

Open access  
**virtual testing protocols**  
for enhanced  
**road user safety**

# **The OpenVT platform: A collaboration and dissemination platform for open access virtual testing**

WP number: 1  
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# The OpenVT platform: A collaboration and dissemination platform for open access virtual testing

Work package 1, Deliverable D1.1

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# Table of contents

Executive summary .....	1
<b>1 Introduction .....</b>	<b>3</b>
<b>1.1 The OpenVT platform: Collaboration, dissemination and open access ..</b>	<b>3</b>
<b>1.2 Open Source and Open Access .....</b>	<b>3</b>
<b>2 Requirements and functionalities.....</b>	<b>5</b>
<b>2.1 Planning and internal survey.....</b>	<b>5</b>
<b>3 The OpenVT platform as GitLab server .....</b>	<b>7</b>
<b>3.1 GitLab.....</b>	<b>7</b>
<b>3.2 User accounts.....</b>	<b>8</b>
<b>3.3 Content visibility and project self-administration .....</b>	<b>8</b>
3.3.1 User administration and privilege levels within Groups and Projects.....	8
<b>3.4 Default platform structure .....</b>	<b>9</b>
3.4.1 Work package Groups .....	9
3.4.2 Public projects .....	9
<b>3.5 Implementation, evolution since the start and time line .....</b>	<b>10</b>
3.5.1 Time line .....	10
<b>4 Guidelines for content quality .....</b>	<b>11</b>
<b>4.1 Open Source licences .....</b>	<b>12</b>
<b>5 Milestones M 1.1 and M 1.2 .....</b>	<b>13</b>
<b>5.1 Milestone M 1.1, "OpenVT platform available" .....</b>	<b>13</b>
<b>5.2 Milestone M 1.2, "First HBM uploaded on platform and interaction with technical users" .....</b>	<b>13</b>
5.2.1 Background and motivation .....	13
5.2.2 Implementation: upload of the HBM files .....	13
5.2.3 Test of model and platform.....	14
5.2.4 Timeline .....	14
<b>6 Summary and outlook.....</b>	<b>15</b>
<b>7 References .....</b>	<b>16</b>



## Executive summary

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This document describes the conceptual development and implementation of the OpenVT platform, which is the combined development and dissemination platform of Project VIRTUAL. As an Open Source and Open Access initiative, it is crucial to VIRTUAL to provide its project results in a way that users can not only access them free of charge, but also actively contribute to their development.

The OpenVT platform was implemented as a GitLab server hosted by the project partner Dynamore Nordic and has been online since December 2018. The existing structures of the GitLab software were applied in a way allowing the developers a fast and obstacle free workflow while still assuring a certain level of quality control of the resulting products.

Two milestones are related to this report and are summarised in brief, while others are still coming up. It is expected that the OpenVT platform will largely gain in content in the upcoming months.



## List of abbreviations

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- **CC BY 4.0:** Creative commons attribution licence (Version 4.0)
- **GNU:** Gnu is Not Unix, an open source software project
- **GPL v3:** Version 3 of the General Public Licence, the licence of the GNU project.
- **HBM:** Human Body Model
- **LGPL v3:** Version 3 of the Lesser General Public License, a more permissive variant of GPL
- **ODC BY 1.0:** An open data licence similar to CC BY
- **OpenVT:** VIRTUAL's platform for VT
- **VT:** virtual testing
- **WP:** work package



# 1 Introduction

## 1.1 The OpenVT platform: Collaboration, dissemination and open access

Open Source and Open Access are core elements of project VIRTUAL. Not only the human body models to be developed, but also the software tools, test protocols and any scientific results such as experimental data created within the project are meant to be openly accessible to any interested individual or institution. This includes the implementations and working principles of any technical output being transparent and openly available (Open Source) as well as any resulting publications, visualisations, reports or protocols being accessible to anyone free of charge (Open Access).

In the world of Open Source software, source code platforms are a crucial element of the development process. They allow a collaborative development as well as an efficient dissemination of the open contents. The users are not only consumers of readily available code and content, but they are actively included in the development process. This shortens ways for feedback and results in higher quality and robustness of the generated products.

The OpenVT (Virtual Testing) platform serves several purposes in this context: in the first place, it is a collaborative development platform for the project members during the active phase of the project. Furthermore, it is a dissemination tool, which makes the project results openly accessible to the community and allows a short-way feedback to the developers. The concept of a code collaboration platform will thereby be applied not only to software code, but also to other types of content such as test protocols or scientific content.

