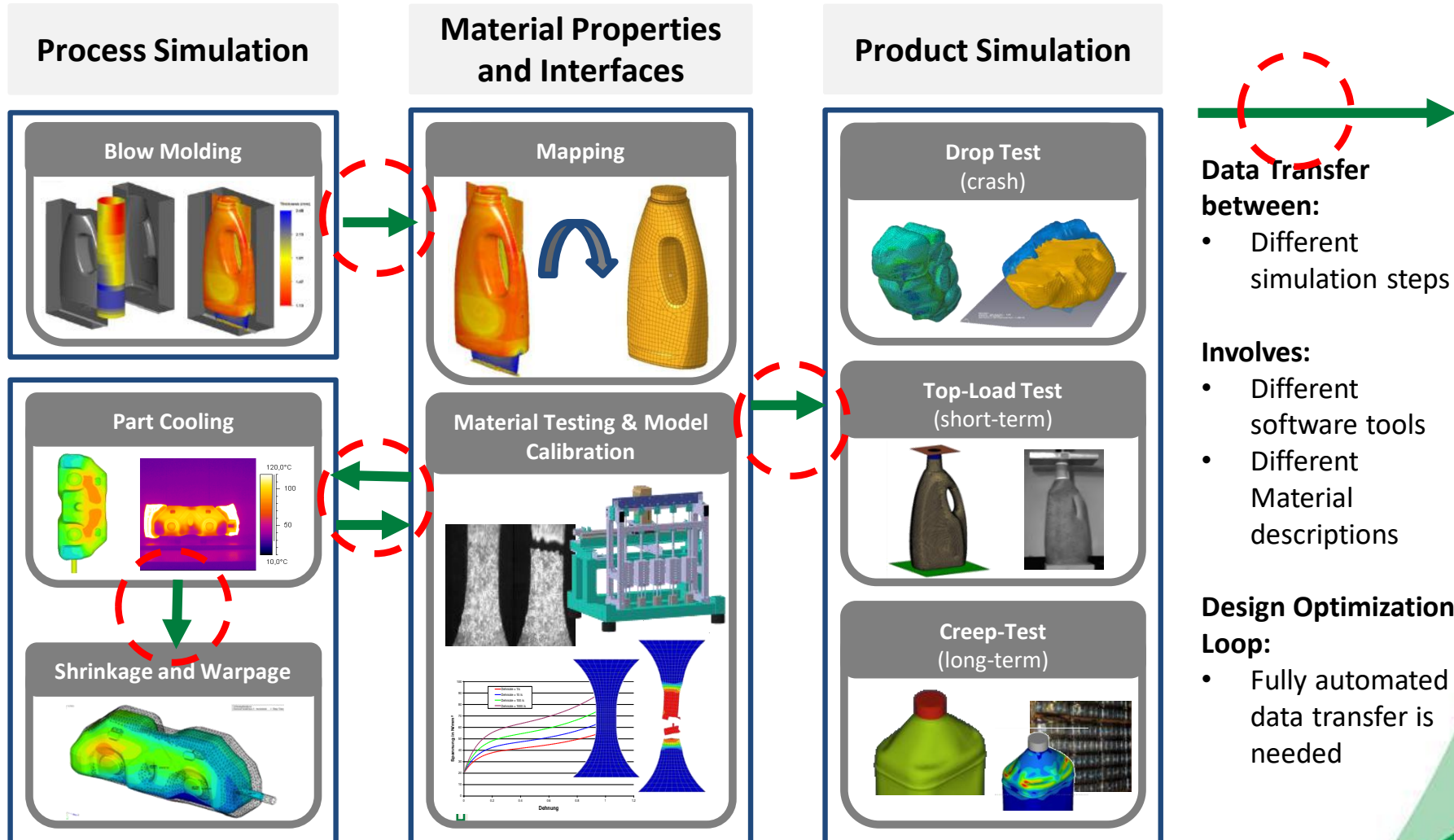
# Virtual Design and Engineering

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