STATUS 2025: VMAP WORKING GROUP FULL MODEL STORAGE

VMAP User Meeting 2025

Oliver Kunc, DLR BT, 18.02.2025

Content

- Introduction to WG Complete Model Storage
- Recap status at user meeting Feb 2024
- Developments in 2024
  - Concepts
  - Comparisons
  - Voting
  - Discussion points
- Next steps and open questions

- Note: examples in this presentation are based on VMAP 1.0.0

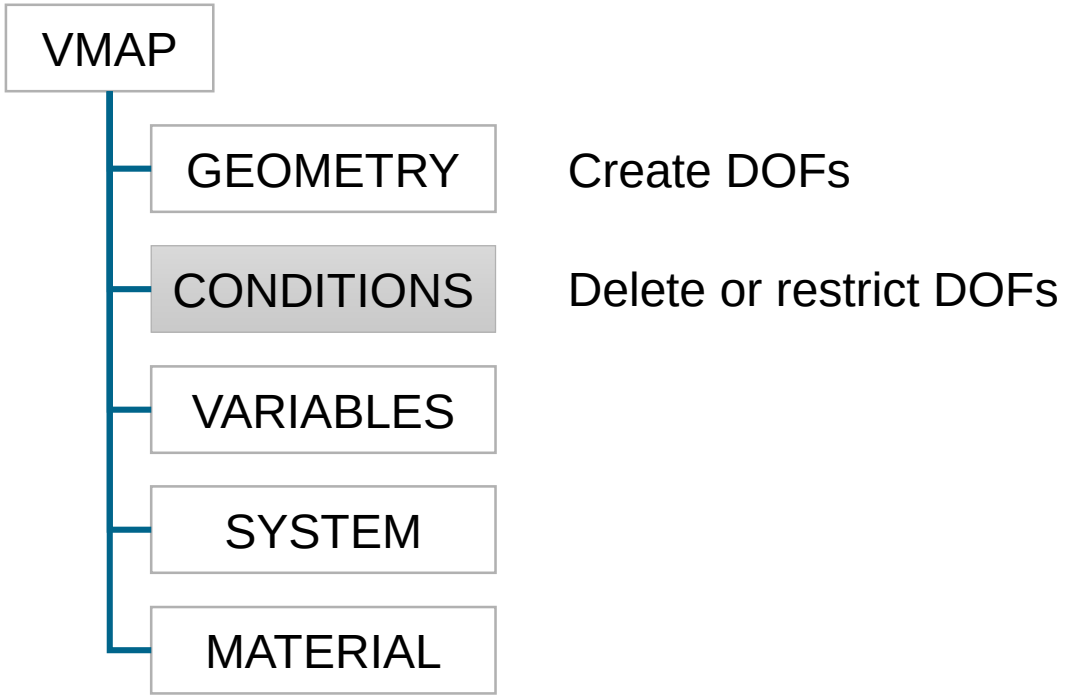
Introduction to WG Complete Model Storage

Institutions
Fraunhofer SCAI
BETA CAE
Key to Metals
BMW
HTW Berlin
BAM
DLR BT
DLR SY

Introduction to WG Complete Model Storage

- Original goals of VMAP ITEA Project (2017-2021):
  - CAE workflow interface for passing results between diverse software
  - Multi-disciplinary use cases
  - Meshes + results
- Complete Model Storage
  - Meshes + results + all information needed to produce the results
  - Boundary conditions, loads, etc.
  - Reproducibility
  - Collaboration (exchange of (almost) full model)

