DOME 4.0

Deliverable D6.5 - "Report on the Three Hackathons"

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Publishable Summary

Deliverable D6.5 summarises the details of the three Hackathons that were planned and held in the DOME 4.0 project. The themes for the three hackathons were:

- Hackathon 1: Ontology Development and implementation and its role in data sharing
- Hackathon 2: Onboarding and data sharing for a new industrial end user from a new sector
- Hackathon 3: Lessons Learnt in enabling success stories via data sharing

As and where necessary, further details about the planning are also covered, and a dedicated section has been added to summarise the lessons learnt in this process. This deliverable is a public report, due on M47 of the project.

Executive Summary

Current deliverable D6.5 summarises the details of the three Hackathons that were planned and undertaken in the DOME 4.0 project. The themes for the three hackathons were:

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1. Introduction

1.1 Overview

According to the Description of Action (DoA) in the DOME 4.0 project, three hackathons have been planned as key dissemination activities in the project, to engage with a wider audience for the digital marketplace ecosystem, involving young researchers, innovators, scientists and engineers from Academia and industry.

Two of these hackathons have also been combined with other events, i.e., Industrial Engagement Open Days. The outreach of the event was increased even more in this way, via engagement with younger and more experienced audience from Academia, Industry, public bodies, etc.

Such engagements were organised as 3-day events, split as a two-day Hackathon plus an extra day of Industry Open Day for two of the hackathons, and a 2-day event as the final hackathon. The first two hackathons were held as hybrid meetings, though all participants were encouraged to attend in-person for maximum impact and effectiveness of the event. The final hackathon was planned as an in-person only event.

Details of Industrial Engagement Open Days are covered in other project deliverable (D6.4), and the current deliverable only focuses on the Hackathon events. For this matter, the general information about the events have been covered in section 1.2 and then further details about each Hackathon is covered in a separate section afterwards.

Each Hackathon section is divided into three sections, covering the planning, holding the event itself and feedback received both from audience and partners towards betterment of the future events. Such feedback has also been helpful during the project, helping more efficient planning for future hackathons and similar dissemination events.

At the end of the document, a section has been dedicated to lessons learnt during the process of holding Hackathons in the project, hoping that such experiences will help both project partners and a wider audience in activities concerning dissemination of highly technical material to younger audience of students and innovators, aiming at high impact contribution to training next generation highly skilled researchers, innovators, scientists, and engineers for Europe.

1.2 Events Details

The Hackathons were distributed across the duration of the project to create an opportunity to engage with the audience for a significant part of the project, and to disseminate the project development and results to the audience as they are created.

Due to this, the events were planned as follows:

- First Hackathon and Industry Open Day, on 17-19 January 2023 in Bologna, Italy
- Second Hackathon and Industry Open Day, on 11-12 October 2023 in Leuven, Belgium
- Third Hackathon, on 11-12 September 2024, UCL East Campus, London, UK

A theme was also selected for each Hackathon in accordance with the overall plan of the events. These themes also reflect the maturity and state of the development in the project. The selected themes for the three Hackathons are:

- Hackathon 1: Ontology Development and implementation and its role in data sharing
- Hackathon 2: Onboarding and data sharing for a new industrial end user from a new sector
- Hackathon 3: Lessons Learnt in enabling success stories via data sharing

Planning of talks, interactive sessions, hands-on training and Hacks took into account such themes for each Hackathon.

The hosts for the event were also a key consideration, as requirements for organising the event in terms of venue etc., along with the need for the location to be a convenient place for travel, made the decisions about the host more important. All the hosts in these events have been chosen based on those criteria and judging by the target audience that each event has finally been able to gather, it seems that these decisions have paid off.

CMCL, both as Coordinator of the project and the task leader, took lead on planning and organisation of the event, but input and contribution from all the project partners were also key in the process. Furthermore, the project has been cooperating and collaborating with a wider group of projects within the same umbrella, especially with those endorsed by the European Materials Manufacturing Council (EMMC) and such collaborations were also leveraged for better organisation of the events.

Just to give examples, partners from the sister project in Industry Commons (OntoCommons) contributed to the first two Hackathons (while the OntoCommons project was running). Also, there were dedicated sessions and contributions from other projects such as SimDOME, OntoTrans, OpenModel, VIPCOAT and MUSICODE in the Hackathons.

It is hoped that the significant collaboration and cooperation between such initiatives has been properly reflected to the public, and more importantly, the message that no project in isolation is able to accomplish too much, has been conveyed through the dissemination of shared developments, common understandings, and collective knowledge to public.

The two-day duration of each Hackathon was broken down into four sessions, each running for half a day, and covering a specific aspect of the main theme for that hackathon. The focus in planning such sessions were to involve and engage the participants as much as possible, via interactive sessions, hands-on training, co-creation and co-development, Hacks, etc. However, in cases the partners of the project found it necessary to have dedicated slots to train the audience on specific aspects of the work, where such information was needed for hands-on sessions later.

Such a combination of training, presentation, hands-on and collaborative sessions proved to be very effective in helping the events' audience learn and apply sophisticated concepts quickly – an objective whose realisation is trickier than it seems in the first sight. To help the process, required packages of the tools were communicated with the participants beforehand, to enable them to come to the event more prepared.

The overall positive feedback received from the participants and partners of the event indicate the effective communication between the audience.

2. Hackathon 1

2.1 Planning

Planning and holding a Hackathon is significantly time-consuming, as many arrangements ranging from technical scope and material, venue and organisation, financial and admin requirements, advertisement, registration, and participant reception, etc. need to be properly arranged for and carried out successfully and within a specific timeframe. Due to this fact, planning for the event start much earlier than the target dates.

Of the key decisions which needed to be made early on, was about the host and dates, which was one of the first items to be discussed and decided among the partners. After several deliberations and discussions on suitable dates and venues, a few places had already been shortlisted to host the event. After final agreements with the SimDOME project, its project partners also were involved in finding the suitable venue. UNIBO took the prominent role here, and finally arranged for a suitable venue in Bologna as another option. This was put to the partners in General Assembly and follow up dedicated meetings between the involved partners, and the conclusion was to host the event in Bologna (Italy) over 17-19 January 2023.

Further discussions with the partners, particularly involving UNIBO as the partner in the region, also helped find a suitable venue for the event, i.e., Bi-Rex. The venue was chosen based on proximity and ease of access as well as facilities to host such an event. The planning for Industry Open Day was also conducted at the same time, and it was decided to hold that event in the same venue as well.

Separate discussions with collaborators from the SimDOME project also concluded with designating a dedicated session to that project, to present developing an Open Simulation Platform (OSP) for materials modelling. This was combined with internal discussions between project partners on the technical scope, where sub-themes for four sessions of the two-day event were chosen to be:

- Session 1: Vocabularies, Taxonomies and Serialisation
- Session 2: Top Level Ontologies, Mid-Level Ontologies, and Industry Commons
- Session 3: SimDOME – Materials and Manufacturing
- Session 4: Data Sharing and Ontologies

Each session (covered over half-day timeslots) was also designated with a dedicated lead, and details of each session were discussed among the partners accordingly. As and when relevant, collaborators from other projects (e.g., OntoCommons) were also involved for presentations, hands-on training, and collaborative sessions.

In particular, new advancements in the Elementary Multiperspective Materials Ontology (EMMO) development, which is common between the DOME 4.0 and SimDOME projects, made the case for involvement of the SimDOME project stronger. Along with that, the unique role of prof Emanuele Ghedini as a key EMMO developer, the SimDOME coordinator, a DOME 4.0 and OntoCommons partner, and the local host for the event, facilitated the whole planning and undertaking of the activities significantly.

Building upon such synergies between the relevant projects, planning for the event was extended to seize the opportunity in creating larger impact. This also entailed requests from SimDOME project partners for

a more prominent role in the event, hence the reason behind a dedicated session for that project. Further involvement of the SimDOME project also helped share the associated costs for the event, which was indeed welcome. This engagement, however, also meant more complicated planning for the event, which was tackled via more frequent and effective communications between the coordinators of the projects.

With each development in the process, the event and its updates were disseminated via project and individual partners' communication channels to inform interested audience about the event. Similar arrangements were also made with the relevant projects, and the event was also disseminated through their channels as well. A dedicated and easy-to-use online form was created for registration, and the page was made public well in advance of the event to make registration for participants smoother.

Given the situation and some local (or organisation related) restriction on travel, the event was organised as a hybrid event, though all participants were encouraged to attend in-person for maximum effectiveness of the event. Organising the event as a hybrid event though, necessitated further arrangements with all participants, presenters, and trainers to ensure both Online and in-person attendees benefit the event the same way.

In the meantime, details of the technical sessions were discussed and finalised between the partners, and final plans were also advertised through communication channels. Specific feedback loops were also designed to collect and channel the feedback from the audience, and arrangements towards discussing such feedback and making them actionable for future events were also made.

Due to the importance of prolonged engagement with the participants and audience, a part of the feedback was dedicated to collect the interest for further engagement with the projects' dissemination activities (e.g., subscription to the newsletters or mailing lists for future events, etc.), which also was received positively.

Overall, the planning for the event was undertaken over a significant period, which was expected. The outcome, however, was satisfactory and it is hoped that the event has contributed to the advancement of the knowledge within European scientific community.

2.2 Event

As mentioned before, the Hackathon was held between 18-19 January 2023, following the Industry Open Day event. The Hackathon was planned as four half-day sessions, involving project partners working on core development, showcases and semantics. The event also enjoyed contributions from collaborators in other projects, most specifically from OntoCommons, and a dedicated session featuring SimDOME project was also included. The details of agenda for the event are shown in Table 1. Over 70 attendees participated in the two-day event.

Specific contributions received from advancements made in other projects included:

- "Highlighting the role of semantics in data sharing" by SINTEF,
- "Guidelines on creating Ontologies" by ENIT
- "OntoCommons tools to help out with DOME 4.0" by UPM

Along with these, the "Session 3: SimDOME – Materials and Manufacturing" was delivered completely by SimDOME project partners, which have had three shared partners with DOME 4.0 project (i.e., UNIBO, FRAUNHOFER and CMCL).

Table 1: The details of agenda for Hackathon 1

Agenda Day 1 – Wednesday Jan 18th 2023		
Item	**Timing**	**Topic**
Session 1: Vocabularies, Taxonomies and Serialisation		
1	09:00	Venue Open to Participants
2	09:15	Warm up session – introduction (CMCL and UCL)
3	10:15	Highlighting the role of semantics in data sharing (SINTEF)
	10:45	Coffee break
4	11:00	Interactive session on data management & digital marketplaces (UKRI)
5	11:30	Vocabularies, taxonomies, and serialisation for linked data (UKRI)
	12:15	Lunch
Session 2: TLO/MLOs and Industry Commons		
6	13:15	Intro to TLO/MLO ontologies such as EMMO (UNIBO)
7	14:15	Guidelines for creating Ontologies (ENIT)
	14:45	Coffee break
8	15:00	Data FAIRness practice (UKRI, EPFL, ENIT)
9	16:10	Semantic enrichment: Connecting DCAT to EMMO (UNIBO, SINTEF and UCL)
10	16:40	Problem from Industry commons - data sharing and FAIRness (BOSCH)
11	17:00	End of day 1
Agenda Day 2 – Thursday Jan 19th 2023		
Item	**Timing**	**Topic**
Session 3: SimDOME – Materials and Manufacturing		
1	08:45	Venue Open to Participants
2	09:00	Introduction to ontology-based frameworks via EMMC (GCL, SINTEF, UCL)
3	09:15	SimDOME Platform Overview (UNIBO)
4	09:30	SimPhoNy OSP Architecture + GUI (FRAUNHOFER)
5	10:00	SimDOME Architecture and APP Description (UNIBO)
6	10:20	SimDOME SDK (FRAUNHOFER)
	10:45	Coffee break
7	11:00	SimDOME APP Presentation and Run (FRAUNHOFER, UNIBO)
8	11:30	Exercise: YAML to CUDS to Wrappers to Engines (FRAUNHOFER, UNIBO)
	12:15	Lunch
Session 4: Data Sharing and Ontologies		
9	13:15	OntoCommons tools to help out with DOME 4.0 (UPM)
10	13:45	Data sharing - Role of ontologies (SINTEF)
11	14:15	Cross-sector maritime air quality virtual sensor (CMCL)
	14:45	Coffee break
12	15:00	Use case from DOME 4.0 with Market4.0 (INTRA) - IDS overview - MARKET4.0 approach with IDS and DOME4.0 integration - Use IDS to exchange data with a predefined IDS data source
13	17:00	Conclusions and end of Event

The event was held at bi-rex facilities which gave a great opportunity to participants to engage with the technical delivery of the material in full swing, and good multimedia preparation for the venue also helped the online-attending participants to actively engage in the discussions. Prior knowledge and preparation

for the hybrid meeting also helped the process, facilitating smooth exchange of ideas between in-person and online attendees. MS Teams links were provided to all participants, and all sessions were recorded accordingly for documentation and dissemination activities.

