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

Material Data Exchange Interface Standard Community Web meeting

13 May 2020 at 17:00 (CET), 1600 (GMT), 11:00 (EDT)

Summary of Meeting

Place: Web meeting

Attendees: Gino Duffett (NAFEMS, VMAP project) - GinoD,
Klaus Wolf (Fraunhofer SCAI, VMAP Project) - KlausW
Priyanka Gulati (Fraunhofer SCAI), VMAP project, PriyankaG.

28 people in total (VMAP Project 10, External 18)
27 entities in total (VMAP Project 9, External 18)

Apologies: 2 people from 2 entities.

Notes: GinoD attempted to make a recording of the meeting for those people who sent apologies but this did not work. Actually the attached presentation covers the meeting very well and there were no technical questions, see point 7 below.

Documents attached:
[1] "ITEA-VMAP_SC_20200513_Community" the presentation made at the meeting.

1. GinoD welcomed all attendees and outlined the meeting Agenda, see [1] page 2:
   - VMAP covid-19 updates [GinoD]
   - VMAP development updates [KlausW, PriyankaG]
   - VMAP Package external use cases [KlausW, PriyankaG]
   - VMAP analytics project update [KlausW]
   - VMAP-SC creation [GinoD]
   - Any Other Business [GinoD]

2. GinoD presented an overview of the VMAP Standards Community (VMAP-SC) size, 141 entities and 42 with confirmed interest (see [1] page 3).

3. GinoD also presented the new VMAP Conference and Meeting dates for 2020; see [1] pages 4-5. He noted that:
    -   The new VMAP Conference date is 15-16 October 2020, to be held in Munich, Germany.
    -   There is no change to the VMAP Conference agenda since no presenter has withdrawn their paper once advised of the new dates.
    -   There is now the possibility of an Exhibition at the Conference so please check the website for more information.
    -   A VMAP-SC web meeting could be held on 28 October 2020 to report back on the conference (15-16 October) and the final project review (21 October).

3. PriyankaG presented the current developments for VMAP v.0.5.0, see [1] pages 7-13. These include:
    -   Multiple file storage
    -   State variable library
    -   A common method for storing composite layers
    -   Material data storage
    -   Generic element type descriptions

4. PriyankaG then presented the VMAP Package v 0.4.0, see [1] pages 14-17, that included:
    -   Details of the VMAP Package contents
    -   Initial release steps
    -   VMAP Integration with other software

5. KlausW presented the concepts within the "VMAP analytics" project that it is hoped will follow VMAP in November 2020, see [1] pages 18-20. The project will extend VMAP Standards to include multi-scale simulation, material databases, cognitive systems and smart machines, analytic and machine learning, digital twins.

6. GinoD then presented the progress and ideas for the VMAP-SC formal creation, see [1] pages 22-27. These are based on those used by FMI/Modelica with their kind permission. He described
    -   VMAP-SC structure: Assembly, Board, Technical Groups.
    -   Members: Contributing, User, Experts.
    -   IP ownership and VMAP-SC formal entity: NAFEMS (not favoured), Separate legal entity (best if finance was available), Shell legal entity (possibly initial step).
    -   "Guestimated" budget for 2021
    -   Proposed Annual Fee.
    -   Timescale for forma creation.
    Action: ALL to provide feedback, ideas and/or agreement to GinoD on these proposals.

7. There were no specific technical or organization questions.

8. GinoD thanked everybody for their participation and closed the meeting.

-------end of document-------

ITEA VMAP

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

VMAP Standards Community

Gino Duffett (NAFEMS)

Meeting May 13, 2020

VMAP

Agenda

1. Welcome [GinoD]

2. VMAP covid-19 updates [GinoD]

3. VMAP development updates [KlausW, PriyankaG]

4. VMAP Package external use cases [KlausW, PriyankaG]

5. VMAP analytics project update [KlausW]

6. VMAP-SC creation [GinoD]

7. Any Other Business [GinoD]

8. End

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- **Standards Community database**
  - 141 entities, 81% external to project
  - 42 confirmed interest, 55% external to project

- **Collaborations**
  - European Materials Modelling Council
    - Material ontologies
  - ProSTEP
    - Engineering data standards
  - AFNet
    - Standardization days