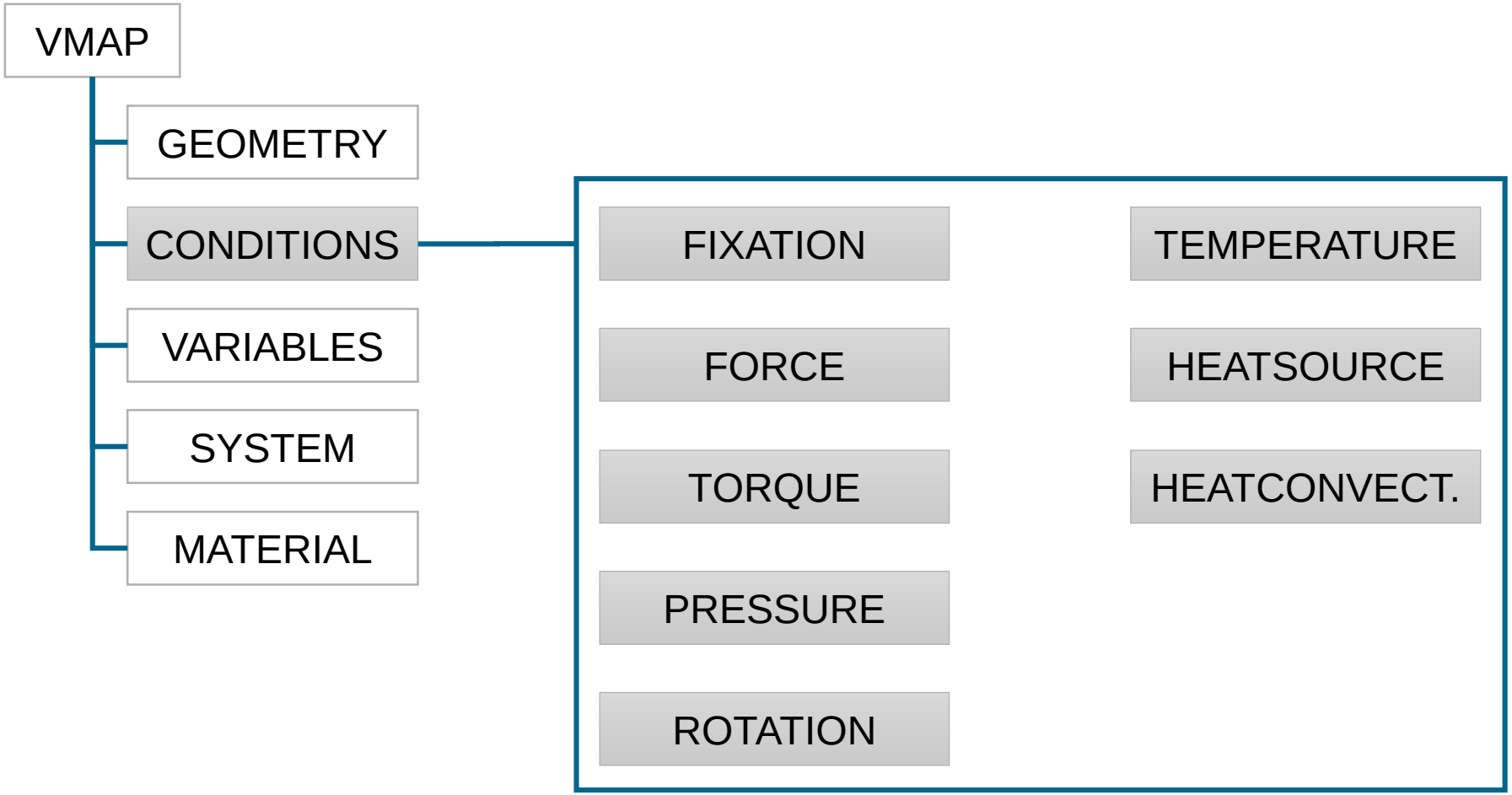
Recap state of complete model storage at UM 2024