With the event underway, a dissemination campaign was also carried out, with frequent updates about the talks, presentations, etc. via the project's dissemination channels, particularly those in Twitter and LinkedIn. Apart from gathering attention to the event, the project pages on social media also enjoyed a boost in number of followers as well as engagement (likes, shares, re-post, etc.) which was an added benefit of the event for project publicity.

The event started with the session 1, covering the overview of the two-day programme as well as technical details which were going to be covered. The first technical subject to cover was the standard vocabularies (see Figure 1). During this session an interactive part was also conducted by the project partner UKRI, to collect participants' views and expectations towards the digital marketplace via online questionnaire. Results from this online survey were interesting and helpful for the purpose of platform development.

Figure 1: Session 1 of the Hackathon 1, introduction to DOME 4.0, standard vocabularies and interoperability tools

The first day of the event continued with a session on Top Level Ontologies, and Mid-Level Ontologies, such as EMMO, as well as ways to enrich the data semantically. A part of this session was also dedicated to an interactive practice on data FAIRness, i.e., how to make data Findable, Accessible, Interoperable and Reusable. The impact of all these on data sharing experiences in industrially relevant environment was also covered accordingly, to wrap up the activities in the first day of the event (See Figure 2).

Figure 2: Session 2 of the Hackathon 1 – ontologies, FAIRness tool and their impact

The morning in the second day of the Hackathon was dedicated to SimDOME project. The project partners in SimDOME first gave an overview of their platform development, including the components, structure, architecture and user interface, and the session concluded with interactive parts working on execution of apps and exercises (Figure 3).
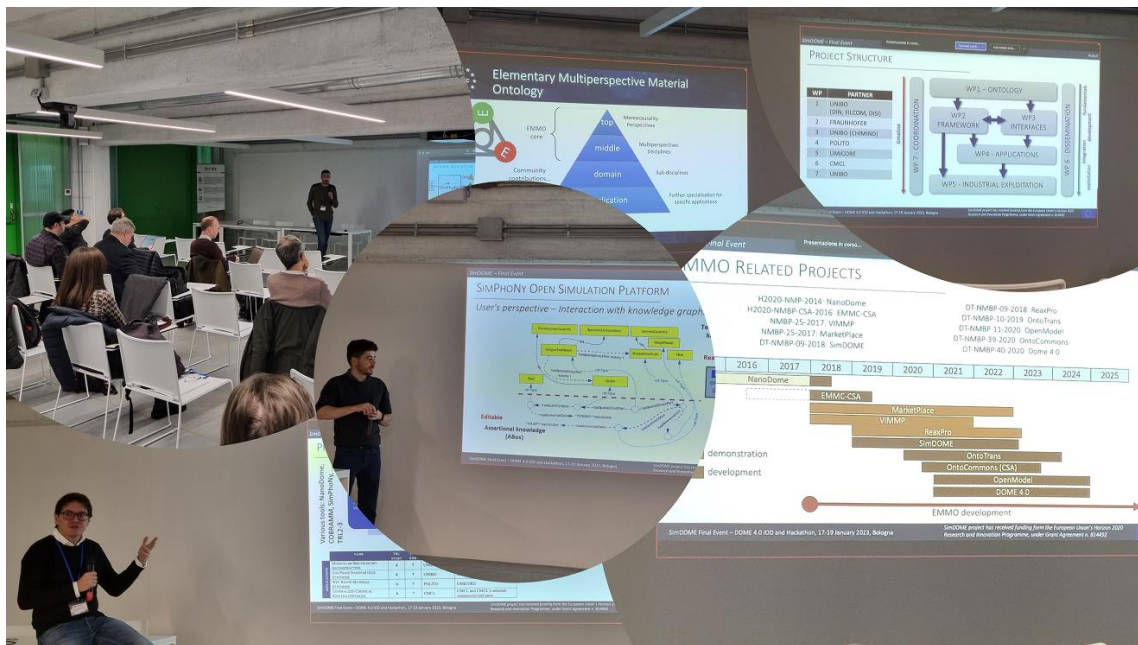
Figure 3: Hackathon 1 – the dedicated session on SimDOME project

The event was concluded with the last session on data sharing and ontologies. The session here was aimed at making use of the material that had been already presented in previous sessions, to run an interactive part to enable data sharing in a real-world example (See Figure 4).

Figure 4: The final session of the Hackathon 1 – interactive sessions and hands-on hack

Along with the event and in conjunction with the Industrial Engagement Open Day, several small enterprises and Start-ups also held an exhibition in the facilities provided by the Bi-rex, which also engaged the participants and gave them an opportunity to present their capabilities (Figure 5).

Figure 5: The SMEs and start-ups exhibiting their capabilities during the hackathon 1

As and when necessary, material was prepared before the event for the participants so that the event itself runs smoothly. With all these efforts, the participants were able to benefit from the technical delivery of the hackathon and engage with the DOME 4.0 technical team to work on the technical tasks.

Overall, this event has been successful in involving a wide range of participants of varied backgrounds, and this was also reflected in the feedback received from the participants (as also summarised in section 2.3)

2.3 Feedback
The key feedback collected form the participants in the event are as follows:

- Documentation of the entire process is of very high importance. This covers both planning, organisation, holding and feedback from the event to help further re-use the knowledge gained in the event
- Planning well ahead for the event is also of importance, to give everything time to happen in their own time and also enough time for dissemination of the event
- Holding the event at Bi-rex was helpful as they could also leverage their network to the benefit of the event. An example here was involvement of the SMEs which were helpful in the event as well
- Involvement of another relevant initiative (SimDOME) in the event was also another positive point, which could be repeated in the future events as well.
- It will be important to designate responsible people for each session, i.e., session leads, so that there is a clear responsible for making things happen, and also to follow up the status. It will help distribute the responsibility of holding the event too

- Timing and location of the event are extremely important, as they help participants in planning and travel. It has been suggested to hold future events at a transportation hub and at a convenient time
- Communication between the organisers, host, partners and participants is also a key – this is important both for planning of the event and also dissemination for further participation
- Any prerequisite material needs to be prepared well ahead of time in an understandable format, so that participants will understand and are able to use it
- Overall, the feedback on the organisation of the event has been very positive, which is a complement to the organisers of the event.

3. Hackathon 2

3.1 Planning

A key lesson learned from planning and holding of the first hackathon was to start as early as possible to allow more time to coordinate activities across the platform and wider team engaged in planning for the next hackathon. Based on this, as soon as the hackathon 1 was held, the planning for next upcoming event started with a surgery session detailing all the positive and negative feedback from the hackathon 1 (as summarised in section 2.3 too). Same activity was also undertaken with the participants of the event as well, to make sure all voices are represented in planning for future event.

Taking onboard all the comments and feedback from the participants, organisers and presenters of the event, the planning for the next Hackathon kicked off. Experience gathered in holding the first hackathon also helped the process.

The first step of the planning was to decide on the key details of the event, such as host, dates, etc. These were discussed with the project partners in different meetings first, and after collecting input from the partners about these, the proposed plan was put to the consortium for final decision. The key decisions made about the event details are as follows:

- Type of the Event: Hybrid – to encourage more participation and also offer more flexibility
- Host: Siemens Digital Industries Software (SISW)
- Venue: Simcenter premises, Leuven, BE
- Dates: 10-12 October 2023 (of which the 10 October covered Industrial Engagement Open day and 11-12 October were dedicated to Hackathon)
- Hackathon Theme: Onboarding Data Providers, Data Consumers and Service Providers

As soon as the key decisions were made, parallel activities were organised to plan for the event, taking into account the following different aspects:

- Planning for technical development work that need to be covered in the event
- Detailing the plans for each day, towards provision of a full agenda for the event
- Detailing the prerequisites required for the event – what expertise is a plus by the participants or what do they need to prepare before the event
- Organisation of the event – coordination of activities with the host and the partners
- Dissemination of the event in appropriate communication channels (i.e., the project website and social media accounts, also through communication channels of relevant initiatives)

A best practice from previous hackathon was to designate lead contacts for key activities, to help smoother coordination among the team. CMCL as the task lead took the role to coordinate all these activities across the consortium, and designated contact leads for each activity also helped manage their contributions to the planning of the event.

It should be noted that on top of the normal activities in the Hackathon, an extra item needed to be covered in this hackathon as well. According to the project's Description of Action (DoA), the Milestone 6 of the project (First external participant on-boarded and connected to the ecosystem through a hackathon) required a hackathon to be fulfilled, which based on the expected time of delivery, would be the Hackathon 2 of the project.

Therefore, in the planning of the event, an extra activity was dedicated to finalising the details of this work within the team. On one hand, development activities and state of the platform were followed up with the team, and on the other hand, potential external participants to the platform were taken into account. After coordination with the partners, it was decided to dedicate a timeslot in the event agenda to fully undertake this activity as a hack. Among the external participants too, the innovation Centre in Digital Molecular Technologies (*i*DMT) – Http://iDMT.Online – was chosen as the potential candidate for onboarding based on their active stakeholders from the pharmaceutical sector, thus providing additionality to DOME 4.0 focus on materials and manufacturing.

Back to the technical content required for the event, the activities were first followed up with the technical core developers of the project (i.e., WPs 1-4 leads) via direct contacts, meetings as well as participation in larger forums such as the weekly Core Development meetings and monthly Executive Board meetings. The aim was firstly to ensure that the technical development for the event is carried out well in advance of the event, and secondly, to also detail the technical sessions required in the event as well.

In parallel, the general structure of the event was discussed and agreed with SISW. The partners and host agreed on keeping the overall structure of the hackathon as they had found it suitable for the material delivery, and therefore, it was agreed to:

- Hold the event as four separate sessions, just like the previous hackathon, with an extra tweak to give each day a separate sub-theme as well
- The event start and end time to comply with the restrictions of the venue
- Each session to have a lead for planning purposes
- The mornings in each day to be dedicated to "setting the tone" for the day's agenda along with information from project's showcases and technical development
- The afternoons in each day to be fully dedicated to hands-on hacks

Once agreed, planning for the details of each session and day were carried out. Firstly, the main theme of the event (i.e., the Onboarding) was broken down into two sub-themes: a) Onboarding Data/Service providers, and b) Onboarding Data Consumers. These sub-themes were designated to each day of the event.

This was further broken down into another level to give a total of 4 sessions in the day, namely:

- Session 1: Onboarding Data Providers
- Session 2: Hands-on Hack – Connector Development
- Session 3: Onboarding Data Consumers
- Session 4: Hands-on Hack – Onboarding an External User

These sessions were further broken down into timeslots for technical delivery of material, hands-on and interactive sessions as well as hacks. Specific planning and details of these four sessions necessitated to engage several partners for planning purposes, and therefore, unlike the previous hackathon it was decided to have leads for each slot and directly follow up the activities and planning with these leads. To ensure best use of the time in each slot, a showcase owner was also engaged in each of the relevant sessions to help organise the delivery of material smoother, while also give the opportunity to present recent developments in the execution of the nine B2B showcases to the event participants.

These planning steps helped take care of the development work required for the event along with the technical material and their pre-requisites for the participants of the event.