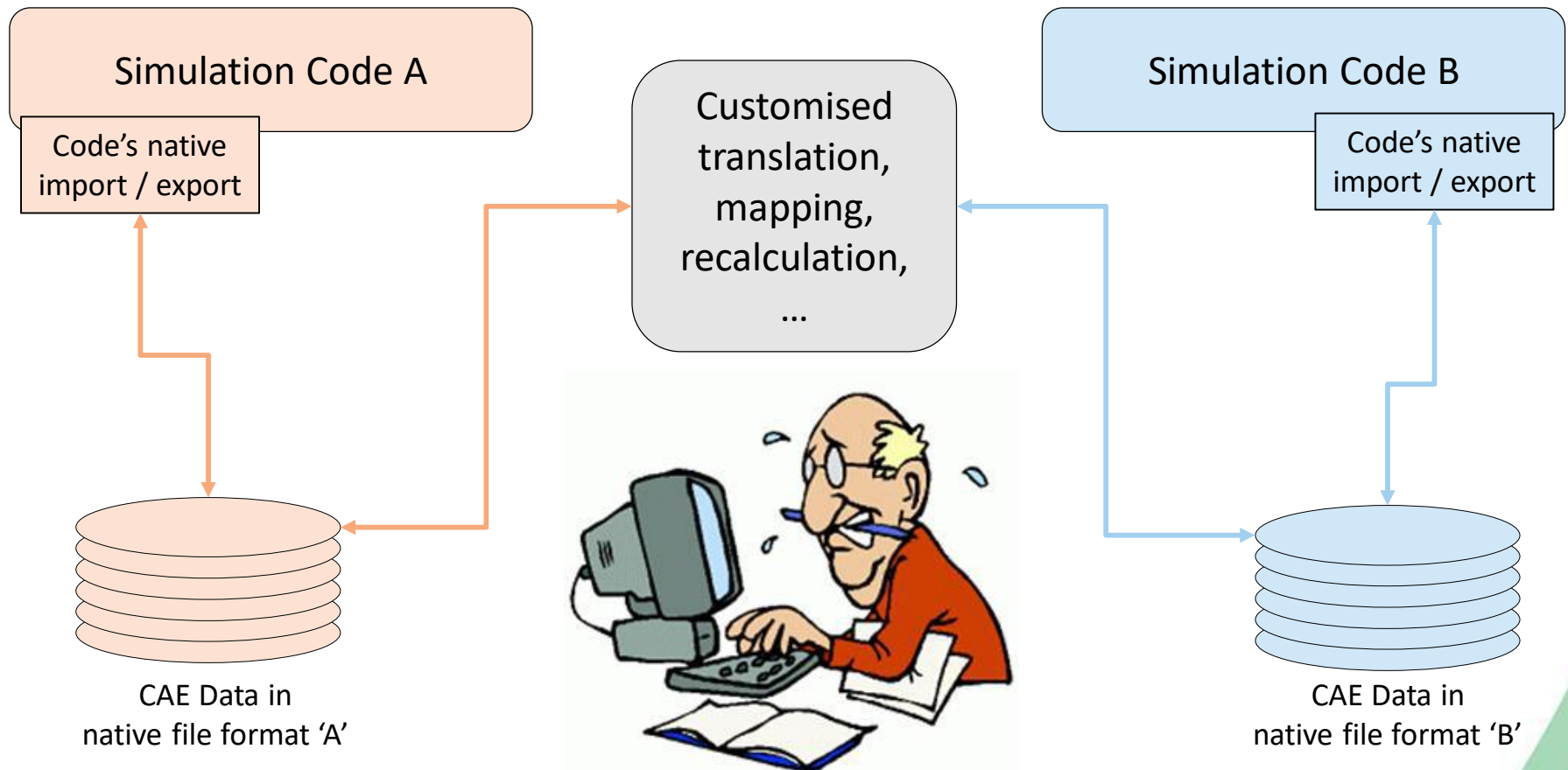
# Virtual Design and Engineering