2. VMAP International Conference

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VIRUS ALERT · VIRUS ALERT · VIRUS ALERT

- **VMAP International Conference on Interoperability**
  - 15-16 October 2020 in Munich-Taufkirchen, Germany
  - Starts on 15 October after lunch,
    session overlap with NAFEMS DACH conference
  - 35 presentations, 34 registrations (69 in total)
  - Includes project Open Day as Poster Wall
    (screens + posters)
    - originally planned to take place at
      Final Project Review
  - EXHIBITION space

  - Presenters notified
    NO Agenda changes to date

1ST INTERNATIONAL CONFERENCE ON CAE INTEROPERABILITY 2020
VMAP 15-16 Oct 2020 | Munich-Taufkirchen

2. VMAP Community meetings

- Web meeting, 13 May 2020   **Today**

- Web meeting, week starting 12 Sept 2020   **Probably not**
  - Planned

- VMAP Conference 15-16 October 2020   **Presentations & Poster wall**
  - possible face-to-face meeting
  - includes Final project Open Day information

- Web meeting, 28 October 2020   **Under discussion**
  - Report back of Conference and final Project Review

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7. Any Other Business [GinoD]

8. End

- VMAP Development – v.0.5.0

  - Multiple File Storage

  - Variable Library

  - Section Types

  - Material data storage

  - Generic Element Type Descriptions

3. VMAP Development - v.0.5.0

- **VMAP Standard I/O Library v.0.5.0**
  - Multiple File Storage
  - Variable Library
  - Section Types
  - Material data storage

- **VMAP Documentation v.0.5.0**
  - All new features
  - More Tutorials
  - Interoperable Test Cases
  - Version release May 2020 pdf & html

v.0.5.0 - Multiple file Storage

■ Multiple File Storage -

- One VMAP file stores all Process runs

- The same structure is maintained with an additional on top Group Process_n, …

- Attributes could be added to the

Process_n group for more inofrmation

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- Variables in Documentaion

  - List of commonly used state variables will be defined

  - Users can aslo define their own variables

10.1 A

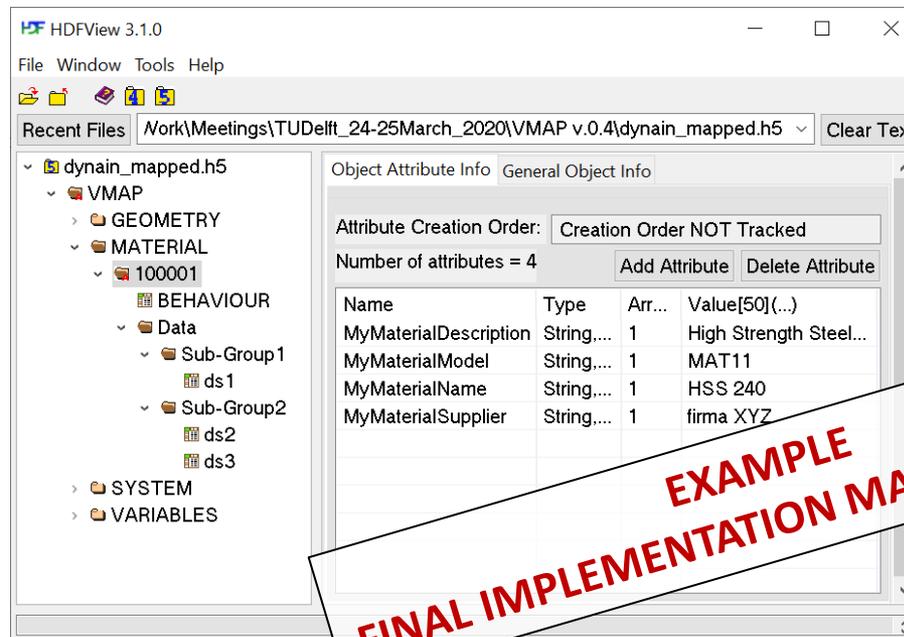|	
AREAL-DENSITY	Definition: Areal density of a 2D object is defined as mass per unit area. Dimension: ML^{-2} , SI Unit: $kg \cdot m^{-2}$ Subtypes defined in VMAP: FIBRE Nomenclature: AREAL-DENSITY, AREAL-DENSITY_FIBRE
ABSOLUTE-HUMIDITY	Definition: Measures the weight of water vapour per unit volume of air. Dimension: ML^{-3} , SI Unit: $g \cdot m^{-3}$ Subtypes defined in VMAP: – Nomenclature: ABSOLUTE-HUMIDITY
AXIAL-STIFFNESS	Definition: It is the extent to which an object resists deformation in response to an applied force (tension or compression). Dimension: MT^{-2} , SI Unit: $N \cdot m^{-1}$ Subtypes defined in VMAP: – Nomenclature: AXIAL-STIFFNESS

