



Project Results

VMAP

A global first in CAE data storage standardisation

EXECUTIVE SUMMARY

The goal of the ITEA project VMAP was to create the first open vendor-neutral standard for computer-aided engineering data storage, thereby enhancing the interoperability of software tools and reducing costs and effort for companies. An open standardisation community will help push this into domains beyond the scope of the project, guaranteeing these benefits in both the short and long term.

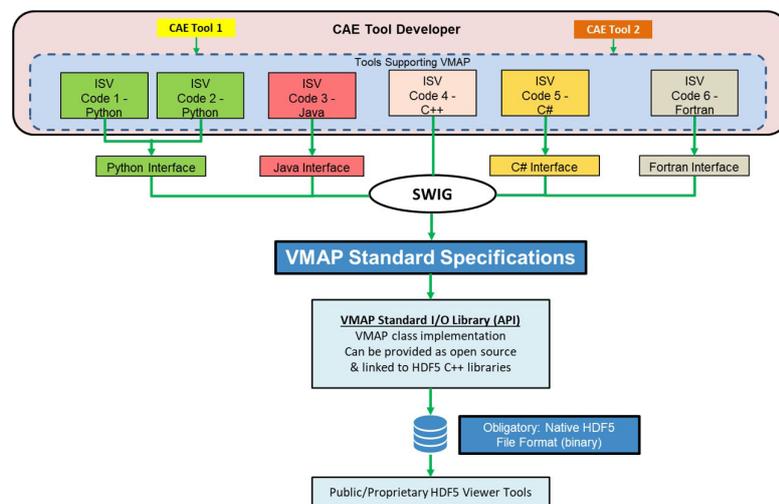
PROJECT ORIGINS

A wide range of computer-aided engineering (CAE) software tools already enable virtual material and product design, virtual manufacturing and machining process parameterisation and virtual product testing of high-tech materials. However, these tools are rarely interoperable and contain multiple native formats for storing the CAE data to be transferred between simulation codes, such as geometrical information, simulation results and metadata. The corresponding lack of standardisation means that companies have to implement customised data transfer solutions – a huge effort in terms of both time and money.

The VMAP (A new Interface Standard for Integrated Virtual Material Modelling in Manufacturing Industry) project has filled this gap by creating the world's first CAE workflow interface standard. This is vendor-neutral, cost-free and completely open to any interested party, helping to maximise its uptake amongst companies of all sizes. Input/output (I/O) routines have also been provided for easy implementation. With the uptake of this standard, VMAP's end-users will enjoy a faster time to market and lower production costs through a decrease in the amount of manual work and corresponding human error in their CAE workflows.

TECHNOLOGY APPLIED

The starting point for VMAP is the identification of the main groups among unorganised CAE data, such as time steps and coordinate systems. The data can then be aligned into a hierarchal



structure of the different fields involved in CAE simulation: geometry, variables, systems and material parameters. Commonalities across different forms of software have been used to build the data storage standard, which is implemented in a number of software tools. This is based on the Hierarchical Data Format (HDF5), an open-source file format which supports large amounts of heterogeneous data in a structure similar to a file directory. Companies can connect their own application programming interfaces to VMAP through the Simplified Wrapper and Interface Generator (SWIG) software architecture, which links C and C++ to high-level languages like Java. VMAP's I/O Library and large number of parameters

for (material) models then enable end-users to read and write VMAP data files and exchange these between simulation codes.

Crucially, the commonalities uncovered by VMAP will enhance interoperability across diverse sectors, as demonstrated in its six use-cases: blow moulding; composites in lightweight vehicles; injection moulding; additive manufacturing of plastics; hybrid modelling of consumer products; and composites in aerospace. In composites for lightweight vehicles, for instance, VMAP's material data storage supports the transfer and eases the mapping of parameters such as fibre orientations, allowing companies to complete their workflow

chain. A similar process occurs with the storage of elements and points at the part level for both blow forming and composites in aerospace. Given the vast nature of the domain, future work will focus on expanding standardisation and normalisation within each sub-field of CAE simulation.

MAKING THE DIFFERENCE

VMAP's major result is simple: computer-aided engineering is now quicker and easier than ever before. One clear example of this has been observed at Philips, where the innovation speed of highly complex parts has increased by almost 50%. Similarly, the time spent on strength assessments in the moulding of plastic parts has been reduced by 42% and the set-up time for virtual process chains for lightweight automotive components with composites fell by 40%. By eliminating the need for customised solutions, delays caused by human errors are also greatly reduced. Overall, VMAP offers a far more cost-effective approach to CAE.

A standard is only as strong as its users. Having so far implemented VMAP in the CAE tools of twelve consortium partners and seven external parties, the project is now taking the unique step of establishing a legal entity called the

VMAP Standards Community. This not-for-profit open standards community will push for further standardisation by contacting vendors and end-users in industry. Early dissemination has already proven successful; the VMAP International Conference, for instance, saw 584 registrations in October 2020. The VMAP community now contains 143 entities, including large players such as Bosch and Philips, and has good links with other groups such as Modelica/FMI and the European Material Modelling Council.

As mentioned, VMAP is the first ever CAE workflow interface standard. One of its biggest strengths is therefore its rich potential, which the community seeks to exploit by extending the standard into technical domains beyond simulation for manufacturing parts. Another ITEA project, VMAP Analytics, has already been formed to apply these innovations to AI analytics and sensor data. VMAP thus represents the tip of the iceberg: as the number of organisations involved in the community increases, so too will the number of engineering domains which can benefit from the faster processes and reduced costs of CAE interoperability.

MAJOR PROJECT OUTCOMES

Dissemination

- Participation in 45 conferences worldwide.
- NAFEMS World Congress 19 had VMAP Interoperability sessions.
- VMAP International Conference on Interoperability received over 400 registrations.
- 6 technical magazine articles and 9 technical papers.
- VMAP Community meetings organised every 3 months during the project.

Exploitation (so far)

New Standard:

- VMAP is a vendor-neutral standard for CAE data storage.
- VMAP Standard Specifications published on the VMAP website: <https://www.vmap.eu.com/vmap-release/>

New Software:

- All project partner softwares support VMAP Standard format.
- VMAP Standard I/O Library implemented for 7 codes external to the project.
- VMAP Standard import and export wrappers developed for Abaqus & ANSYS.

New System:

- Engineering workflows completed using VMAP Standard – blow moulding, composites, additive manufacturing etc.

Standardisation & Spin-offs

- Creation of VMAP Standards Community (SC) e.V.: The VMAP-SC is a non-profit association, established in Germany, which will work on the dissemination of VMAP Standard, including development and maintenance of a uniform library.

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VMAP 16010

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KE-works

Materials innovation institute M2i

MSC Software Benelux

Philips

Reden

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Sintratec

Project start

September 2017

Project end

October 2020

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