## Example - Blow-Formed Containers

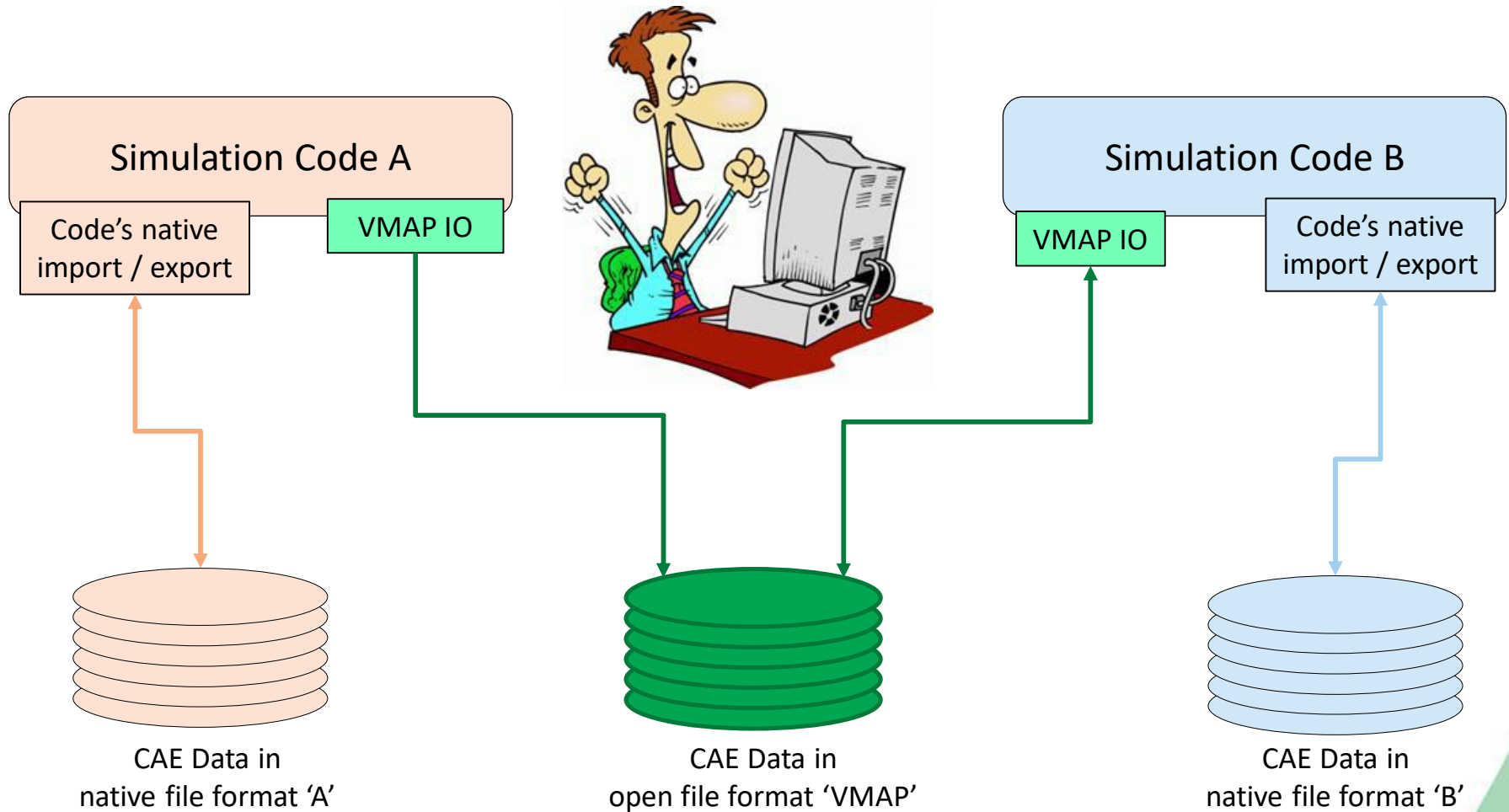


# Interface standard is missing

# Current Situation



# Ideal Solution



# VMAP Goal: A new interface standard for material data transfer in CAE workflows



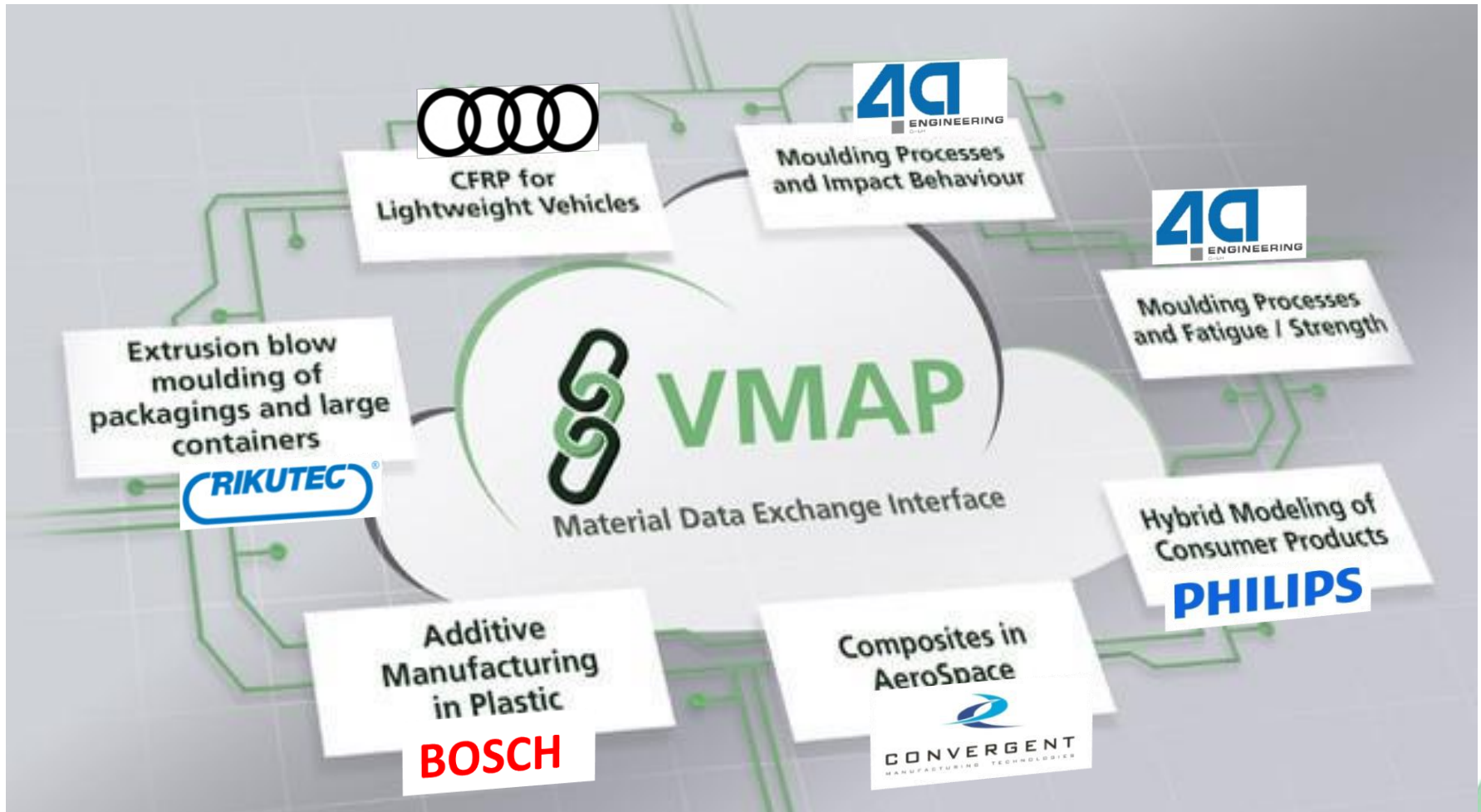
The major goal of the project VMAP therefore is to gain a common understanding and interoperable definitions for virtual material models in CAE. The VMAP project will run industrial use cases from major material domains and with representative manufacturing processes.

- VMAP will generate universal concepts and **open software interface specifications** for the exchange of material information in CAE workflows.
- VMAP will realise **prototype implementations** for extended CAE tool interfaces and – where necessary – translation tools which follow the open interface specification.
- VMAP will implement virtual **industrial demonstrators** for relevant material domains and manufacturing processes and provide best-practice guidelines for the community.
- VMAP will establish an open and vendor-neutral **‘Material Data Exchange Interface Standard’ community** which will carry on the standardisation efforts into the future.



[https://www.nafems.org/about/vendor\\_network/](https://www.nafems.org/about/vendor_network/)

# Material Data Interface VMAP Demonstrators





# Material Data Interface VMAP Consortium



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THE NETHERLANDS



THE NETHERLANDS



CANADA



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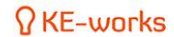
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Software Development