- **Section Types**
  - To support the Composite layer storage
  - Other Shell Elements with variable thickness
  - Section Type data list:

```
int               myIdentifier;        /**< Unique identifier of the section          */
const char*       myName;              /**< The name of the section                   */
int               myType;             /**< Type of section, see eSectionType         */
int               myMaterial;         /**< The material id of the section            */
int               myCoordinateSystem; /**< The reference coordinate system of the section */
int               myIntegrationType;  /**< The integration type of the section        */
int               myThicknessType;    /**< The thickness of the section               */
```

v.0.5.0 - Material Data Storage

- ■ Material Data Storage
  - Initial data will be stored in XML files and then can be transferred to VMAP
  - Here is a sample representation in HDFView

- Element Type Description

  - Initial Idea - Store the solver specific Element type description

myTypeName	myTypeDescription
VMAP_ELEM_3D_TRIANGLE_3	Abaqus: S3R
VMAP_ELEM_3D_QUAD_4	Abaqus: S4R
VMAP_ELEM_3D_QUAD_4	Abaqus: S4

  - VMAP v.0.5.0 - Store a more generic type description

myTypeName	myTypeDescription
VMAP_ELEM_3D_TRIANGLE_3	Thermal
VMAP_ELEM_3D_QUAD_4	Structural
VMAP_ELEM_3D_QUAD_4	Acoustic

4. VMAP Package v.0.4.0

- **VMAP User Guide**
  - Documentations
    - VMAP Standard Specifications
    - VMAP General Document
  - Licenses
    - BSD
    - ULA
- *VMAP Library*
  - API
  - Wrappers (only Document)
- *VMAP Test Cases*
  - 01_BreakForming_MetalBracket

NAFEMS   ITEA3
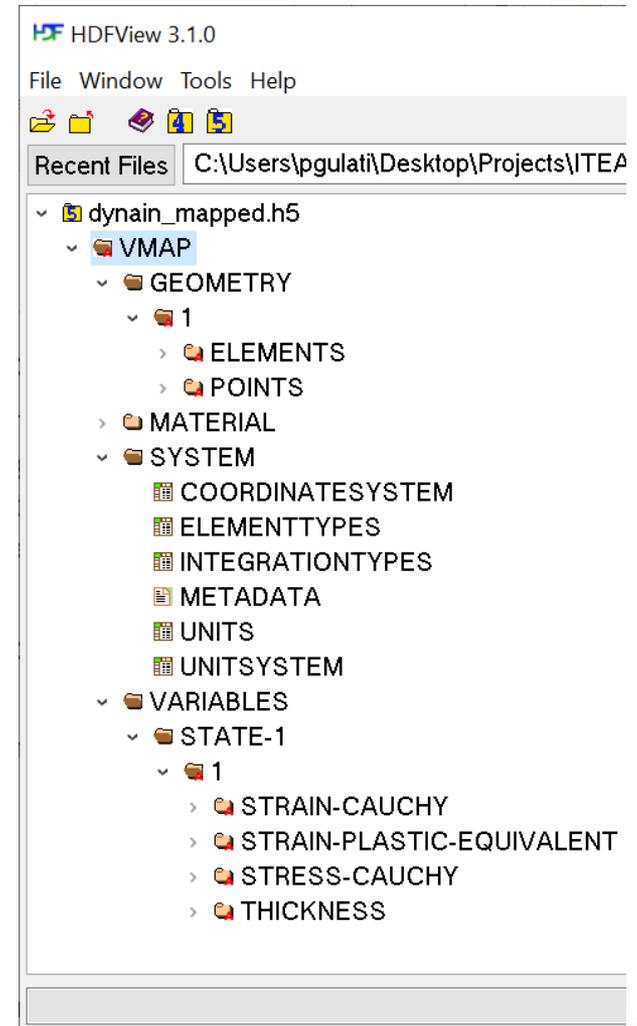
4. VMAP Package v.0.4.0

- **External use cases**
  - 8 primary contacts
    - discussions starting to deliver VMAP Package
  - 26 requests for implementation
    - communicated but on hold until tested by primary contacts
  - 59 document web downloads