In parallel to all the technical activities, the details of the event were also finalised with SISW, with actions about the venue access, A/V support for the hybrid event, registration, catering etc. Such coordination also involved other partners as and when necessary, in particular the partners from CNT who were also helping in planning for the Industrial Engagement Open Day.

Further details of the event sessions were communicated with the hosts when available. Feedback from the host was also taken back to the consortium accordingly. To help the process, a weekly recurring meeting between all involved parties was set up as a stand-up meeting. Other meetings in the project, including the WP6 biweekly, or the weekly Core development meeting and the Executive Board meetings were also leveraged for more widespread communication across the team.

Similar to previous hackathon, dissemination of the event was also carried out through communication channels of the project, the project website and social media accounts accordingly. The announcement and updates were carried out frequently to keep the audience engaged with the event, and further details as well as the event agenda were also published online when they became available.

As a separate activity, the event announcements were also sent to the relevant projects (e.g., OntoCommons, OntoTrans, OpenModel, etc.), associations (e.g., the European Materials Modelling Council – EMMC) and through to the project EAB and stakeholders via direct messaging to help spread the word more widely.

On the dissemination front, it was also coordinated with SISW to take onboard the marketing team at their end to help produce some more social media material (video, interviews, social media posts) during the event. A social media campaign on project's communication channels was also planned and carried out during the event. LinkedIn and X were considered as main channels to carry out the campaign after positive feedback from previous hackathon.

Furthermore, a timeslot was dedicated to a live survey from the participants to collect their views, feedback, and input towards the organisation of the event as well as the key areas of interest to the DOME 4.0 project.

Overall, the planning for the Hackathon 2 went smoother than the first Hackathon, particularly with the experience of organising the first hackathon.

3.2 Event

As planned, the event was held on 11-12 October 2023 after the second Industrial Engagement Open Day. Key aspects of the development in the project were covered through interactive and hands-on sessions in the hackathon, spanning the latest platform status, the DOME 4.0 concept for onboarding the users, updates in the showcases' execution and finally hands-on hacks. Details of the agenda for the event are summarised in Table 2.

Although the main focus in this hackathon was the development made in the DOME 4.0 platform, further development from other relevant initiatives were also covered in the event. More specifically, further alignment with the standardisation in OntoCommons project, or technical development shared between DOME 4.0, OntoTrans and OpenModel projects were also covered in different sessions in the event. Such

developments show synergies between the developments made under wider umbrella of the relevant projects.

Table 2: The details of agenda for Hackathon 2

Agenda Day 1 – Wednesday Oct 11th 2023		
Item	**Timing**	**Topic**
Session 1: Onboarding Data Providers		
1	08:45	Venue Open to Participants, Onsite Registration
2	09:00	Welcome by DOME 4.0 Consortium (CMCL)
3	09:15	Welcome by the Host (SISW)
4	09:30	Intro to The DOME 4.0 - Activities in the DOME 4.0 (UCL)
5	10:00	State of The DOME 4.0 Platform (UCL)
	10:30	Coffee Break
6	11:00	Industry Commons, multi-sided (operational) aspects, personas (SINTEF)
7	11:45	Data Providers - MARKET4.0 and AiiDA data (SINTEF, UCL and INTRA)
	12:30	Lunch Break
	13:20	Photo-Op
Session 2: Hands-on Hack - Connector Development		
8	13:30	Connector Hack – Session 1 (SINTEF)
	15:00	Coffee Break
9	15:30	Connector Hack – Session 2 (SINTEF)
10	17:00	End of Day 1
Agenda Day 2 – Thursday Oct 12th 2023		
Item	**Timing**	**Topic**
Session 3: Onboarding Data Consumers		
11	08:45	Venue Open to The Participants and Onsite Registration
12	09:00	Recap of Day 1 (CMCL)
13	09:15	Semantic analytics of manufacturing assets (BOSCH)
	10:30	Coffee Break
14	11:00	Example problem - material data for design in engineering (Fraunhofer IWM and BOSCH)
15	12:00	Survey and Feedback (UKRI)
	12:30	Lunch Break
Session 4: Hands-on Hack – Onboarding an External User		
16	13:30	Onboard the External Party in The Afternoon – Session 1
	15:00	Coffee Break
17	15:30	Onboard the External Party in The Afternoon – Session 2
18	16:45	Concluding Remarks (CMCL)
19	17:00	End of The Day and The Event

MS Teams links were provided to all participants, and all sessions were recorded accordingly for documentation and dissemination activities. SISW provided the venue with full Audio and Video support, which helped both in-person and online participants to benefit from interactive engagement in the event.

Similar to the previous round of Hackathon, dissemination campaign accompanied the technical delivery of the event to get more engagement with the public. This time as well, such a campaign indicated a boost in the interactions on social media channels of the project.

The event kicked off with welcome presentations from the project coordinator (Dr Amit Bhave, CMCL) and the event host (Stijn Donders, SISW), setting the tone for the event via covering the overview of the DOME 4.0 along with the benefits of such a digital ecosystem for an industrial user like SISW. (see Figure 6 and Figure 7).

Figure 6: Hackathon 2 – introduction to DOME 4.0 by Dr Amit Bhave (Project Coordinator)

Figure 7: Hackathon 2 – introduction by the host (SISW)

The floor was then passed on to Prof Adham Hashibon (UCL) to cover deeper dive into the technical details of the DOME 4.0 platform, its vision and capabilities, as well as current status of the development in the project (Figure 8). Multiple aspects of the ecosystem including different services enabling data provenance, sovereignty, authentication and authorisation, FAIR monitoring, Semantic brokerage etc. were covered in these talks, and their integration with each other and also with the User Interface elements of the platformed were also described. Graduate students at the university also joined the event, giving it a double benefit of taking onboard the feedback and views of next generation researchers while also contributing to the training of such researchers, scientists, and engineers.

Figure 8: Hackathon 2 – DOME 4.0 platform and features

These sessions also covered the development of SimPhoNy-based services for the platform, which at the same time could be leveraged for the development in other relevant Open Innovation (OIP) project OpenModel. This showed the synergies between the projects which are brought together under the umbrella of DOME 4.0 project.

After the break, the event continued with SINTEF giving insights about how DOME 4.0 platform enables onboarding of the users via introduction of platform connectors. Different persona of data providers, data consumers and service providers were explained and covered in this session. Using development in OntoTrans, the Open Translation Environment (OTE) project, as an example data provider, connector development basics and concept for onboarding data or service providers in the DOME 4.0 project were explained in an interactive session (Figure 9).

Figure 9: Hackathon 2 – introduction to the DOME 4.0 connectors

The activities in the first session set the tone for the day and also provided the necessary background for the afternoon hack, which went underway in the afternoon of the first day during session 2.

In this session, participants attempted a live hack of development of an example connector to onboard Zenodo (https://zenodo.org/) as an example source. To streamline the process, a Cookiecutter (https://www.cookiecutter.io/) template had been prepared beforehand, and was shared with the participants, so that they can only focus on the key points in the hack.

A step-by-step guide was also introduced and shared with the participants beforehand so that they knew what to expect in the session. These steps were followed in the session, and the technical team also helped and supported the participants with their technical issues.

The idea was to set up the machines to be able to run the scripts, deploy the template connector, modify it, and tailor that to the specific needs of the target source (Zenodo), deploy the connector and finally register the new data source on the front-end of the platform as a new data source. An example data search using the platform's front-end to confirm the onboarding concluded the process (Figure 10).
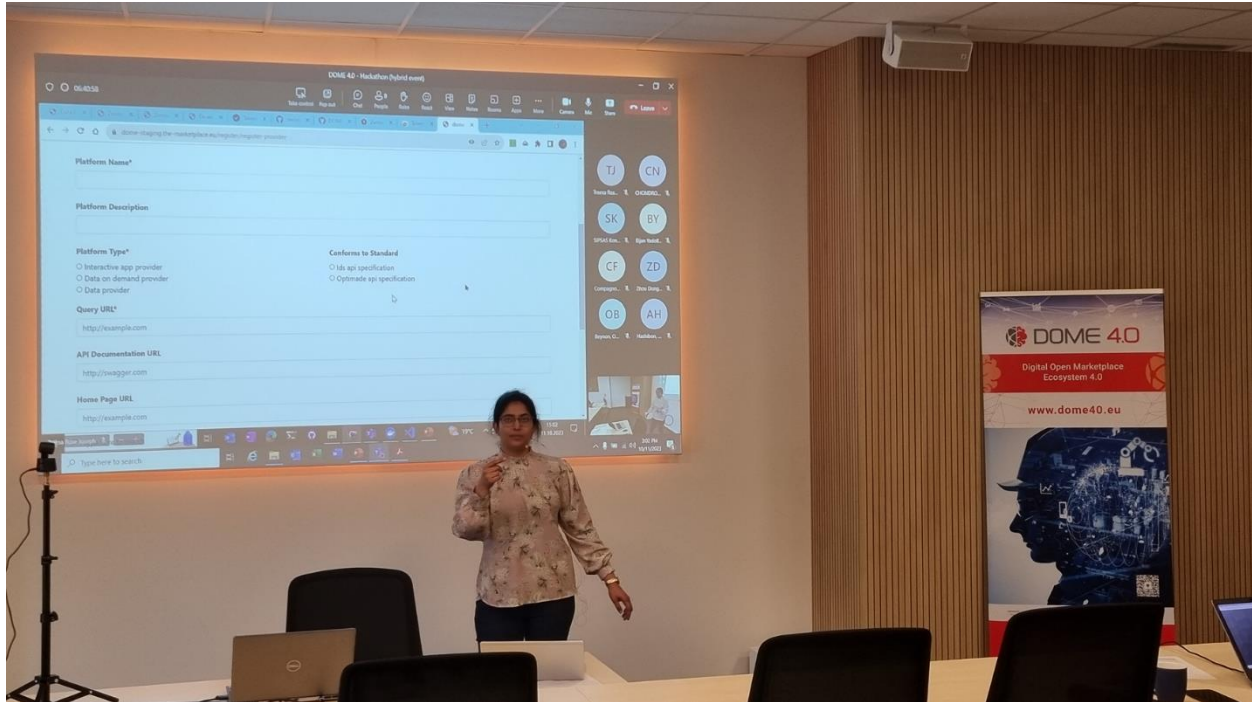
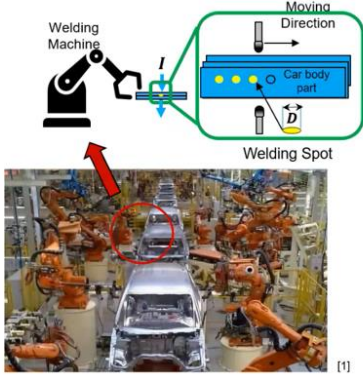*Figure 10: Hackathon 2 – onboarding example using Zenodo*

This procedure was followed by all participants in the event with the support from the technical team. Whenever necessary, the participants were given further explanation about the process as well, and in the end, a successful connector was developed and deployed, and the data source was registered on the platform. During the connector development, the similarities and differences between development of connectors for the data consumers and data providers were clarified, which effectively make the connector development a generic task for both personae.

The activities in the first day of the hackathon concluded with this exercise. CMCL gave a wrap-up brief to the participants and set the scene for the second day accordingly.

The hackathon's second and final day kicked off with a recap of the day 1 by CMCL. The next item on the agenda was a virtual talk by BOSCH (Dr Anees Ul Mahdi) to provide an insight about the BOSCH Knowledge Graph, how they leverage it how DOME 4.0 helps them in execution of the Showcase, how this can add value (See Figure 11). Further updates about the execution of the Showcase were also presented.

Figure 11: Hackathon 2 – the BOSCH Knowledge Graph and its use via DOME 4.0 showcase

The next slot was dedicated to Fraunhofer IWM and BOSCH for a discussion about the provision of data from DOME 4.0 to their showcase in the project, and how they have leveraged the DOME 4.0 as a platform to perform data enquiries with regards to their requirements in materials properties data for engineering design of the materials for automotive use. As a part of the activity, the results of a data enquiry campaign were presented showing relative maturity of the platform for such tasks even at this nascent state of development (Figure 12).