In order to increase the impact of the project and to make it more sustainable, the OpenVT platform will be kept alive beyond the active phase and funded duration of the project. Even though the dissemination aspects will be more important at that time, all platform functionalities will be kept available. Investigating options to organize and fund the platform beyond the project duration will be subject to a sub-task in the progress of work package 1.

## 1.2 Open Source and Open Access

Fundamental design principles of the VIRTUAL project are "open source" and "open access." These two are similar yet slightly different concepts with completely different origins.

"Open access" is a concept that has emerged in publicly funded scientific research and has been increasingly popular in recent years. Basically, in the natural sciences a certain level of transparency and openness has always been a fundamental ingredient to the scientific method: Scientific results have to be published with all necessary information on how they have been produced in order to allow other researchers to reproduce, test and if necessary correct them. This principle makes the workflow of scientific knowledge gain a self-correcting process, where erroneous findings will be revealed sooner or later. In spite of this fundamental need for transparency, scientific results, data and publications were in the past accessible mainly via costly subscriptions with private publishers. Moreover, scientific data sets were often only partly available. The principle of "open access" addresses these concerns and implements the needs for transparency of scientific results in a more consequent way. It comprises the publication of scientific articles in open access journals (available online free of charge to any interested person) as well as the systematic publication of data sets so they would be accessible to further research. In recent years, many public research institutions and



funding bodies tend to enforce increasingly strict Open Access policies on their supported projects. This not only makes results accessible to any interested individual or institution: it also makes scientific research more transparent, self-correcting and of more sustainable impact.

Unlike in scientific research, where transparency and openness are fundamental methodological requirements, in the world of software development, industrial secrets have for a long time been considered a vital part of the business model. Nevertheless, in recent years the concept of "Open Source" has become increasingly popular and successful in this field. The idea is to release software together with its source code. In consequence, the users can not only transparently see what the software does and how, but also – if they have the capabilities thereof – actively participate in the development process. They can detect and fix problems and vulnerabilities or even add new features to the software. Similar to the transparent scientific method, this adds an element of self-correctiveness to the development process, ideally resulting in better, safer and more stable products, available to any interested person free of charge. This latter point seems to be hard to match with commercial software development on the first glance – and there are a number of open source projects which are mostly developed at public institutions on public funds. However, also many private IT companies develop open software, relying on business models different from selling proprietary products.

Given the setup of the VIRTUAL project as a scientific project with a high amount of code and method development, the two concepts naturally merge and overlap. Not only will the resulting software tools all be open source and the scientific results will all be publicly available, the project is also in general of a collaborative nature - both between the participants spread all over Europe and an external user community interested in applying the resulting tools and methods. In turn, it becomes even more important to provide a well-organized channel for the collaborative development of code and content, the open access dissemination of project results as well as for the interaction with the user community outside of the project.

The tool for all of this is the OpenVT platform. Therefore, it has to be designed in a way that it can safely and efficiently manage the large variety of interactions, content type and user demands to be expected. Furthermore, a number of contradictory demands, such as "fast and dynamic dissemination" vs. "quality control of public content" will need well-balanced solutions in order to assure that the project output will be useful to a greater user community.



## 2 Requirements and functionalities

### 2.1 Planning and internal survey

In the planning phase of the OpenVT platform, a brain storming session with VIRTUAL projects partners about “which functionalities should the OpenVT platform have, and who should have access/control of them?” resulted in a list of desirable properties of the platform. This list was sent to all project partners and re-iterated according to their feedback. As a result, **Error! Reference source not found.** was obtained, which served as a basis for designing an OpenVT platform as close as possible to user demands. In the table, the access to the different platform features is defined for either the members of project VIRTUAL and users from outside of the project (“community users”). This is marked by “+”: full access, “-”: no access, “(+)” limited access.