- **Webpage for full VMAP Package**
  - Documentation, IO Library, Wrappers, Licences
  - In progress
  - Launch date to be decided

VMAP Standard Interface Integration

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Legends: | supported | In Progress | planned |

Softwares	Platforms	Type Integration	VMAP Import	VMAP Export
DYNAmore Envyo	Windows, Linux	Integrated	v 0.4.0	v 0.4.0
4a FIBERMAP/MICROMEC	Windows	Integrated	v 0.4.0	v 0.4.0
Beta CAE Ansa Beta CAE Epilysis	Windows, Linux	Integrated	v 0.4.0 v 0.4.0	v 0.4.0 v 0.4.0
SCAI mpCCI Mapper	Windows, Linux	Integrated	v 0.4.0	v 0.4.0
inuTech Diffpack inuTech OOT	Windows	External Wrapper	v 0.4.0 v 0.4.0	v 0.4.0 v 0.4.0
MSC Marc	Windows	External Wrapper	v 0.4.0	v 0.4.0
Simcon CADMould	Windows	Integrated	v 0.4.0	v 0.4.0
ESI Virtual Env.	Windows	External Wrapper	v 0.4.0	v 0.4.0
e-Xstream Digimat	Windows	Integrated	v 0.4.0	v 0.4.0

4. Status:
VMAP Standard Interface Integration

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Legends: `supported` `In Progress` `planned`

Softwares	Platforms	Type Integration	VMAP Import	VMAP Export
Simulia Abaqus	🪟🐧	External Wrapper	v .4.0	v 0.4.0
Openfoam	🐧	External Wrapper	v 0.4.0	v 0.4.0
Autodesk Moldflow	🪟🐧	External Wrapper	v 0.4.0	v 0.4.0
ANSYS	🪟🐧	External Wrapper	v 0.4.0	v 0.4.0
Autodesk FUSION	🪟	Integrated	First Discussions are Ongoing	
Transvalor	🪟	Integrated	First Discussions are Ongoing	