Figure 12: Hackathon 2 – discussion on the DOME 4.0 as data provider to SCs

UKRI then held a live survey session to collect participants' inputs and views about both the platform and the event. Feedback from the participants has informed other activities in the project, for example the development of the services in the platform, or the business aspects of the platform.

With every other activity in the event completed successfully, the afternoon of the last day was dedicated to the onboarding of the first external participant. Professor Alexei Lapkin represented the *i*DMT in the event, and firstly introduced the centre and their activities, also covering how the platform can help them realise their objectives in the current and future (Figure 13).
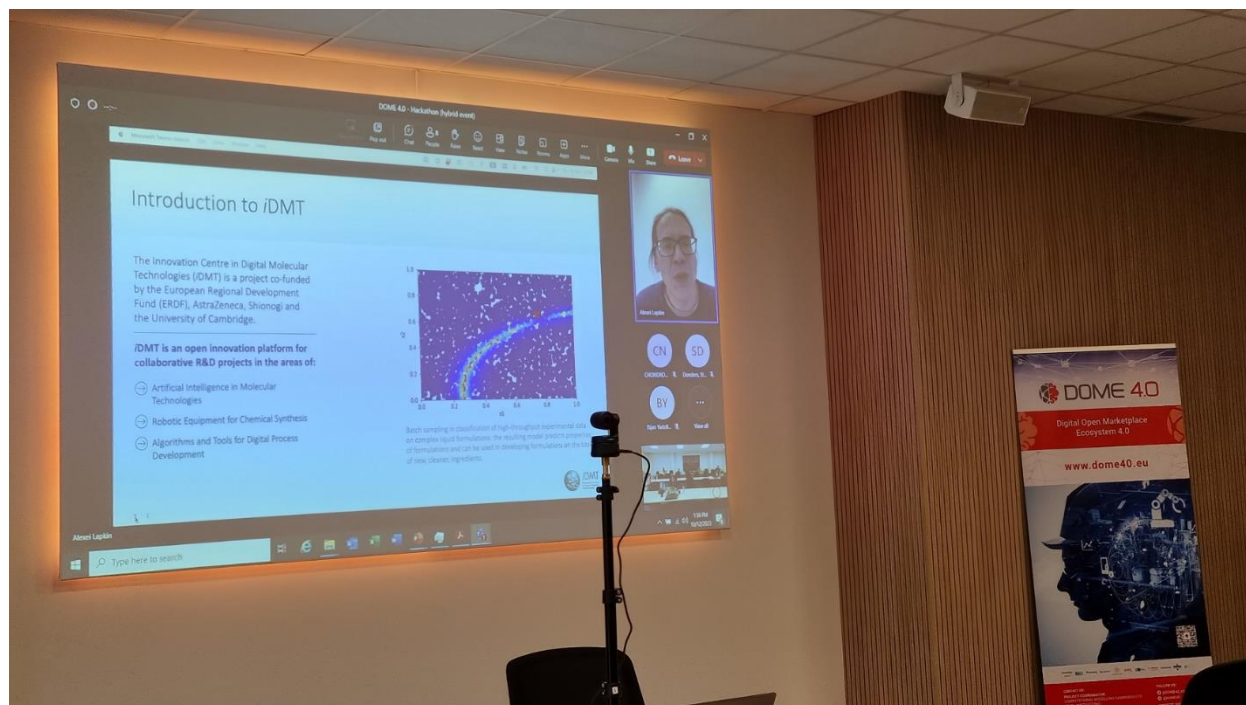
Figure 13: Hackathon 2 – presentation by Prof Alexei Lapkin (UCam) and onboarding the iDMT

After this initial introduction, the participants attempted the exercise to onboard the *i*DMT using a provided sample data set. This data set represented a lab automation experiment at *i*DMT and was already in RDF format, which was quite handy for the exercise.

Based on the first day's experience in development of an example connector, the participants were much more familiar with the process of onboarding this time, and the same procedure for onboarding the external participant was carried out. At the end of the exercise, a connector was successfully developed and deployed, the *i*DMT was registered on the DOME 4.0 platform, and example searches returned successful results which indicated successful implementation of the connector.

With this outcome, the Milestone 6 of the DOME 4.0 project was also fulfilled.

This successful exercise concluded a successful event of second Industrial Engagement Open Day and Hackathon in DOME 4.0 project. The event closed out with a wrap up of the event as well as some concluding remarks and take-home messages to the participants by CMCL as the coordinator of the project, along with a photo-op of the event participants (Figure 14).

Figure 14: Hackathon 2 – some snapshots of the event participants

3.3 Feedback

Overall, the second hackathon in the project was also a success. The following section summarises the key feedback collected or received from the participants and partners about this event. Also results from the live survey have been retrieved to complement the direct feedback received:

- The event organisation and hosting were a key plus for this hackathon. The hosts were particularly helpful over the entire process, making it smoother to plan and hold the event
- The dissemination campaign of the event was also another positive
- For an event of such a quality, the number of participants could be higher – although the total number of attendees were quite good. Maybe the specific theme of the event, or unforeseen clashes with similar events have had an effect, but it is encouraged to hold the next event during the same time period in 2024, at a convenient place like Leuven for Hackathon 2, to build upon strong points of organisation for the event
- Pre-requisites for the technical sessions have been communicated with the participants in time, but it will be helpful if this can happen even earlier to give the participants a chance to familiarise themselves with the material
- Despite hacks being never tested before, they worked during the event, which was another positive for the platform, particularly so in the case of onboarding the external participant. This shows relative maturity of the platform
- Attendance of the graduate students was a positive point to observe in the event. It is therefore encouraged that next event be held at a university partner or somewhere so that the students could also benefit. Holding the event during the semester time can be helpful, though it might at

the same time create challenges in both finding a venue at the potential host and the free time of the students to join the event

- It was emphasised again that the planning for the event needs to happen well in advance, for everything to happen in time and also to give enough time for dissemination of the event to get more participants
- If done well, hybrid events offer many benefits and can also collect more participants who could not attend in-person. Although face-to-face meetings are preferred for a hackathon type of activity, such hybrid events have also shown to be successful. This indeed depends on the organisation, equipment, and expertise in holding and moderating the hybrid sessions.
- Distribution of the responsibilities for the sessions needs to be further explored in future events, as one responsible for everything leaves a huge burden on one partner, which is not fair and responsible.

4. Hackathon 3

4.1 Planning

Like the planning for Hackathon 2, and to put the feedback from the Hackathon 1 into the practice, the planning for the final Hackathon event of the DOME 4.0 project was also started early. This was even more important compared to the planning for Hackathon 2, as in this case the DOME 4.0 consortium had to engage with 3rd party service providers for organisation of the event.

According to the project's Description of Action (DoA), the third hackathon in the project was planned to be organised by a 3rd party service provider. Regular engagement with 3rd party providers was planned and realised. However, it became clear that such engagements with the 3rd party providers entail significant risks from legal and financial perspectives within the limited time available for the delivery. Therefore, the matter was put to a special meeting between the project partners, and the consortium unanimously decided to deliver the third hackathon using the resources from the consortium itself mainly due to the legal risks for a single organisation to assume liability on behalf of the entire consortium for a medium TRL system such as DOME 4.0.

Although changing track midway through the planning introduced some challenges, the clarity of the final decision enabled rapid mobilisation of the partners towards planning for a successful event. Therefore, as there already was some mobilisation between the CMCL and some core partners, extended actions to plan and organise the third hackathon got immediately underway.

Decisions about some key details of the event had already been made during the time the DOME 4.0 consortium was in communication with the 3rd parties. As the first step in internal organisation efforts, these decisions were confirmed, and other key details were also added and were also agreed upon by the project partners. These decisions covered the host, location and dates of the event as well as some other details:

- Type of the Event: In-person only – to facilitate live hacks in groups
- Host: University College London (UCL)
- Venue: UCL East Campus, London, UK
- Dates: 11-12 September 2024 (i.e., a two-day event as per the DoA)
- Hackathon Theme: Lessons Learnt in enabling success stories via data sharing

Based on the latest status of the showcases' execution and the DOME 4.0 platform, it was decided to focus on the services and capabilities available via the Graphical User Interface, to also test the functionality of the platform under real-world conditions. This was a bold move, given the fact that some latest updates of the features had not yet been integrated with the platform, and work was ongoing to finalise these features at the time of the decision.

Similar to previous hackathons, as soon as the key decisions were made and confirmed by the project consortium, several activities were carried out to organise the event. These were aimed at ensuring the highest quality event given the available time and resources for the event:

- Follow ups on the status of the latest developments in the DOME 4.0 platform and showcases, aiming to feed them into the agenda for the event

- Contacts and communications with potential keynote speakers for the event, to bring different viewpoints in one place
- Details of technical content that was required to be covered in the event
- Breakdown of the plans per day and half day, to prepare an agenda for the event
- Collecting the prerequisites for the planned technical work in the event, to also prepare participants for the event
- All the details of the organisational activities, coordinating with the host and the partners as well as participants
- Dissemination activities – project website, social media posts, direct emails, communications with the relevant projects and other initiatives, etc.

To expedite the whole process of planning and organising the event, dedicated weekly standup meetings were introduced on top of current meetings attended by the key partners involved in the planning of the event, while decisions concerning the whole consortium were made in the General Assembly in Oslo (Month 42), monthly Executive Board meetings or similar. A slot in the weekly Core development meeting was also dedicated to updates with regards to the preparation of the technical work for the event.

Based on the comments and feedback received from the partners, it was decided to allocate slots for two categories of "hacks" in the event, i.e., those pertaining to the DOME 4.0 and its showcases, and those focused beyond the current showcases, and even beyond current scope of the platform. Discussions also followed about the details of these hacks, and lists of potential problems for each category of hack was created and updated by CMCL with the help from the technical core development partners. Likewise, it was decided to attempt solving the hacks through dividing the participants in smaller groups, so that each group can focus on the problem with a manageable number of team members, to also maximise the engagement of each participant with the hacks.

Positive experience from the organisation of previous hackathons was also leveraged in the planning here, with designation of the lead contacts among the partners for each slot in the agenda. This provided clarity in lead organisers for each slot in the agenda and made coordination of activities easier.

To help organise the event smoother, the host (UCL) also hired an event lead at their end, to solely focus on the organisation and venue-related arrangements. In retrospect, this experience also proved to be positive because firstly a lot of coordination was required at the venue to ensure everything is in place for the event, and secondly, a single point of contact for several of these arrangements was introduced, that streamlined coordination with the rest of the partners easier. As necessary, the event lead also engaged in dissemination activities and communications with the potential participants as well, which also helped the process of registration and onboarding the participants.

The development work in the months leading up to the third hackathon helped deliver a more stable version of the platform with the latest updates in the services and components also included. This helped planning the technical hacks as well. The recent activity in onboarding the nine Business-to-Business showcases also was helpful, and hacks about those activities were also considered accordingly.

The updates in the status of the platform as well as the onboarding of the showcases were carried out directly with the core developers in WPs 1-4 during the regular meetings in the project. Dedicated weekly meetings for hackathon planning also consolidated these efforts and gave an opportunity to the project partners to also focus on the planning for the two-day event.

Based on the positive experience in holding the previous two hackathons in the project, and upon agreement from the host (UCL), the general structure of the event was finalised. In particular, the partners agreed to:

- Hold the event in two separate days, but also break each day into two separate sessions with different sub-themes
- Consider two categories of hacks, to be focused upon in each day separately
- Allow enough time for each hack to be attempted and concluded.
- The event start and end time to comply with the restrictions of the venue
- Allow timeslots in each day for keynote speakers, preferably in the morning to set the tone for the day
- Provide an update of the DOME 4.0 platform and showcases status at the start of the event
- Each session to have a lead for planning purposes

Based on the status of the developments in the project, a list of the potential hacks was compiled, both focusing on the DOME 4.0 features and its connection to the external world. Preparation for these hacks (in case a pre-event preparation was required) was also communicated to the concerned parties, so that the requirements are met for the event.