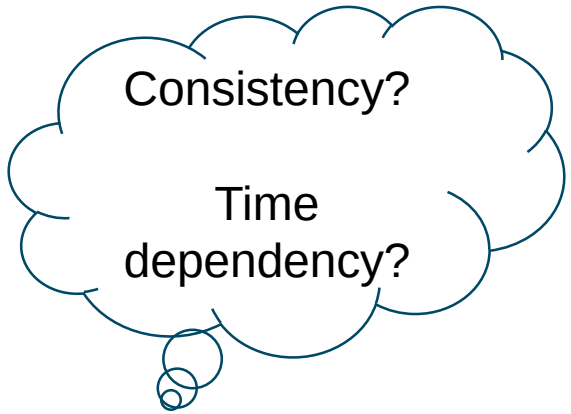


Create DOFs

Delete or restrict DOFs

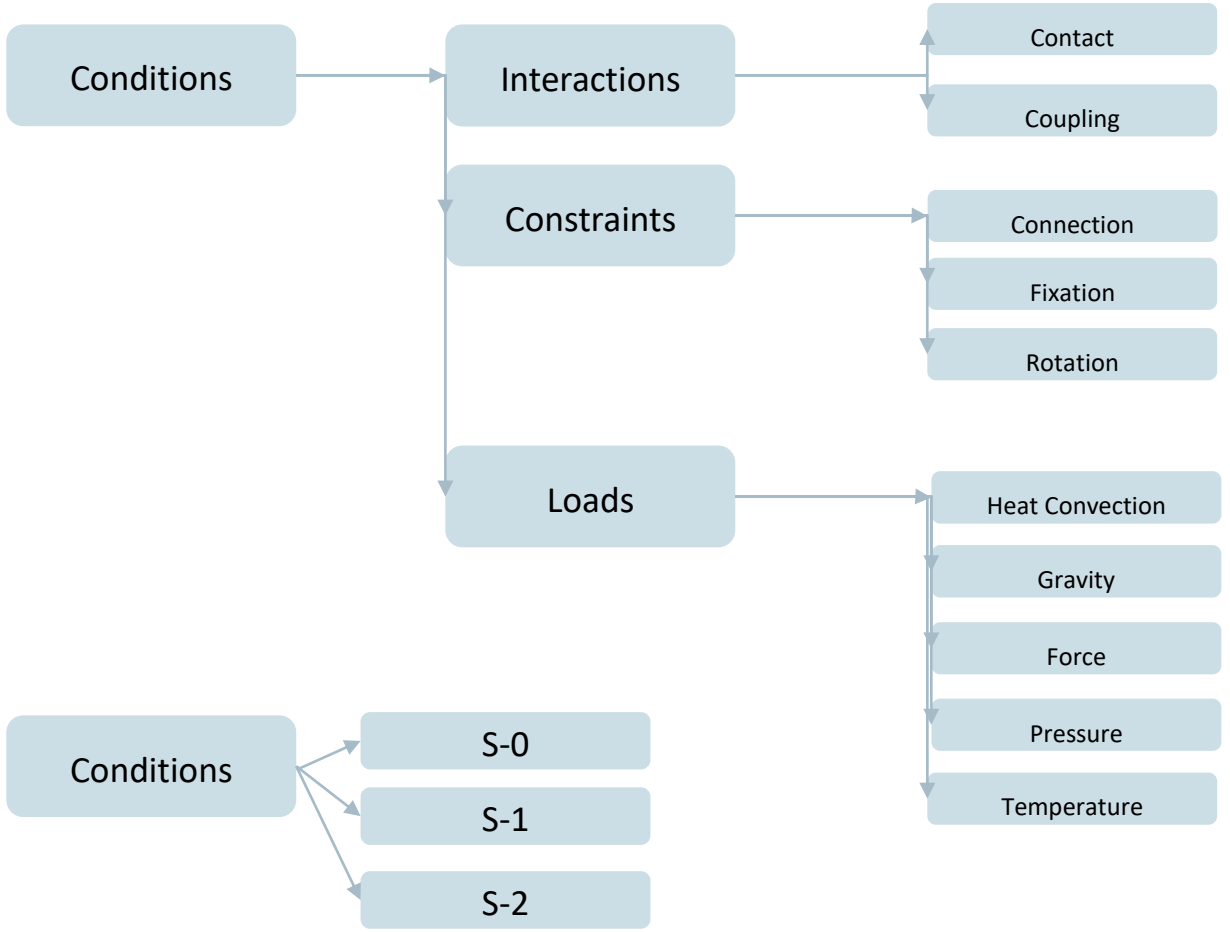
Recap state of complete model storage at UM 2024





WG Developments 2024

- How to group conditions?
  - *Engineering* hierarchy?
  - *Mathematical* hierarchy?
  - Group *loads* by kind
  - Group *constraints* by kind
  - Easy *re-use* in …
  - … *analysis steps*: different conditions in steps?
- How do other projects solve this?