5. VMAP analytics
Vision

Multi-Scale Simulation

Material Data Base
& Experiments

VMAP 2.0 analytics

VMAP 2.0 analytics

VMAP 2.0 analytics

VMAP analytics

Open Ontologies for Material and Manufacturing

Cognitive Sensors & Smart Machines

VMAP 2.0 analytics

VMAP 2.0 analytics

Analytics & ML

Digital Twins

Wednesday, May 13, 2020

18
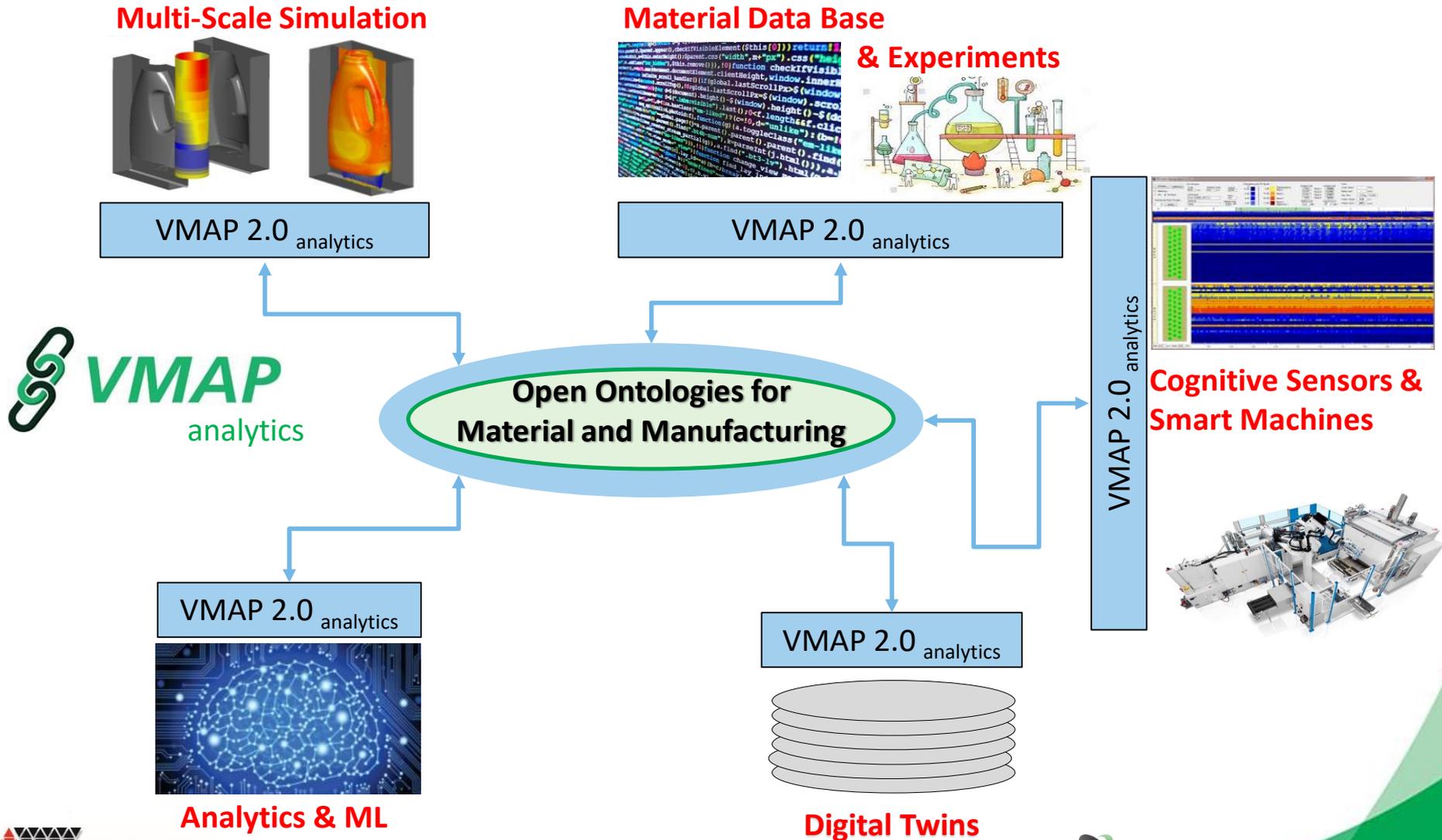
Austria

1. 4a engineering

Belgium

1. *e-Xstream (self-funded)*

Sweden

1. Gemit Solutions
2. Morgardshammar
3. Kanthal
4. Outokumpu Fagersta Steel
5. Swerim

Germany (self funded)

1. Dr Reinold Hagen Stiftung
2. Fraunhofer SCAI
3. Fraunhofer IWMS
4. KIT Fast
5. Rikutec
6. Simutence

Switzerland

1. Key2Metals (self-funded)

UK

1. Ansys Granta (self-funded)

Germany/Spain

1. NAFEMS (partner funded)

Netherlands

1. Eindhoven University
2. InSumma
3. KE-works
4. KxA Software Innovations
5. LifeTec Group BV
6. Philips Consumer Lifestyle
7. Philips Electronics Nederland
8. Reden BV
9. University of Groningen