Similar to the previous hackathons, sub-themes for each half-day were also considered and agreed upon between the partners. The final 4 sessions in the event were finalised as:

- Session 1: DOME 4.0 and Industry Commons
- Session 2: Hands-on with DOME 4.0 – Hack 1, Materials and Manufacturing Sector
- Session 3: Hands-on with DOME 4.0 – Hack 2, Cross-sector Use Cases
- Session 4: DOME 4.0 and Beyond

Each of these sessions were also further broken down into shorter slots, covering the keynotes, team build-up and problem statement as well as hacks and the pitch and feedback sessions. Although most of the slots were concerned with the hacks, session leads were assigned to help moderate the activities within each slot. Along with the technical work and preparation for the technical sessions, follow ups were also planned to communicate with potential keynote speakers, and a list of candidates was also devised for this activity.

CMCL led the efforts in communications with the potential speakers, and DOME 4.0 core partners also helped this process. It was aimed to include at least one and ideally up to three keynote slots in the agenda, also taking into account the time constraints for this. After communications and contacts with several potential speakers, three keynote speakers were confirmed for the event, namely:

- Dr Iker Esnaola-Gonzalez (BASF Digital Solutions)
- Christoph Mertens (IDSA) – also an EAB member of the project
- Kate Lin (Google)

Upon the receipt of the confirmation, these keynote slots were included in the agenda accordingly.

As the technical programme for the event took shape, the organisation also progressed with several arrangements for the venue, the informal dinner with all the participants, the A/V and equipment in the room etc. were also planned and finalised with the help from the host and the event lead.

Similar to previous events, a comprehensive campaign of dissemination was planned, to disseminate the updates about the event, send those updates within the communication channels etc. for better outreach to get more participants onboard. Further details about the agenda were communicated with the dissemination team as and when provided to help the process. Along with dissemination of the event via the project website, social media channels and the mailing lists, the updates to the event were also communicated with the partners to disseminate via their own dissemination channels, sent to relevant projects and initiatives (e.g., the CODEX cluster, EMMC, etc.) and was sent as direct messages to the individuals who were active in the area and might be interested to join.

With the help from the project's dissemination lead (INTRA), a similar dissemination campaign was planned to be carried out during the event and after that too. Creation of the social media material (photos, etc.) was also considered to help this process, and main focus was put on LinkedIn and X as the two main social media platforms for the project.

Overall, these activities helped finalise the plans for the hackathon, and good process in several fields, including the updates in the platform as well as confirmed keynote speakers hinted for the successful delivery of the event.

The preparation for the third hackathon took more energy and effort due to unavoidable challenges in setting up the agreement with the third party, and the extended focus on planning the final main dissemination event in the project. However, the final plan for the event provided the grounds for a successful delivery, and with the help of the host, the organisation of the event also looked in a good shape. All these signs, hinted for a good event, and set the tone for the successful event.

4.2 Event

With the required planning activities completed successfully, the event was finally held on 11-12 September 2024 at the UCL East Campus, London, UK. As the final hackathon in the project, the event covered the latest developments in the platform, updates in the online execution of the nine B2B showcases, live hacks as well as three interesting keynotes. The full agenda of the event could be found in Table 3.

Aligned with the plans in previous hackathons, efforts were made to also showcase the DOME 4.0 relevance in the framework of the wider range of relevant initiatives, this time through the hacks to connect services or data across these initiatives. Synergies between the initiatives, and the value offerings of DOME 4.0 to the wider community were elaborated in these efforts, aiming at increasing the impacts of the developments in the project.

To facilitate the experience of working together towards solving a technical problem, the event had been organised as in-person only. This proved to be an effective decision in getting the participants fully engaged in one room, focusing to solve a specific problem. The venue provided by the host (UCL) also helped set up the hack teams in a collaborative environment, while even break-out space was also provided to the participants in case that was required. Overall, these arrangements also helped the event organisers and participants to fully focus on the agenda and the hacks.

Table 3: The details of agenda for Hackathon 3

Agenda Day 1 – Wednesday Sep 11th 2024		
Item	**Timing**	**Topic**
Session 1: DOME 4.0 and Industry Commons		
1	08:45	Venue Open to Participants, Onsite Registration and Welcome Coffee
2	09:00	Welcome by DOME 4.0 Consortium – Introduction to the Project (CMCL)
3	09:15	Welcome by the Host (UCL)
4	09:30	Status of the DOME 4.0 Platform – Available Tools and Services and How to Use It (UCL/SINTEF)
	10:15	Coffee Break
5	10:45	DOME 4.0 Showcases – A Guided Tour (SISW)
6	11:30	*Keynote 1:* Iker Esnaola-Gonzalez (BASF Digital Solutions) - Driving innovation through semantics at BASF
	12:15	Lunch Break
	13:05	Photo-Op
Session 2: Hands-on with DOME 4.0 – Hack 1, Materials and Manufacturing Sector		
7	13:15	Team Build up, Problem Statement (SINTEF/UCL)
8	13:45	Problem Hack 1 – how to get the data hosted on DOME? (UCL)
	15:00	Coffee Break
9	15:30	Problem Hack 1 – Continued (UCL/SINTEF)
10	16:30	Short Pitches by the Teams on Solutions to Hack 1 (UNR)
11	17:00	Dinner announcement and end of Day 1 (UCL)
Agenda Day 2 – Thursday Sep 12th 2024		
Item	**Timing**	**Topic**
Session 3: Hands-on with DOME 4.0 – Hack 2, Cross-sector Use Cases		
12	08:45	Venue Open to Participants and Welcome Coffee
13	09:00	*Keynote 2:* Christoph Mertens (IDSA) – International Data Spaces and Connectors
14	09:45	*Keynote 3:* Kate Lin (Google) – Open Ecosystem for Data Discovery
	10:30	Coffee Break
15	11:00	Cross Sector Hack – Storyboard Development (SISW/SINTEF)
	12:30	Lunch Break
Session 4: DOME 4.0 and Beyond		
16	13:30	Problem Hack 2 – Continued (SISW/SINTEF)
	15:00	Coffee Break
17	15:30	Finalisation of the Proposed Solutions – Presentation to the Forum (UCL/UNR)
18	16:00	Feedback from DOME 4.0 Team (UCL/SINTEF)
19	16:30	Announcement of the Winning Use Case (CNT/UNR)
20	16:45	Concluding Remarks (CMCL)
21	17:00	End of The Day and The Event

Like previous hackathons and with the help from the partners, a dissemination campaign was also carried out during the delivery of the event via website and social media posts, which helped outreach. Similar to the previous hackathons, this campaign also helped boost the interactions on the social media channels of the project.

The first day of the event kicked off with a brief welcome presentation by the project coordinator (Dr Amit Bhave), introducing the project, its basic structure, an overview of the showcases, latest developments in the platform, services provided by the platform, semantics behind it and facilitation towards data sharing

in a trusted environment. A few showcases were covered in more detail here, showing the data sharing across domains (SC1), across DOME 4.0 and Market4.0 marketplaces (SC5) and also communications between data and software through Materials Cloud and AiiDA Lab (SC7).

As a part of this talk, business architecture of the DOME 4.0 was also covered, focusing on the value offerings facilitated by the platform and SCs. A discussion was made towards the enablers for the project, and the talk was concluded with a recap of the previous two Hackathons (including the external user onboarding in the Hackathon 2), as well as the overview of the programme for the current hackathon. A Q&A session followed this talk. (Figure 15)
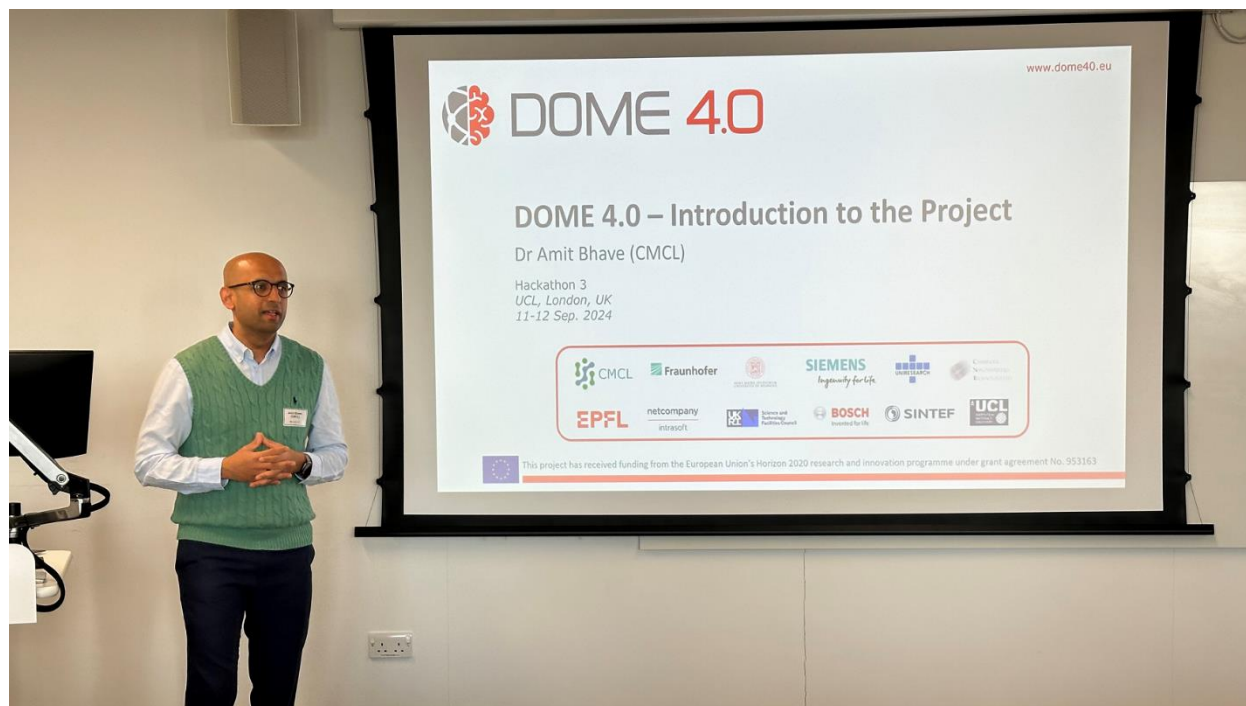

Figure 15: Hackathon 3 – introduction to DOME 4.0 by the project coordinator (Dr Amit Bhave)

Then the event host (Prof. Adham Hashibon, UCL), introduced the university, the Institute of Material Discovery (IMD), and their activities in terms of integrated modelling and experiments, data driven exploration of materials, renewable energy generation and storage, biomaterials and bioelectronics, etc. (Figure 16).