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Industrial Applications



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Modelling Experts

February 7, 2019

Dissemination



GERMANY

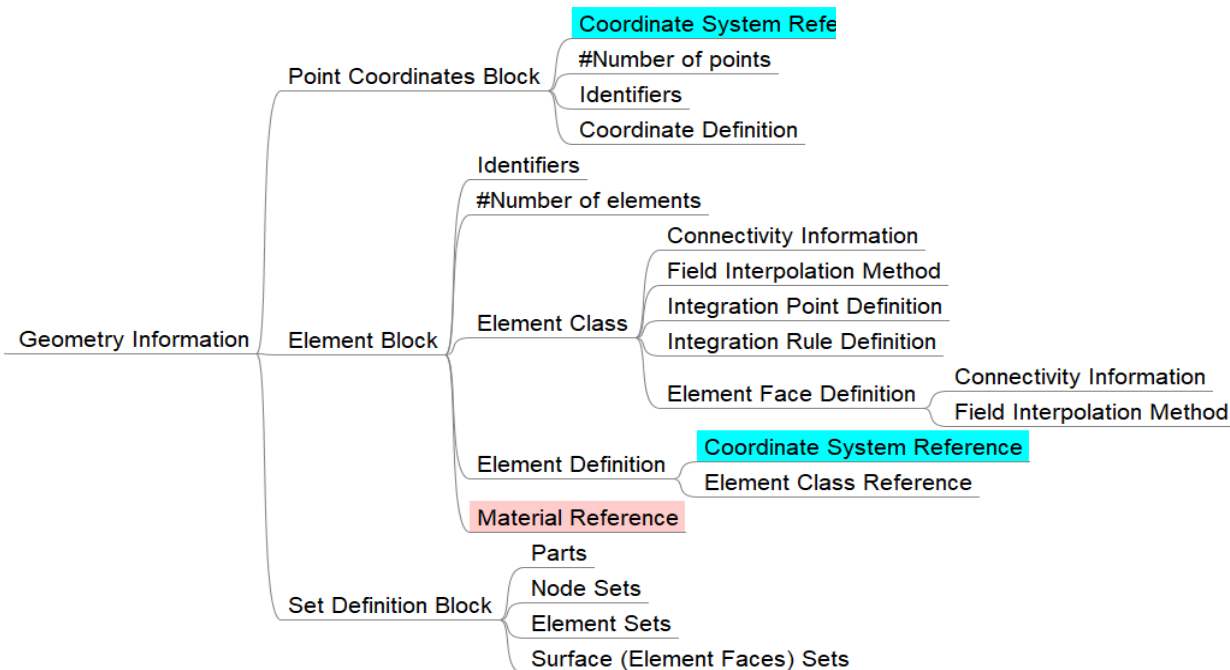
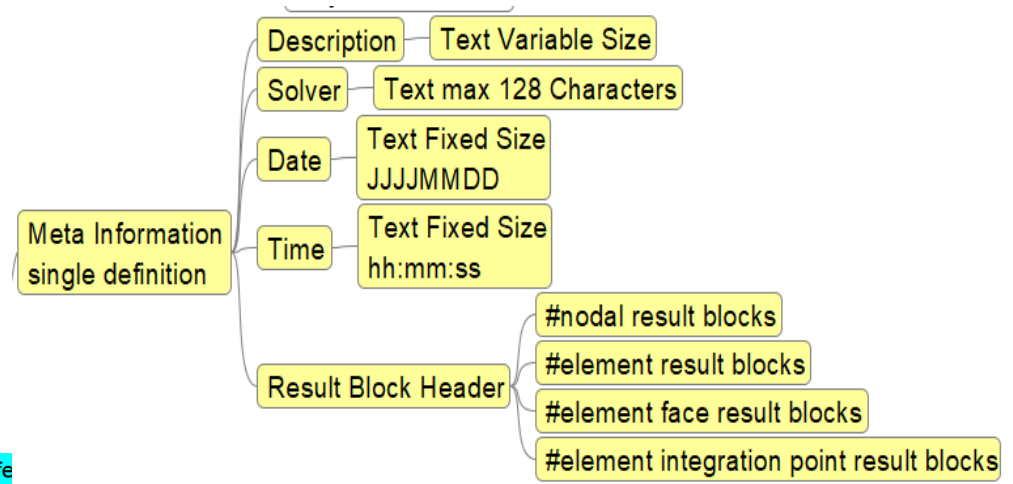


# Material Data Interface

## VMAP Interface Concept



- Meta Information
- Geometry Information

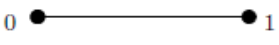
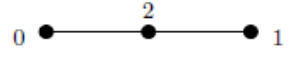


# Material Data Interface

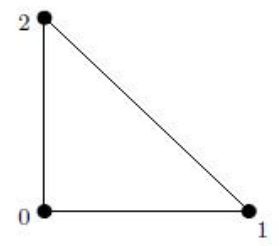
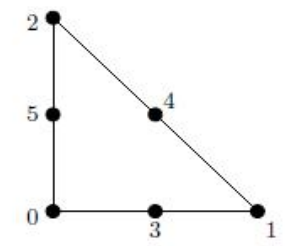
## VMAP Interface Concept



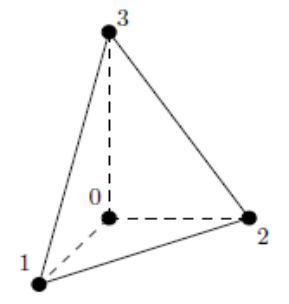
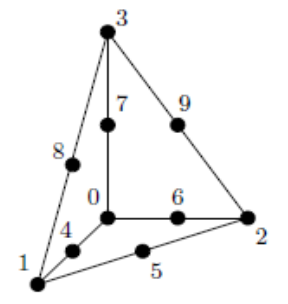
### line elements