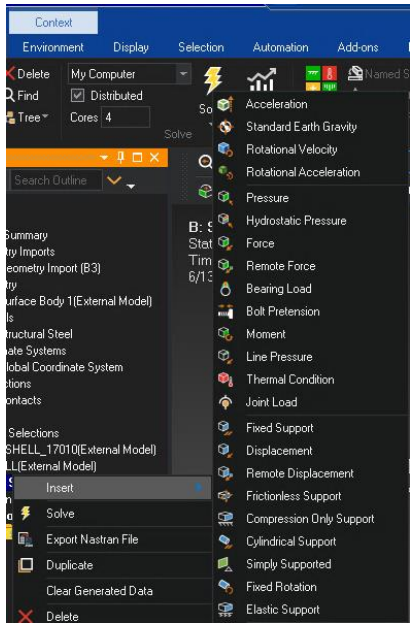


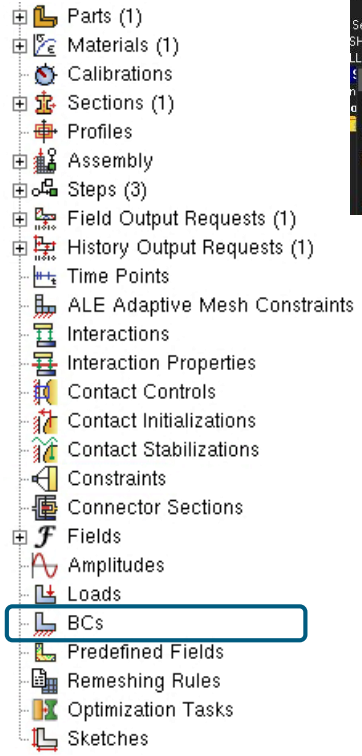
WG Developments 2024

Numerous contributions by WG members for comparisons:

- ABAQUS (general)
- ANSA (general, in numerous solver modes)
- ANSYS (general)
- HyperMesh (turbine use case in ABAQUS mode)
- SMILE (full vehicle crash case with ABAQUS and LS-DYNA translations)

WG Developments 2024





SMILE

```
<INITIAL.CONDITIONS>
 <VELOCITY Id="VEL-1" Ref="FZG"  Values= "15555.556 0.0 0.0"
   Ref_Ori="ORI-Global"/>
</INITIAL.CONDITIONS>
```

Abaqus

```
*INITIAL CONDITIONS , TYPE = VELOCITY
FZG_NSET,1, -15555.555556
FZG_NSET,2, 0.0
FZG_NSET,3, 0.0
```

LS-DYNA

```
*INITIAL_VELOCITY
$#  nsid    nsidex   boxid   irigid    icid
59000300      0       0       0        0
$#   vx      vy       vz      vxr      vyr      vzr
-15555.556    0.0      0.0     0.0      0.0      0.0
```