Figure 16: Hackathon 3 – introduction by the event host (UCL)

Further details about the DOME 4.0 platform status were covered next by UCL (Prof Adham Hashibon). The platform structure, core challenge it tries to tackle (connecting prosumers to data and knowledge bases etc.). The connector structure and the data-ontology mapping were also covered here, with further focus on the semantic discovery through ontologies, data service and data persistence using FUSEKI, a purpose-built tool specifically in DOME 4.0 project for this task (some snapshots of the session are shown in Figure 17).
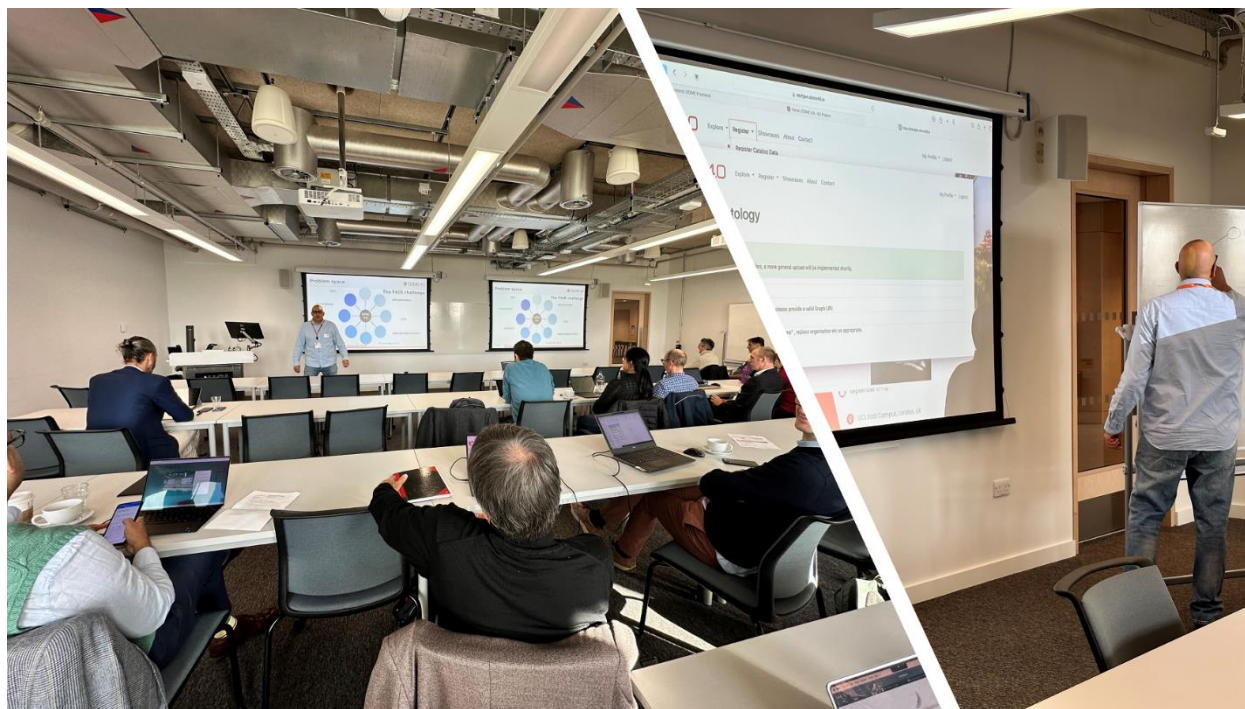
Figure 17: Hackathon 3 – DOME 4.0 status, platform structure and capabilities

This session also included exploration around data registration along with discussions about provenance and limitations of the W3C in this case. It was elaborated that with the need to standardise, the ontologies also required to be described in an appropriate way. DOME 4.0 approach in doing so was demonstrated via tutorials and example use cases. It was also emphasised that DOME 4.0 works with semantic data and solves interoperability, while the core data still in its original own platform.

After a short break, the programme resumed with the overview and guided tour of the nine B2B showcases in the project by Adrien Scheuer (SISW), with special emphasis about different features each bring into the DOME 4.0 platform:

- SC1: visualisation for the emission data (not the simulation part)
- SC2: dataset registration on DOME 4.0
- SC3: polymeric additives for corrosion protection. PubChem + comptox work, enabling on-the-fly prediction services
- SC4: structural adhesives fatigue life, dataset + local tool
- SC5: market40 website, registered connectors and tools and how the button works
- SC6: materials cloud. AiidaLAB app
- SC7: ChASe (Chemical availability search), and also tool screenshot
- SC8: spot-welding monitoring by BOSCH, and the welding ontology
- SC9: customer-tailored composite material (open compounds systems). dataset + ML model tool

Showcasing the latest development in the platform via the industrial use cases, this session was received well by the participants in the event. A lively Q&A session concluded this item in the agenda (see some snapshots of the session in Figure 18).
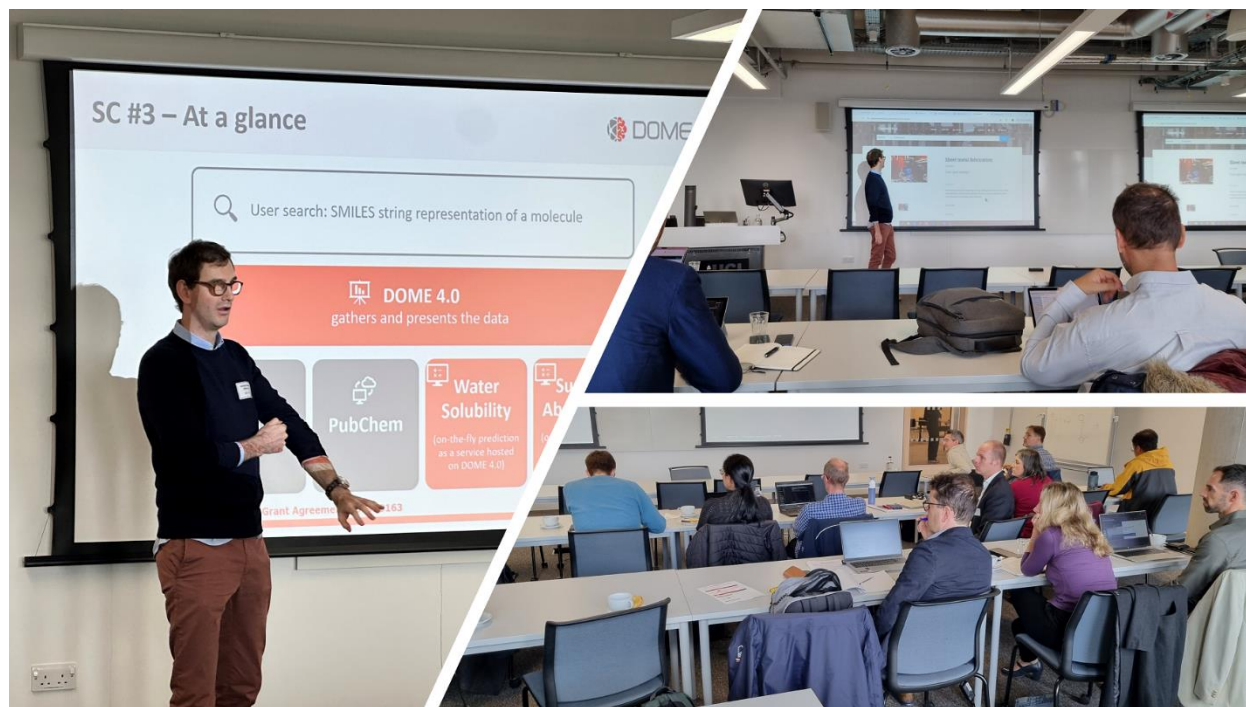
Figure 18: Hackathon 3 – status of the bisuness-to-business showcases, onboarding and online execution

The next item in the agenda covered the keynote talk from Dr Iker Esnaola Gonzalez (BASF) on driving innovation through semantics at BASF. The talk covered an introduction about the company as well as their use of semantic technologies and other tools and frameworks to enable interoperability. It was elaborated that innovation: need digitalisation, therefore, one needs to enable data collection for turning it into knowledge.

The Ontoogy tool was introduced in the talk, as a flexible framework for harmonising vocabularies and interrelating knowledge, and some features and capabilities enabled by that were also covered. BASF's knowledge-graph based approach was introduced and also grounding LLM with RAB approaches were covered in the talk. A specific example of the work by the Knowledge System team was provided via the portal for internal R&D reports.

It was emphasised that this approach empowers the domain experts via letting them to maintain the ontologies, and also use auto processing to reduce miscommunication, error and delays. It also proposed training the domain experts to remove semantic experts' role from success.

The talk further elaborated on the synergies between the developments in the DOME 4.0 project with the internal work at BASF, and some lessons learned in their internal process were also shared, emphasising the key role of semantics for the innovation, and empowering the users with the tool.

This keynote was followed by a Q&A session, which was also received well by the participants (Figure 19).

Figure 19: Hackathon 3 – the keynote talk by Dr Iker Esnaola Gonzalez (BASF), and the event's participats photo-op

This item concluded the first session of the event, leading to the lunch break followed by a photo-up of the participants at the venue.

The afternoon Session, which was dedicated to the first day's hacks, was kicked off with Prof Adham Hashibon (UCL) and Bjørn Tore Løvfall (SINTEF) delivering an overview of the available tools in DOME 4.0 and its services. A quick introduction about SPARQL queries and RDF formats were provided (see https://atomgraph.github.io/SPARQL-Playground/) and Discomat, the SPARQL package which simplifies the SPARQL queries was also introduced.

Details of the designed hacks for the first day were covered next, stating that these hacks will be carried out with the notion of "pure end user" in mind. The general aspects of working with the platform, including, e.g., search for a material, registering data sets or catalogue data, uploading, visualising and using the ontologies etc. as well as registering and using connectors were covered here with the aim to prepare the participants to attempt the hacks. Some snapshots of the session have been shown in Figure 20.
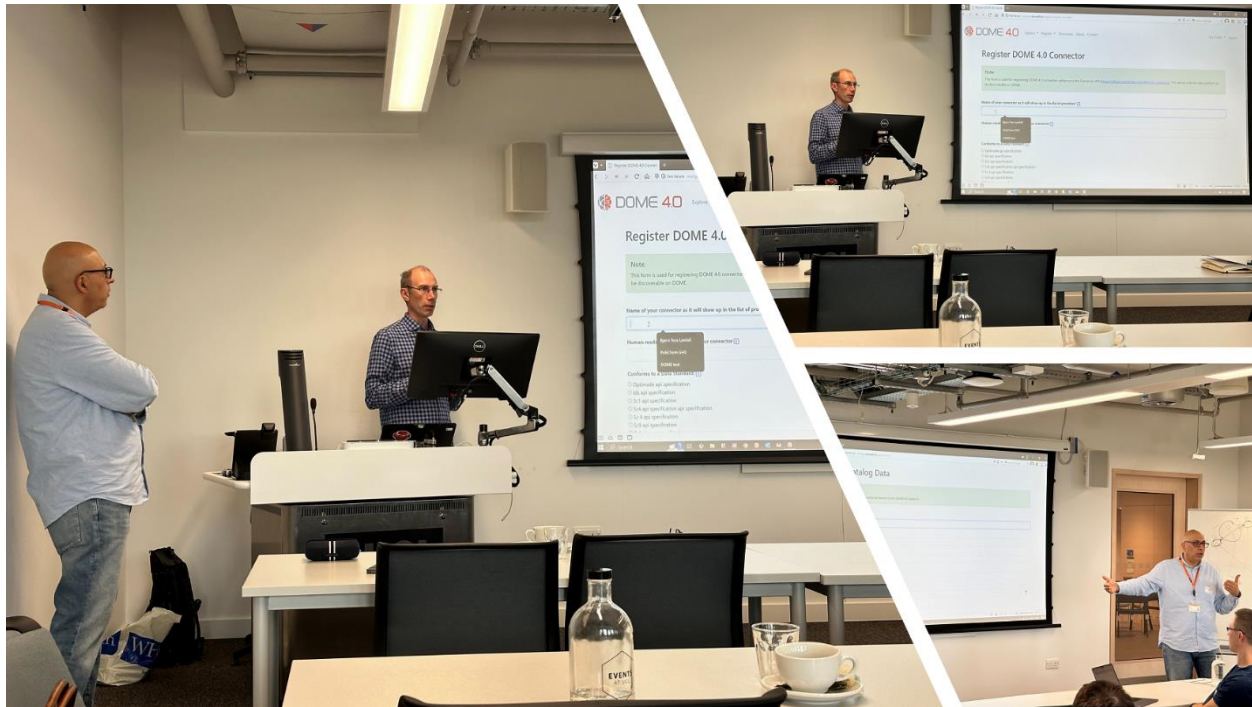
Figure 20: Hackathon 3 – DOME 4.0 platform services and functionality

In the next steps, the participants were divided into teams, and the hacks were put to the teams to attempt, using the information gained in working with the DOME 4.0 platform. The key activity here was to try and attempt to add new sources onto the platform. Participants tried the hacks hands-on while the technical development team also contributed to each team accordingly, to further support the activities in each team.

Based on the pre-event planning, it was decided to also assign some technical core developers to each team, to help guide the teams further in attempts to address the challenges introduced by the Hacks. This decision also proved to be effective as teams were able to interact with the platform after a short period of time.