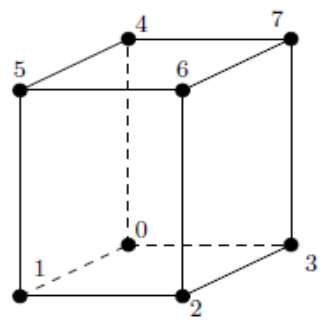
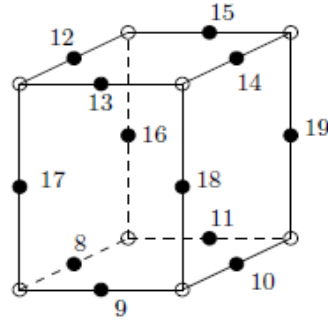
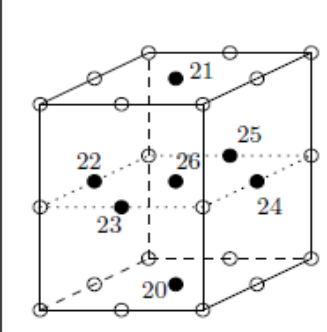
2 nodes	3 nodes
*_LINE2	*_LINE3
	

### triangular elements

3 nodes	6 nodes
*_TRIA3	*_TRIA6
	

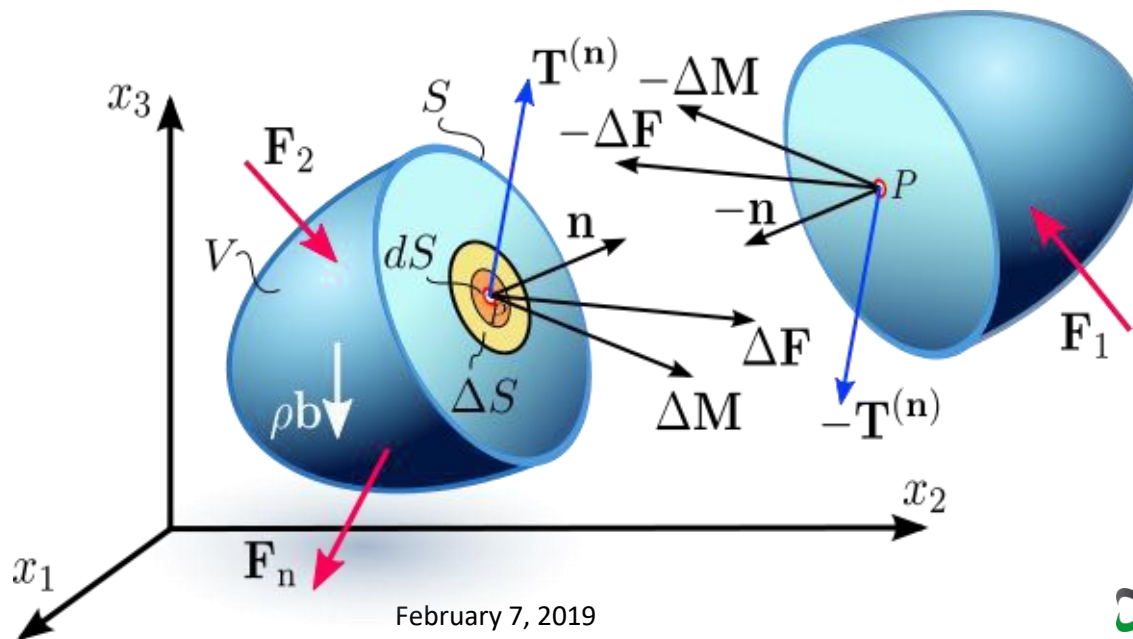
### tetrahedral elements

4 nodes	10 nodes
*_TET4	*_TET10
	

8 nodes	20 nodes	27 nodes
*_HEX8	*_HEX20	*_HEX27
		