Turkey

1. ACD Bilgi islem
2. Alpata technology
3. Argedor Information Tech.
4. Inovasyon Muhendislik
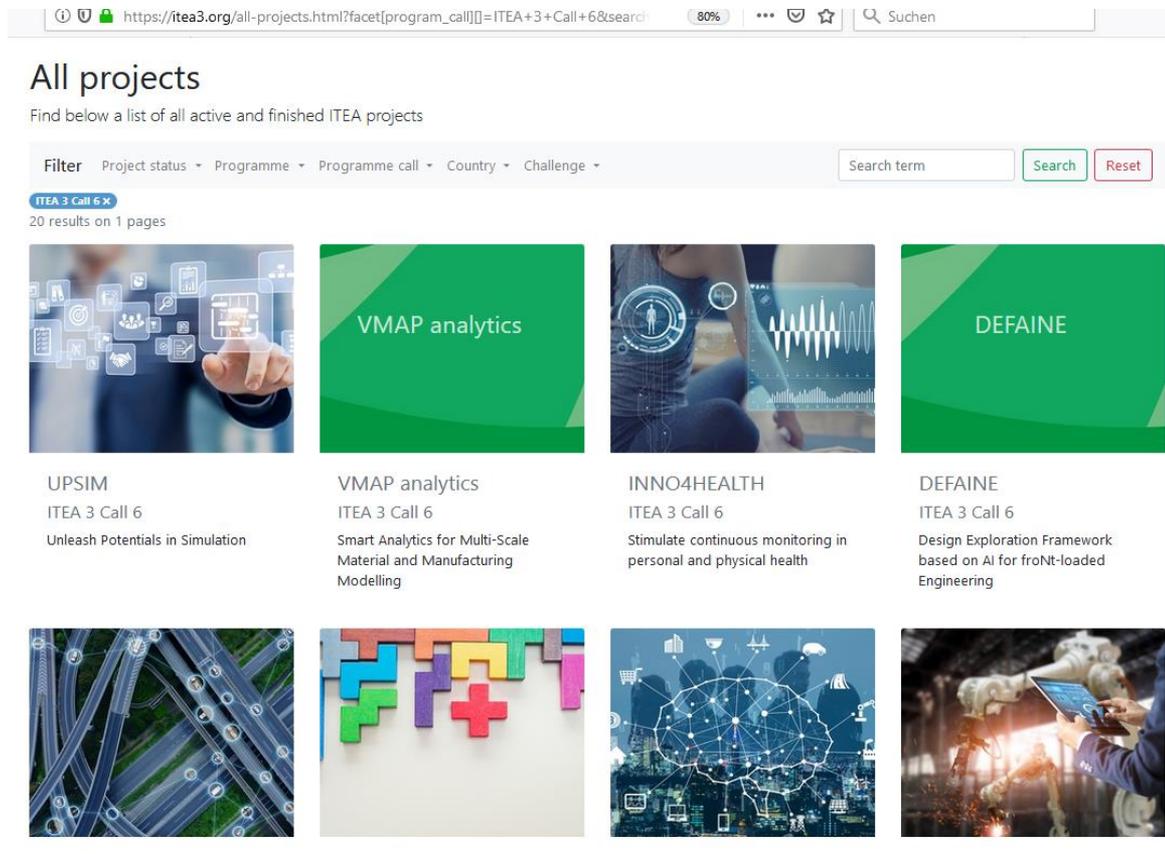5. Karel Electronics
6. Tubitak

ITEA

- Project has been labelled by ITEA on March 21, 2020

National Funding Applications

- Consortia from Austria, Netherlands, Sweden, and Turkey wait for acceptance by national PAs
- Consortia from UK, Belgium, Switzerland, and Germany participate as self-funded partners

Project Start

- Is planned for Nov. 2020

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7. Any Other Business [GinoD]
8. End

6. VMAP-SC… Structure

VMAP-SC

VMAP-SC Assembly

Assembly meeting defined in ByLaws
Voting on decisions

- all members present at the VMAP-SC meetings
- the highest decision-making body
- will confirm and make all decisions

VMAP-SC Board

Chairperson	• lead all negotiations • signing authority
Vice-Chairperson	• signing authority
Secretary	
Treasurer	• signing authority
Members for specific duties (max 5)	
VMAP-PR Leaders (unlimited)	

- main point of contact
- budget proposals
- operation planning
- items to be discussed at the Assembly meetings,
- administrating the VMAP-SC funds and owned rights,
- approving proposed changes to Bylaws,
- working for the good of the association

VMAP-SC Technical Groups

Tech-Manager	• Leader of Standards and Libraries maintenance projects (Fraunhofer-SCAI)
VMAP-PR Leaders	• Leaders of the technical development work defined via projects (VMAP-PR)
VMAP Technical issues	• Take responsibility to oversee specific issues (e.g. wrappers)

- take responsibility for specific issues related with the VMAP Standards
- may be defined and dissolved as necessary