Furthermore, the *i*DMT onboarding connector (which were developed as a part of the activities in the previous hackathon, and further extended since) were introduced to the participants, and the teams were requested to attempt answering questions using advanced search features in the DOME 4.0 platform. Each team got direct involvement with the platform front-end and attempted the solution to the hack in their own way.
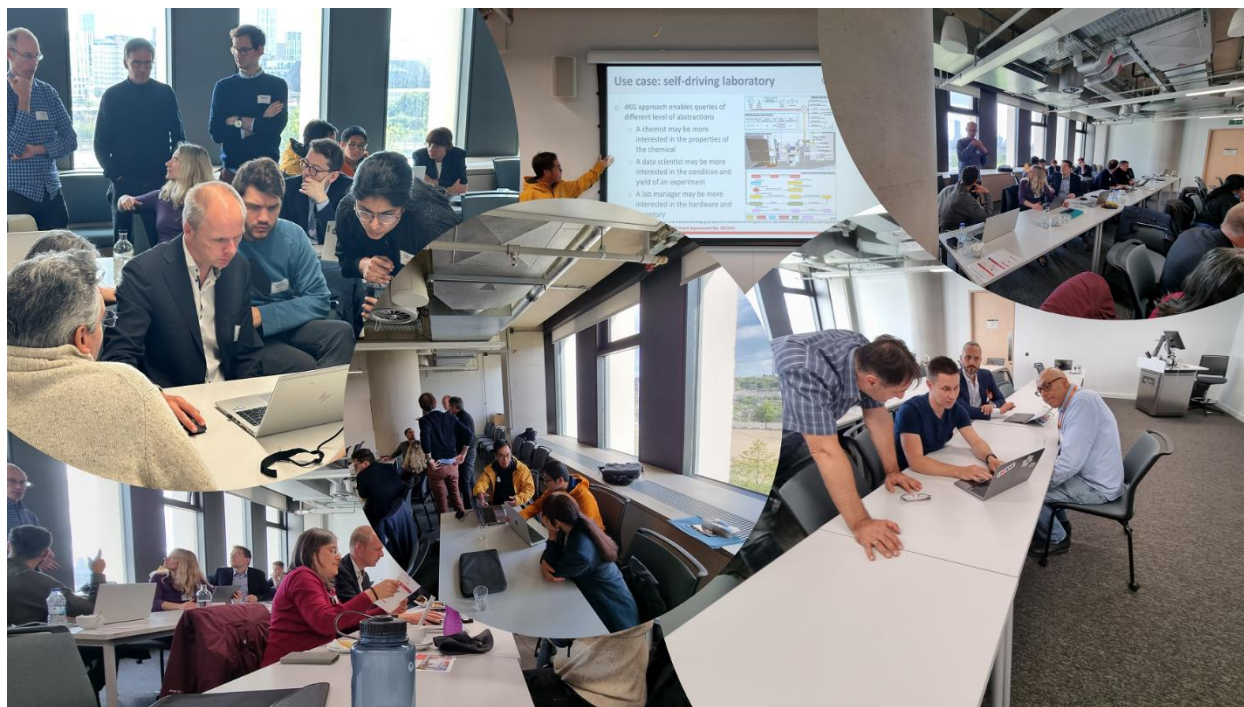
Figure 21: Hackathon 3 – live hacks in day 1

According to the agenda, each team also provided a short pitch of their progress, feedback and learnings to the entire forum at the end of the session and the day. This was the concluding agenda item for the day 1 of the event. Based on the feedback received from the partners, the hacks for the second day were adjusted accordingly. Furthermore, the experience of working with the DOME 4.0 platform by multiple teams at the same time also helped gaining further insight into how the platform works and how it adds value to the current processes in connecting the data consumers to data and services providers.

Second day of the event started with a recap of the first day by the project coordinator (Dr Amit Bhave, CMCL). The rest of the morning session was dedicated to two keynote speakers. First, Christoph Mertens of IDSA – who also is a member of the EAB for the project - talked about "next level data spaces: data space protocol - interoperability on global scale".

Through interesting analogies, the point about data hunger for training the large AI models (such as GPT) was elaborated upon, and the idea of having shared connectors that could be leveraged to create connections between data spaces from countries across the world was also brought up, with special emphasis on creating big enough data sets for training large models. An overview of the current state of data availability and data requirement for the training purposes was also made. This will build upon the collaboration agreements between the data owners in the first place. Interoperability was also stressed upon as the key enabler here. The IDSA architecture and data structure was presented, and some key features were covered. The synergies between the IDSA architecture and that of DOME 4.0 were also emphasised.

In interoperability the multiple layers that IDSA considers, Legal, organisational, and technical etc. were also introduced and examples were provided. Idea of the "connectors as a service" was also introduced, helping the end users to actually focus on the things that are important for them, and leave the rest of

the technical items to lie under the hood. The data spaces protocol was also introduced and elaborated upon. The talk was followed by a live Q&A particularly given the synergies between the two initiatives, and how these synergies could be leveraged (Figure 22)

Figure 22: Hackathon 3 – keynote talk by Christoph Mertens (IDSA)

After a short coffee break, the second plenary talk was delivered by Kate Lin (Google) covering some of the practices and advancements in dataset semantics, building dataset search and other research work at the Google data set team. Examples of how the Google works on the FAIR data was mentioned, with the specific emphasis on the Findability. Google's way of how to apply different filters to enable findability of the data were also mentioned – google search, google scholar, etc. Also, datasets and data set pages were introduced and elaborated upon. With regards to semantics, metadata from schema.org or similar is used to create the structure for the data. Requirements for the data discovery (open ecosystem, metadata data and open standards) were also mentioned.

The process of cleansing the data and making the entire process useful was also elaborated upon. Types of data reconciliation were also mentioned here. Some research questions arising from the attempts to streamline the entire process were also discussed. In particular, ways to identify the different relationships between the datasets was covered. Social and technical challenges in front of the work, with introduction of the Croissant as a framework for data relationship identification were elaborated upon.

This talk was continued with a lively Q/A as well, also with emphasis on the commonalities between the developments in the DOME 4.0 and those practices used at Google data set team. Some snapshots of the session are shown in Figure 23.

Figure 23: Hackathon 3 – keynote talk by Kate Lin (Google)

After another short break for a photo-up, a forum discussion was held about the business model and sustainability of the DOME 4.0 project continued with the views from the speakers as well as the participants onboard. Connecting what the users need with what platform has on offer within a marketable package was also focused upon. Some work carried out in DOME 4.0 project, including the business canvases, the Kano survey, value streams etc. were also elaborated upon, and the participants provided their views on these topics (see Figure 24).
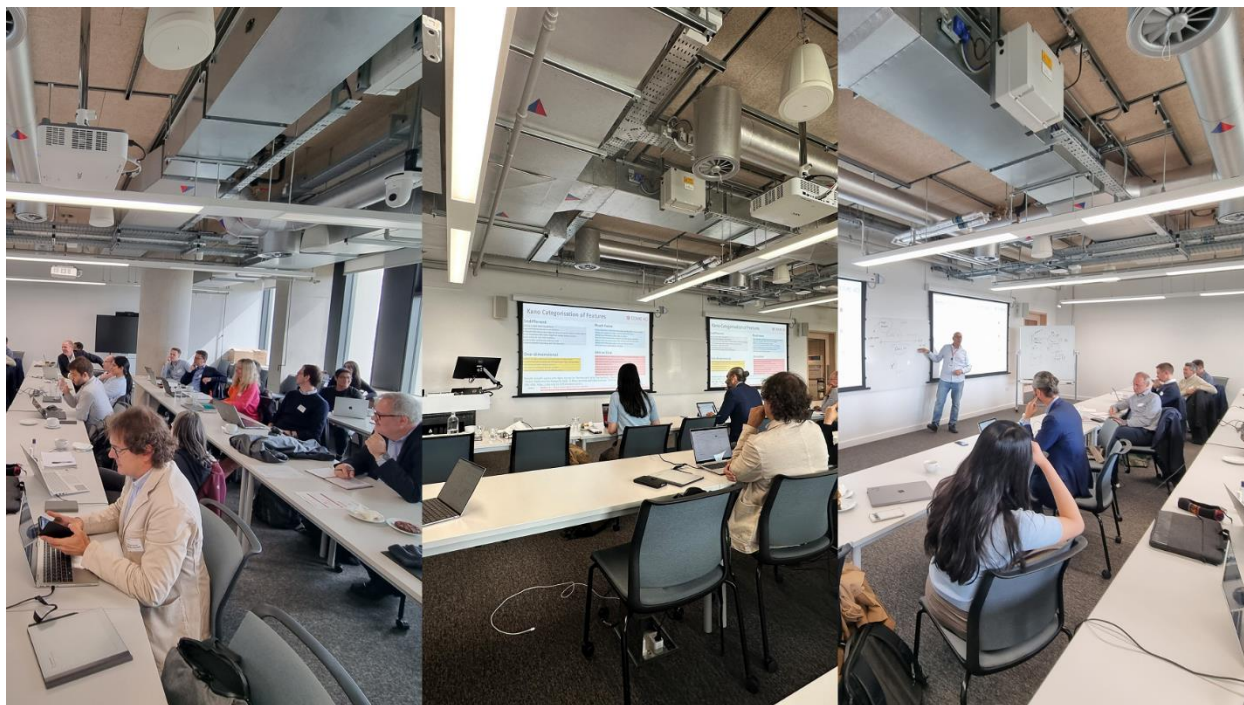
Figure 24: Hackathon 3 – mini-hack on business model and sustainability

This concluded the agenda for the morning.

After the lunch break, the programme resumed with the technical hacks. Similar to day 1, there were different topics for the hacks and the participants attempted these hands-on with the support from the DOME 4.0 technical team. The first hack got participants to work on the use of Discomat for the dataset ontology, and through that with the CUDS. This is a common interoperability toolset that will enable working with different datasets outside the DOME 4.0 showcases, and also enables connecting to other sources. During the hack, steps such as scraping the data using NLP methods, ontologising the data and uploading it to the DOME 4.0 were carried out. Also, connecting to the materials space also was undertaken as a part of the hack.

As another hack, a connection between the DOME 4.0 and VIPCOAT projects was tried with the data at DOME 4.0 made available to that project. SINTEF team (who are shared partner between the two projects) led the work here and demonstrated the work accordingly while the participants followed the steps. During the hack, the OTEAPI tool that has been developed in the OntoTrans project and is currently in use in the VIPCOAT project, was leveraged to develop a tool to integrate the data available on DOME 4.0 with external data. Some snapshots of the session have been shown in Figure 25.
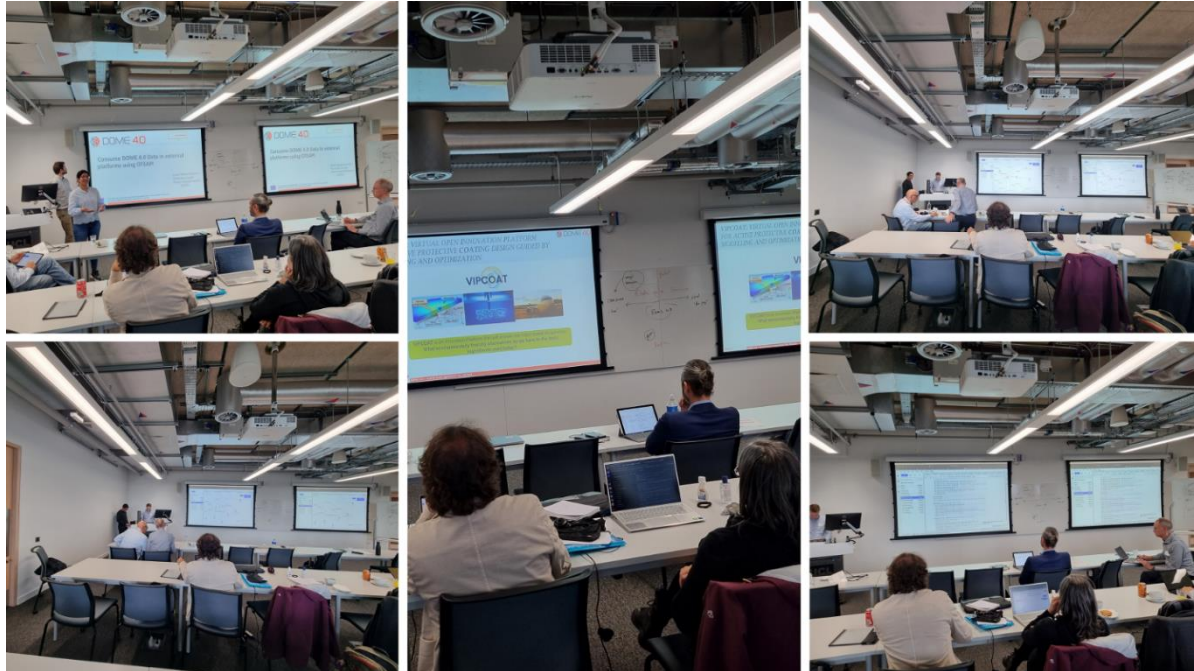
Figure 25: Hackathon 3 – live hacks in day 2