**Stress tensor** may refer to:

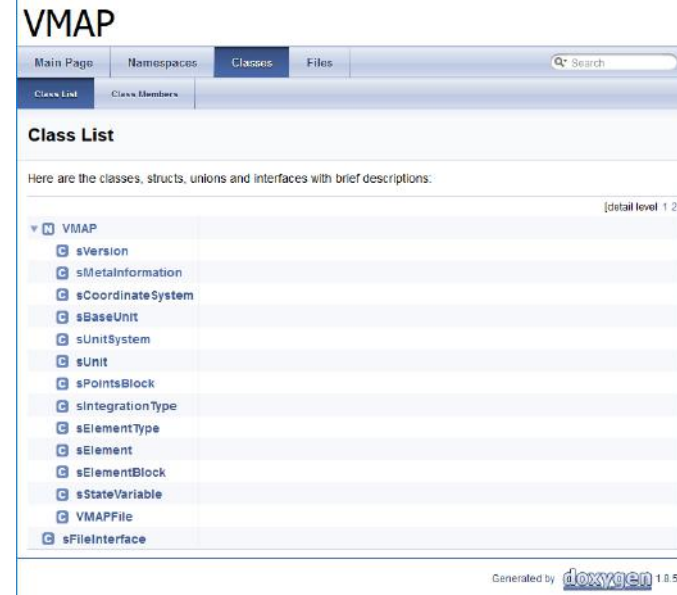
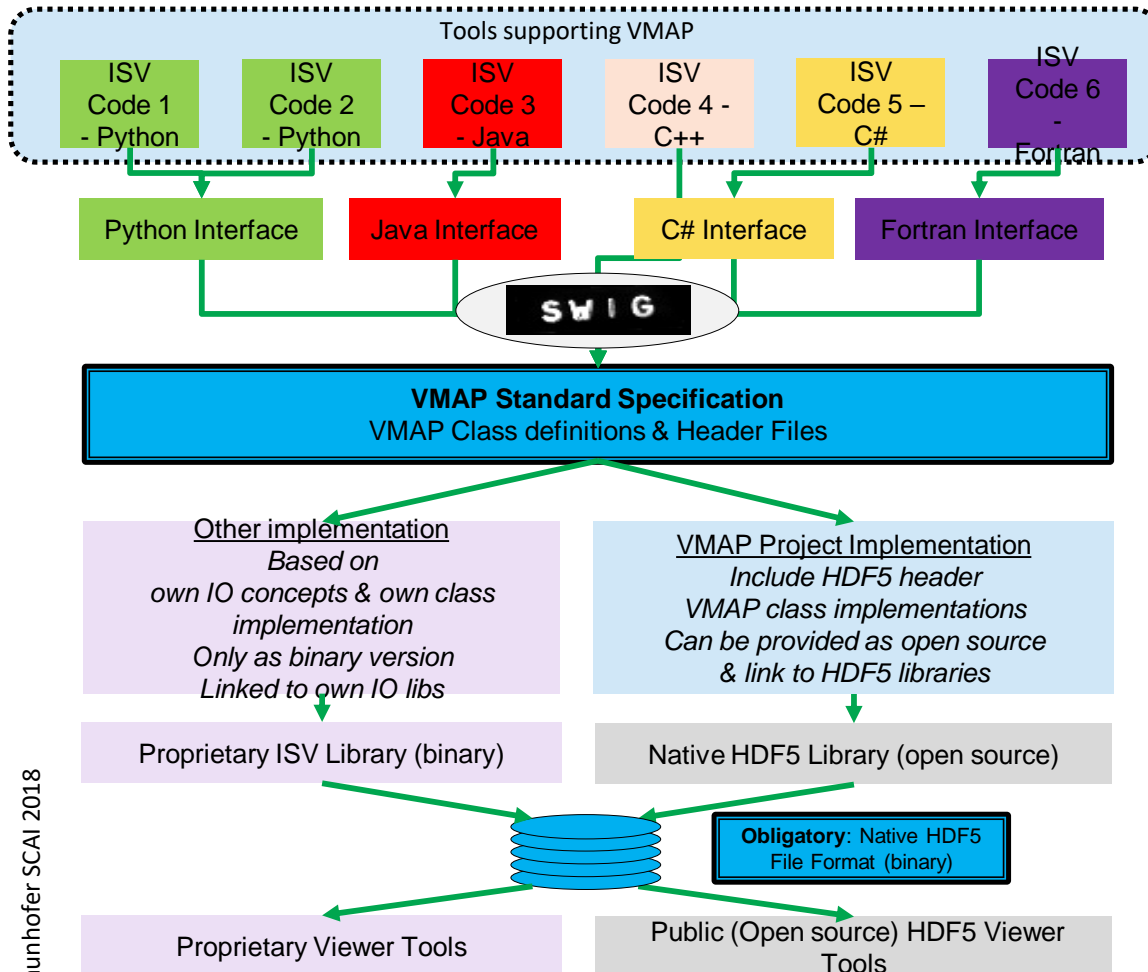
- [Cauchy stress tensor](#), in classical physics
- [Stress deviator tensor](#), in classical physics
- [Piola–Kirchhoff stress tensor](#), in continuum mechanics
- [Viscous stress tensor](#), in continuum mechanics
- [Stress–energy tensor](#), in relativistic theories
- [Maxwell stress tensor](#), in electromagnetism