Nastran

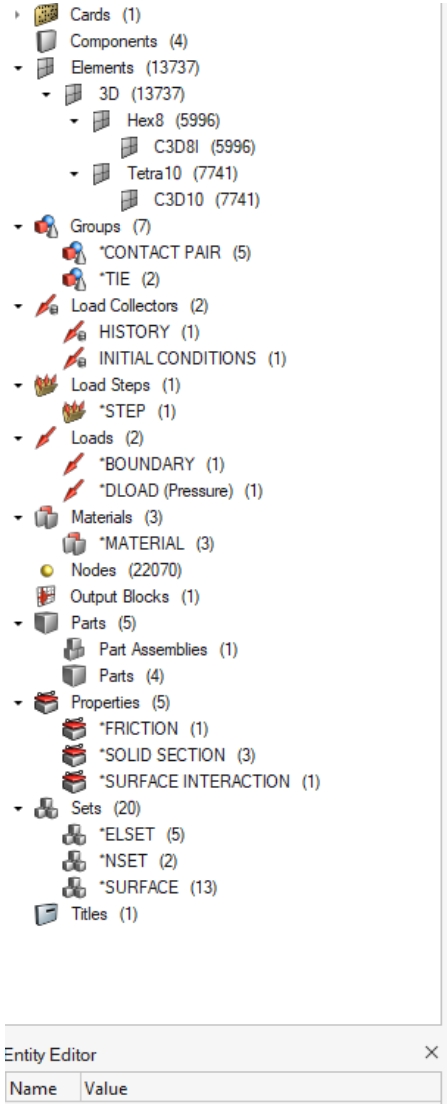
Abaqus

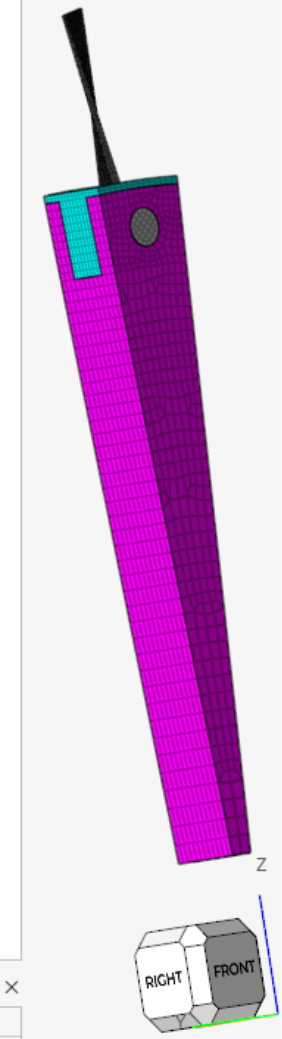
ANSYS

PAMCrash

Marc

LSDyna





WG Developments 2024

- First conclusion:

  Separate conditions in Boundary Conditions (BC) and Initial Conditions (IC)

- Exactly how to group conditions?

➢Vote

WG Developments 2024

- WG voting on the following options:

  1. separation of conditions into **IC** & **BC**

  2. separation of conditions into **IC** & **BC**. Separation of **BC** into two further groups **Dirichlet BC** and **Neumann BC**

  3. separation of conditions into **IC** & **BC**. Placing **Dirichlet BC** and **Neumann BC** as an attribute to the **BC**

WG Developments 2024

More discussion points:

- Still no full definition on how to group conditions
- BC fields possible
- Temporal BC (fields) possible via tables
  - Still, IC stand out from an engineering perspective
- Consistency of IC & BC (logical, chronolgical) should not be part of VMAP, which should just provide a language for description.
- Consider simple, universal use cases …

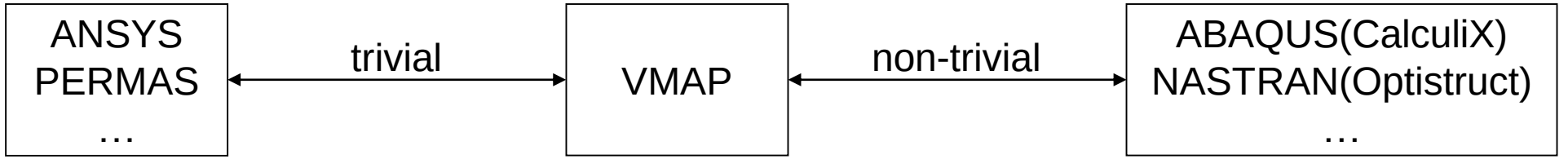
WG Developments 2024

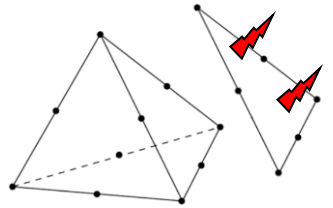
- Suggestions for simple thermal and mechanical problems:
  - Plate with hole under tension (2D)
  - Three-point bending truss (3D)
  - Heat conduction through plate (2D)
  - Heat convection of brick in air (3D)
  - Rotating bladed disk (3D, includes CONNECTION)
  - …?
- Consensus: no 1D use cases
- Important: possibility to store solver specific data not covered by use cases
- Besides grouping of conditions, modelling approaches need to be chosen …