After a coffee break, the last technical item in the agenda was covered with an update about the extension of the Showcase 1 as a mini hack (Figure 26). This short item concluded the technical part of the event. Following these, some live feedback was collected from the participants, including the comments from the Project Advisor.
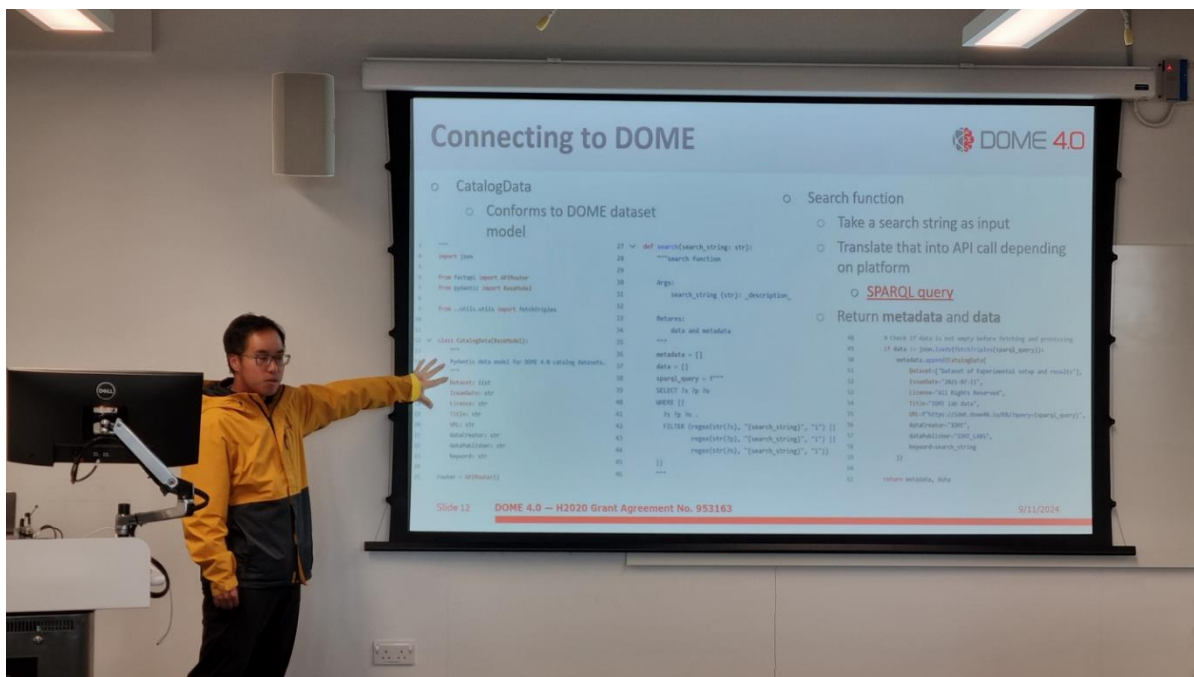

Figure 26: Hackathon 3 – the mini hack on the showcase 1

The final item in the agenda was a recap and wrap up, in which Dr Amit Bhave (CMCL) summarised the achievements during the two-day event (and throughout the course of three hackathons in the project) and pointed out some key lessons learned. The hosts also spoke along the same lines and at the end, all the final remarks were delivered by CMCL to conclude the event.

4.3 Feedback

Despite the challenges faced during the planning phase of the third hackathon, the event was a success, which concluded the series of three hackathons on a high note. The event organisers actively sought feedback from the participants and partners throughout the process, and the following are the key items in the list:

- Effective communications with the partners particularly with the details of the contacts with the 3rd party organiser was helpful in the process, and this was showcased in the quick decision making and mobilisation after the decision to organise the event internally within the partners
- Assignment of an event lead from the host helped the process of organising the event significantly
- The dissemination campaign of the event also was positive
- Extensive efforts were made to disseminate the event, though the delay in the planning due to change to plan B had a negative effect in preparation for the event
- During the event, the participants attempted the hacks live on the latest deployment of the platform. This was an intention of the partners to put the platform under real stress test. Overall, the platform could handle such a test, which is a positive outcome and shows a relative level of maturity in the development.
- None of the hacks in the event had been tried before, and the fact that they worked, and even the participants could also test them live, was another complement to the DOME 4.0 platform.
- Although the participants could work the DOME 4.0 platform, documentation and "how to" manuals would be beneficial. This feedback has been also given by the Project Advisor, and has been taken up by the technical team
- The "start early" feedback from the previous hackathons was put in practice for this hackathon too, and had it not been for this fact, the DOME 4.0 team would definitely have had major challenges in finding alternative plans after organisation by 3rd party was ruled out.
- The functionalities provided through the DOME 4.0 project were received positively by the event participants, and there was significant interest to these features.
- The project advisor also recommended to get external users' feedback for the platform, which has also been taken up by the DOME 4.0 partners
- The event was held only in-person, which helped with the way the hacks were carried out. Also, break down of the participants within teams, and also including members of the DOME 4.0 core developers was beneficial for effective undertaking of hack tasks.
- Like previous hackathons, distribution of the responsibilities and tasks were helpful in reducing the burden on the core team planning and organising the event. Despite these efforts though, the unexpected changes in the planning phase, demanded a significant amount of energy and effort by the core team to change track, plan again, and deliver the event on-time.

5. Conclusions / Next steps

The deliverable D6.5, "Report on the Three Hackathons" covers the details of planning and holding the three hackathon events in the DOME 4.0 project. It summarises all the activities carried out during the project to ensure these events are held to the highest quality, and appeal to a wide audience. To help the readers, special emphasis has been put to report the key steps in decision making during the planning stages, and through the feedback sections for each hackathon, the key take-home messages in planning and organising each event have been also mentioned.

The evolution of the three hackathon events in the project also reflect the status of the developments in the project, and particularly so the status of the DOME 4.0 platform. This was also reflected in the themes for the events, and as the project progressed, further and further emphasis was put on using the front-end features of the platform. The nature of the hacks in each event were also changed aligned with the robustness of the platform, with the most challenging hacks planned in the last hackathon.

Overall, and with the help from all the involved partners, the three hackathons have been a success, and in their own way, contributed to the successful delivery of the DOME 4.0 project. organising and holding the three hackathons in the project helped the DOME 4.0 project and the team in multiple ways, namely:

- They provided a great opportunity to disseminate the latest developments in the project to a wide range of audience, ranging from students to researchers, engineers, scientists, collaborators from relevant initiatives, professionals in materials and manufacturing sectors as well as small enterprises and start-ups, and hopefully help train next generation researchers on the way.
- They also provided real-time, live feedback from the participants on the status of the platform, its user friendliness, usability, etc., that could be directly used in next iteration on the development or improvement of the services.
- They help put the DOME 4.0 platform into a real stress test by live participants with no prior experience of using the platform, and assess the robustness and flexibility of the platform in handling jobs
- They offered an opportunity to exchange ideas with the researchers focusing on the similar technologies, and to put such experiences to the test via live hacks
- And finally, they acted as the first "test environment" for new ideas in the project – that could be consolidated in next steps after the events

6. Lessons learnt

The depth and breadth of the activities carried out to organise the three hackathon events in the DOME 4.0 project entailed engagement with a wide range of partners, activities and participants. Throughout the process of the three hackathons, several lessons were learned, the most important of which have been summarised in this section. Please note that some of these lessons took the form of feedback, and have been reported in the feedback sections related to each hackathon, and are not repeated here:

- Large scale hackathons such as those planned in the DOME 4.0 project require a significant lead time to prepare the technical material and organise the event. It is therefore recommended that any planning for such an event starts as early as possible, despite the uncertainties around the technical development and state of the platform. The agile approach adopted by the core tech team within DOME 4.0 proved to be particularly helpful in managing these events.
- Direct involvement of the key stakeholders, particularly technical platform developers was key in successful delivery and undertaking of the hacks.
- The research nature of the activities in the project and the associated TRL levels demand a specific set of requirements for the planning of the dissemination events. This and the associated liability and operational risks should be taken into account when thinking of addition of a 3rd party delivery partner for such events.
- Having plan B prepared for the activities will be important in case the original plans do not work or something unexpected happens.
- The technical hacks and the delivery material need to be tailored to the audience of a diverse skillset, ranging from no relevant skills at all to expert in the field. This also alludes to designing the whole programme to be "engaging" for participants, i.e., not too easy and not too hard.
- Distribution of the responsibilities for the activities was a key activity that also helped reduce the burden of the work on one partner. However, even with this in place, there still were some significant amounts of time required from some partners to carry out the planning, organisation and continuous coordination of activities.
- Dissemination of the event via the right communication channels will help get the best outreach and interest in the event. The role of the Project Officer as well as the project External Advisory Board in reaching out to sister projects supported by the European Commission research programmes was impactful.
- Social media campaigns also help publicising the event before, during and even after the event
- Technical material for each hackathon should be prepared well in advance, and even distributed within the participants, so that they can prepare for the event in advance.
- The hacks and technical steps should be planned in accordance with the maturity and competence level of the participants. Too easy or too difficult hacks equally fail to engage the participants in a meaningful way.
- Unplanned uses such as those happening at the hackathons are actually a good ground to test the capabilities and robustness of the platform, though this is best accompanied with a feedback mechanism, so that the participants and users could reflect upon the experience in a timely manner.
- Although hybrid event help gather a large audience, the decision about holding such events should take into account both the equipment available at the host venue and the nature of the

technical hacks. Some events demand in-person while others could be managed online as well. These points should be considered beforehand and at the planning stage.

- Considering event and session themes and assigning the session leads help in the organisation and coordination of the activities for the event by providing single objectives and single points of contact.

7. Deviations from Annex 1

N/A

8. Acknowledgement

The author(s) would like to thank the partners in the project for their valuable comments on previous drafts and for performing the review.

Project partners:

#	Type	Partner	Partner full name
1	SME	CMCL	Computational Modelling Cambridge Limited
2	Research	FHG	Fraunhofer Gesellschaft zur Förderung der Angewandten Forschung E.V.
3	Research	INTRA	Intrasoft International SA
4	University	UNIBO	Alma Mater Studiorum – Universita di Bologna
5	University	EPFL	Ecole Polytechnique Federale de Lausanne
6	Research	UKRI	United Kingdom Research and Innovation
7	Large Industry	SISW	Siemens Industry Software NV
8	Large Industry	BOSCH	Robert Bosch GmbH
9	SME	UNR	Uniresearch B.V.
10	Research	SINTEF	SINTEF AS
11	SME	CNT	Cambridge Nanomaterials Technology LTD
12	University	UCL	University College London

9. Table of Abbreviations

Abbreviation	Explanation
DoA	Description of Action
EMMC	European Materials Modelling Council
EMMO	Elementary Multiperspective Materials Ontology
FAIR	Findable, Accessible, Interoperable, Reusable
GA	Grant Agreement
*i*DMT	innovation Centre in Digital Molecular Technologies
OIP	Open Innovation Platform
OTE	Open Translation Environment
SC	Showcase
TRL	Technology Readiness Level