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# Material Data Interface

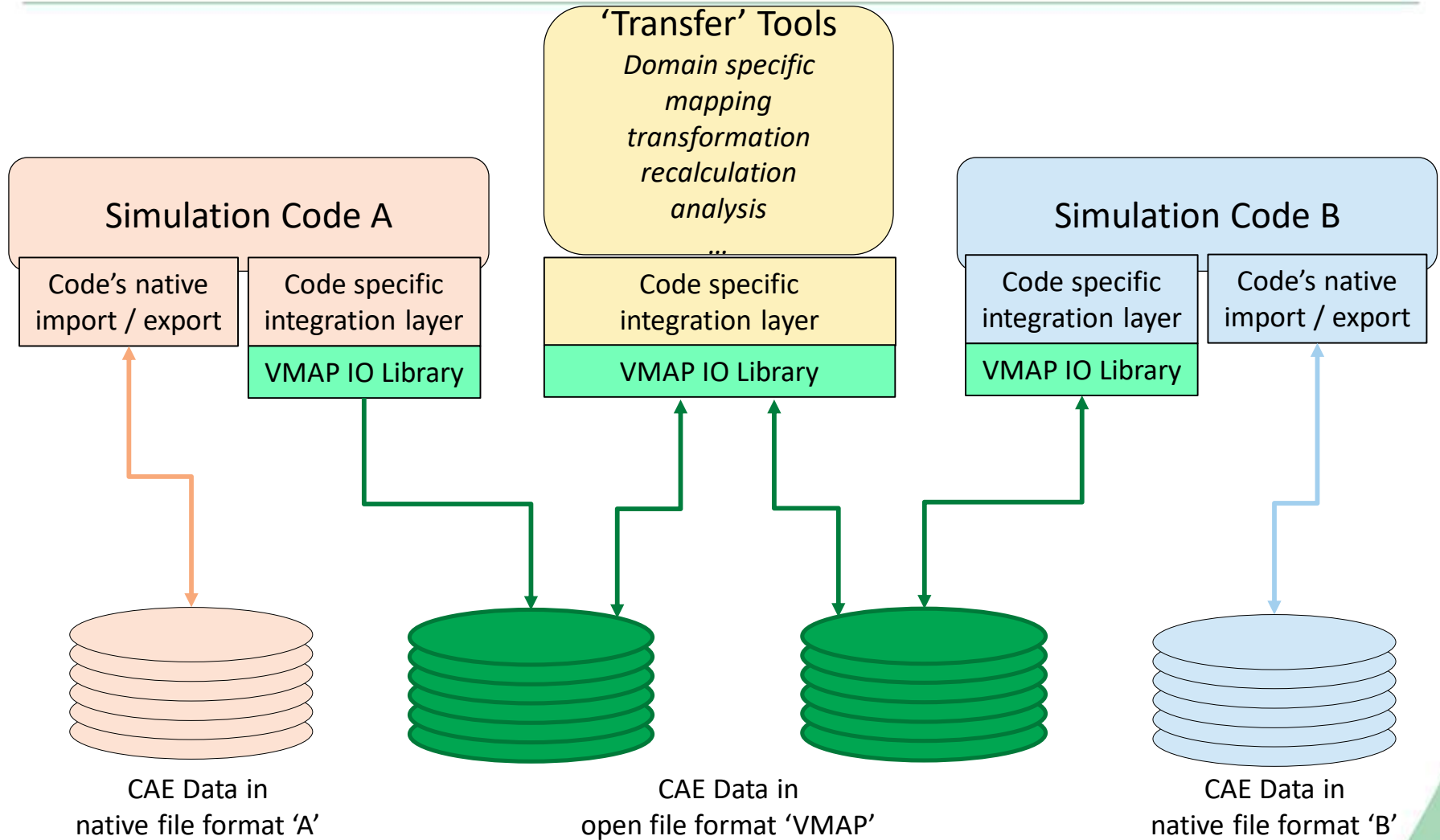
## VMAP Interface Concept



### HDF5 file format must be a part of VMAP specs

- Other ISVs might use their own IO concepts for VMAP class implementations
- **The file format must be compatible with HDF generated files (part of VMAP specification)**
- End users thus can use any VMAP compatible tool and viewer
- ...

# VMAP Approach



## Points for Discussion

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What kind of standardisation is needed to use an OSP for interoperability?

- Commercial tools for material and manufacturing simulation in 3D continuum mechanics are only available as 'black box' codes
- users cannot change internal details but extend available material models e.g. by adding numerical integration rules for specific discretization element types
- If multiple process steps shall be simulated the user needs a seamless transfer of simulation/result data between commercial tools. In the VMAP project this transfer will be standardized

## Points for Discussion

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How would you want to use an open framework to fully automatize data transfer between models?

- For a fully automated transfer of data between 3D CAE tools we would first need a common understanding and fully documented implementation details of material models in each of the related codes
- (Unfortunately) the details of material model implementation are core business secrets of the ISVs .....
- In the midterm an ontology (based on publicly available information) on material model implementation and parametrization could help to automate data transfer



## Points for Discussion

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What would a framework have to offer so that you would use it regularly?

- Standards for model import and data/result export
- Open definitions on material models
- Good handling to set up complex engineering workflows