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VMAP-SC

- Contributing members — *VMAP Contributor License Agreement (CLA)*
  - actively working on VMAP Projects
  - carrying out VMAP maintenance (via VMAP Projects)
- User members — *VMAP User License Agreement (ULA)*
  - utilizing the VMAP Standards and VMAP IO Software Libraries within their software or simulation processes wishing to maintain a close collaboration with VMAP-SC
- Expert members
  - expert members promoting the VMAP Standard (marketing, articles, etc.)
  - those contributing to the maintenance (software, documentation, etc.) of the VMAP Standard
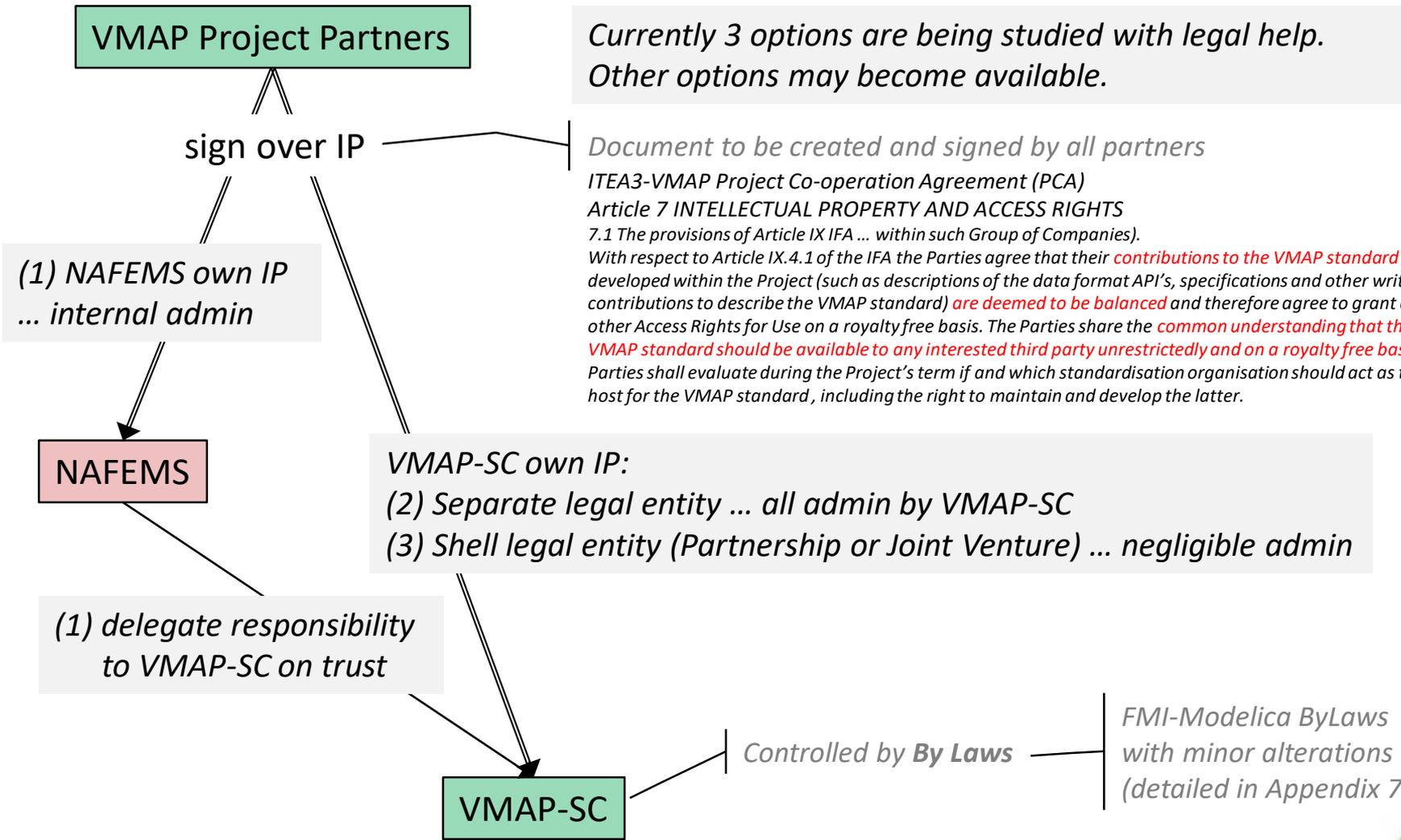
Individual persons, companies, institutes, universities and other organizations who agree to work in accordance with the purpose of the association and follow the Bylaws of the association.
(an organizational member has to appoint an individual person affiliated to the organization to represent the organization in all matters)