Example of established modelling approaches and VMAP integration options

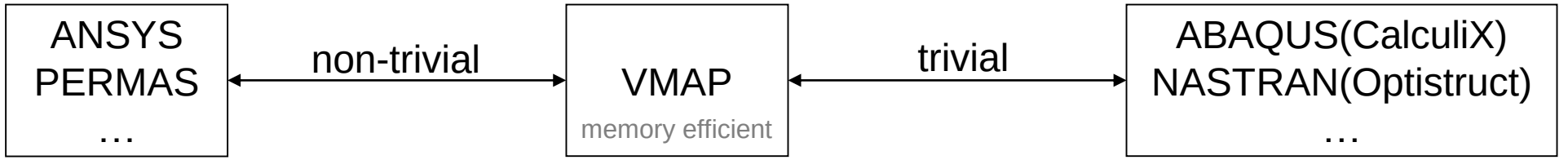
Examplary condition: heat convection. Options: VMAP uses …

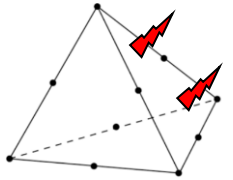
1. … ANSYS/PERMAS standard



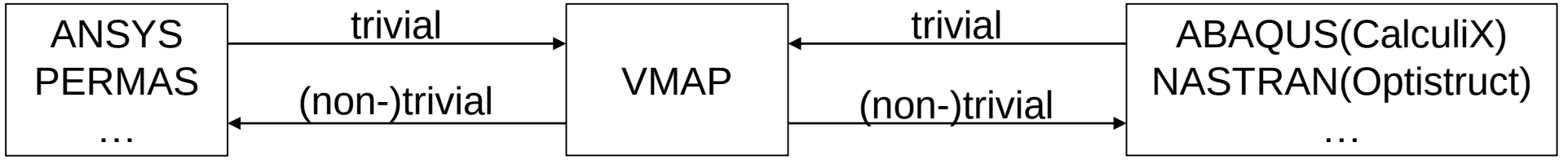


2. … ABAQUS/NASTRAN standard





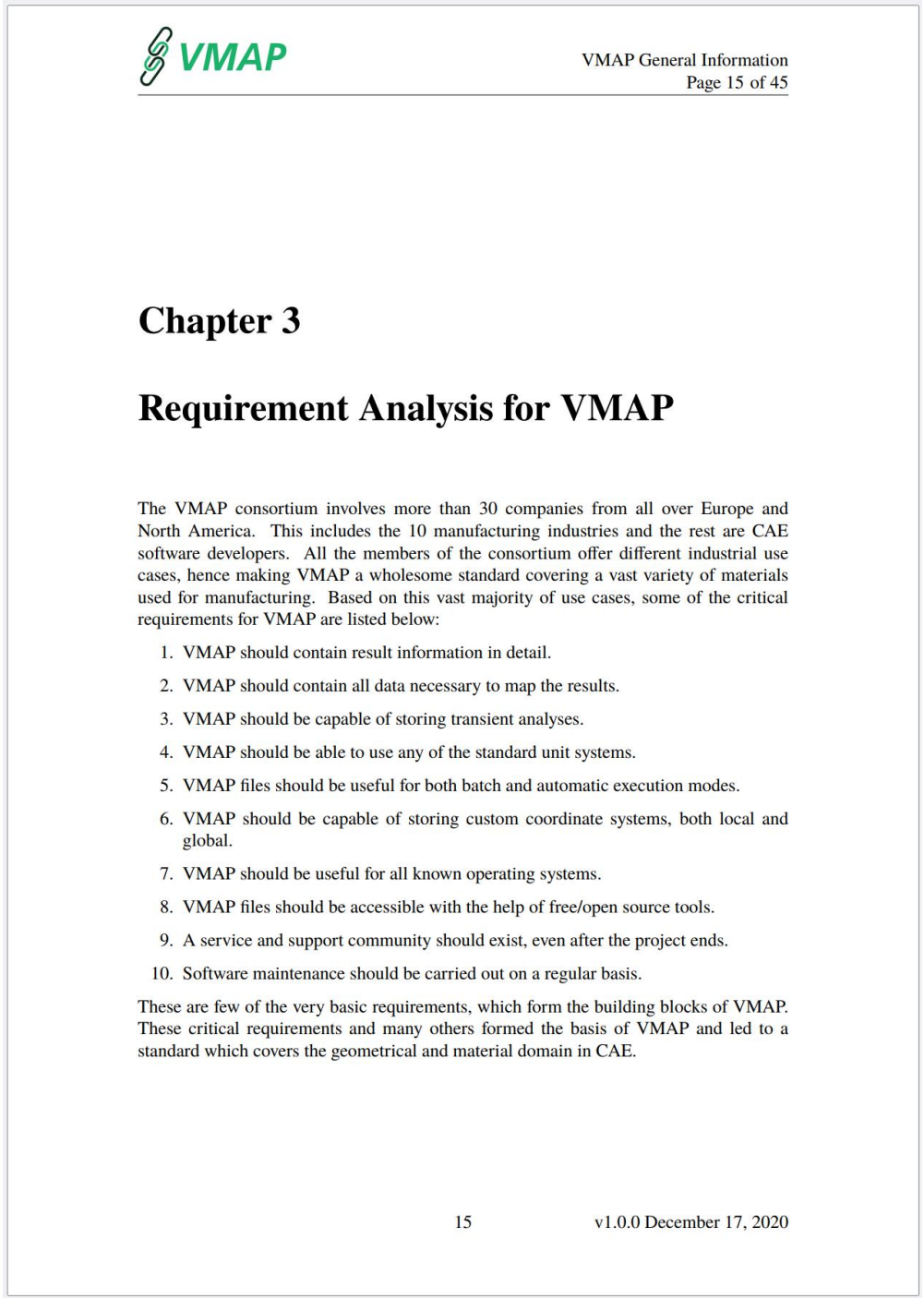
3. … a „Double Standard“



Requirement Analysis

Suggested additional requirements:

- „VMAP should be capable of storing **model setup information in detail for standard examples**.“
- „VMAP should be capable of storing **static and** transient analyses.“
- […, modal analysis, …]



VMAP

VMAP General Information
Page 15 of 45

Chapter 3

Requirement Analysis for VMAP

The VMAP consortium involves more than 30 companies from all over Europe and North America. This includes the 10 manufacturing industries and the rest are CAE software developers. All the members of the consortium offer different industrial use cases, hence making VMAP a wholesome standard covering a vast variety of materials used for manufacturing. Based on this vast majority of use cases, some of the critical requirements for VMAP are listed below:

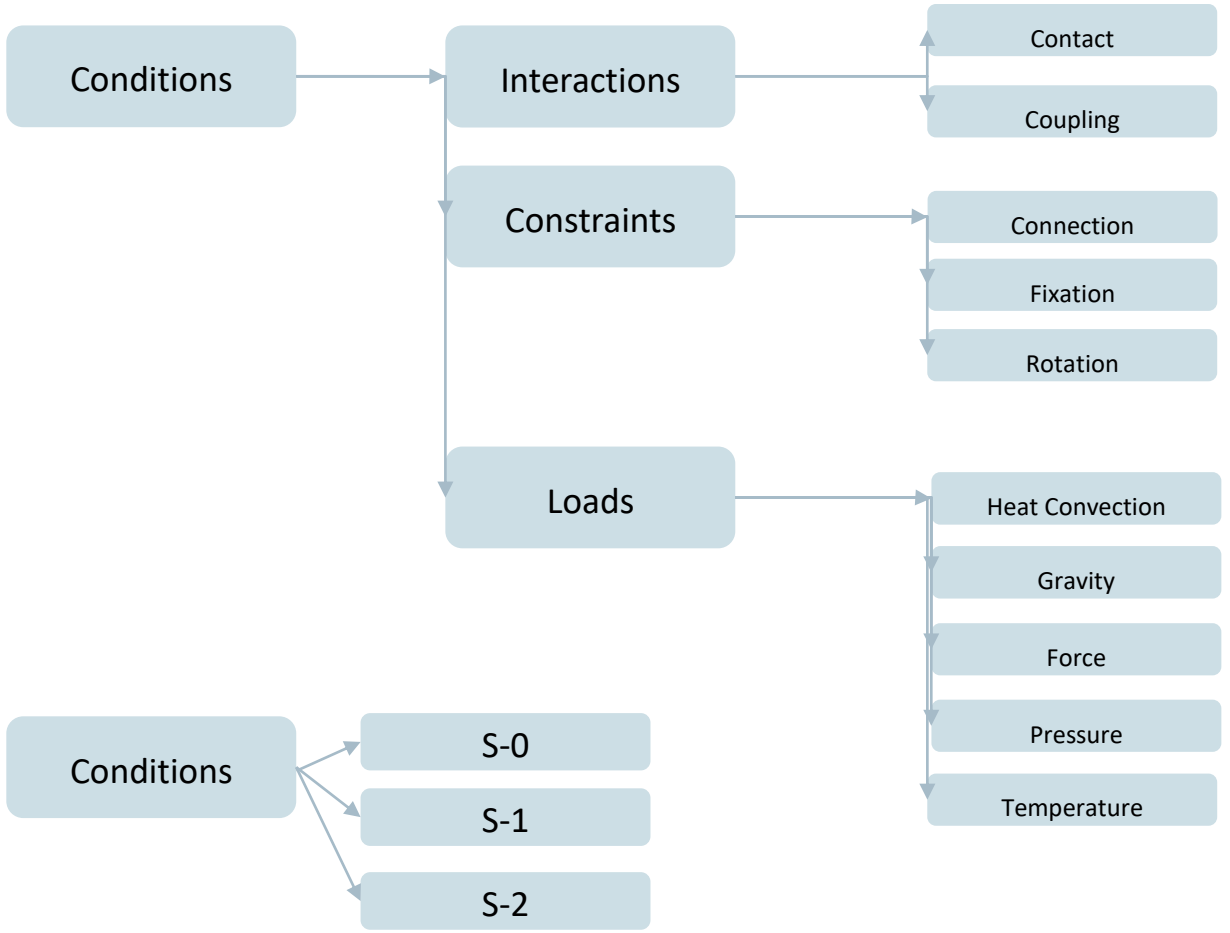
1. VMAP should contain result information in detail.
2. VMAP should contain all data necessary to map the results.
3. VMAP should be capable of storing transient analyses.
4. VMAP should be able to use any of the standard unit systems.
5. VMAP files should be useful for both batch and automatic execution modes.
6. VMAP should be capable of storing custom coordinate systems, both local and global.
7. VMAP should be useful for all known operating systems.
8. VMAP files should be accessible with the help of free/open source tools.
9. A service and support community should exist, even after the project ends.
10. Software maintenance should be carried out on a regular basis.

These are few of the very basic requirements, which form the building blocks of VMAP. These critical requirements and many others formed the basis of VMAP and led to a standard which covers the geometrical and material domain in CAE.

15 v1.0.0 December 17, 2020

Open Questions

- How to reflect the outcome of the voting in the concept?
- How to model each condition?
- What about the analysis layer?
- HDF5←→JSON
- …



Imprint

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