6. VMAP-SC… IP ownership

VMAP Project Partners

Currently 3 options are being studied with legal help.
Other options may become available.

sign over IP

Document to be created and signed by all partners

ITEA3-VMAP Project Co-operation Agreement (PCA)
Article 7 INTELLECTUAL PROPERTY AND ACCESS RIGHTS
7.1 The provisions of Article IX IFA … within such Group of Companies).
With respect to Article IX.4.1 of the IFA the Parties agree that their contributions to the VMAP standard to be
developed within the Project (such as descriptions of the data format API's, specifications and other written
contributions to describe the VMAP standard) are deemed to be balanced and therefore agree to grant each
other Access Rights for Use on a royalty free basis. The Parties share the common understanding that the
VMAP standard should be available to any interested third party unrestrictedly and on a royalty free basis. The
Parties shall evaluate during the Project's term if and which standardisation organisation should act as the
host for the VMAP standard , including the right to maintain and develop the latter.

(1) NAFEMS own IP
… internal admin

NAFEMS

VMAP-SC own IP:
(2) Separate legal entity … all admin by VMAP-SC
(3) Shell legal entity (Partnership or Joint Venture) … negligible admin

(1) delegate responsibility
to VMAP-SC on trust

*Controlled by **By Laws***

FMI-Modelica ByLaws
with minor alterations
(detailed in Appendix 7)

VMAP-SC

6. VMAP-SC… Budget

VMAP-SC

- ■ "Guestimated" budget €117.000 per annum
    - Fraunhofer SCAI for Technical Management
    - NAFEMS for administration
        - ■ Databases & Management (membership, collaborators, users, etc.)
        - ■ Website, Leaflets
        - ■ VMAP-SC Meetings (web, face-to-face)
        - ■ Webinars, Workshops (limited), etc.
        - ■ No (or very limited) budget for Symposia and Conference

- ■ Financed by
    - Membership fees
    - Website, Conferences, etc.
    - Possible VMAP analytics project
        - ■ Overlap of some tasks

Members could possibly advertise on web
Int. Conf. on Interoperability (zero in 2020)

6. VMAP-SC… Annual membership fee

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VMAP-SC

■ Membership

Application, acceptance, rejection templates in Appendices 3, 4, 5

- by application

- approved by Assembly

- all VMAP Project Leaders must be members

■ Annual membership fee

Fees defined in Appendix 6

- can be changed at Assembly

- no payment, no vote

proposal, not confirmed Any comments?

VMAP-SC annual fee	DRAFT		15/04/2020
	Organization size		ISV
Individual		300 €	
Company	1-9	300 €	600 €
	10-99	600 €	1.200 €
	100-249	1.000 €	2.000 €
	250 and above	3.000 €	6.000 €
Research Institute	(per institute)	600 €	
Research Organization		3.000 €	
Univeristy		3.000 €	

6. VMAP-SC… Timescale

18 March 2020	Agreed VMAP Standards distribution to 3rd parties	**AGREED**
31 March 2020	Confirm VMAP Package, Distribution tasks	**DONE**
April 2020	Distribute VMAP Package to initial users	**STARTING**
31 May 2020	Decide IP ownership	**IN PROGRESS**

·NAFEMS ·VMAP-SC legal entity ·Shell legal entity (Partnership or JV)

June 2020   Legally create VMAP-SC
Agree VMAP-SC near-future budget

July 2020   Move VMAP partners into VMAP-SC
Decide VMAP-SC Board (VMAP project partners)

September 2020   Sign project IP over to VMAP-SC

October 2020   Invite new members into VMAP-SC
·Define contributors, users, experts

October 2020   End of VMAP project

November 2020   *Hopefully include* VMAP-analytics project partners

March 2021   VMAP-SC Assembly meeting

7. Any Other Business

 VMAP Group

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 Contact/Download

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