Table 2.1.: Functionalities for different user groups according to internal survey

	<b>VIRTUAL members</b>	<b>Community users</b>
<b>Access content</b> Read and download source code, documentation etc., access experimental data	+	+
<b>Initiate new project</b> Start a new project tree, which can contain e.g. a new model or a new tool or other content	+	-
<b>Upload model</b> Either as a new tree or as a part of an existing one	+	-
<b>Create user accounts</b> (Admin users only)	(+)	-
<b>Change user privileges</b> (Admin only)	(+)	-
<b>Create project teams</b> Invite other member users to participate in your project tree	+	-
<b>Formulate requests</b> E.g., ask the developer of a tool to include certain functionality.	+	(+)
<b>Issue tracking</b> Report issues and provide fixes	+	+
<b>Version control</b> Keep track of changes	+	-
<b>Branching</b> Work on content in separate branches	+	-
<b>Merging</b> Merge formerly separated branches: project owners/administrators only	(+)	-



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<b>Navigate</b> Search through content and project trees	+	+
<b>Backup/restore</b> In addition to versioning, content of the platform should be backed up	+	-
<b>Commit content</b> Can external users also contribute?	+	+?
<b>Participate in discussion board</b> Ask the community questions	+	+
<b>Moderate discussion board</b> Prevent discussions from becoming pointless or rude	+	-

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## 3 The OpenVT platform as GitLab server

Based on the results of the planning phase, different software solutions were evaluated, leading to the conclusion that a self-hosted GitLab server would be the best match with the formulated requirements. This decision was supported by the Project Assembly in November 2018; shortly thereafter, the server was set up and is hosted at the project partner Dynamore Nordic. It can be reached on <https://virtual.openvt.eu/>. A screenshot of the login screen is shown in Fig. 3.1.

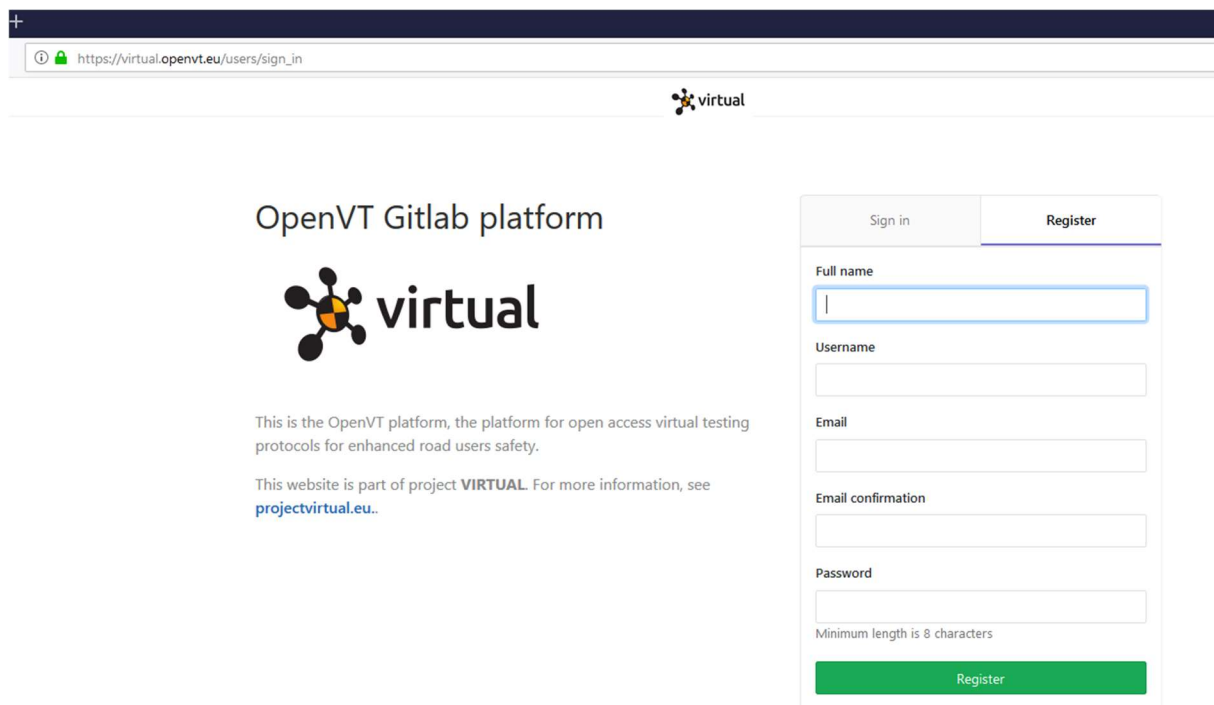


Figure 3.1 Screenshot of the sign up/login screen of the OpenVT platform.

### 3.1 GitLab

GitLab is an open source repository management system based on the Git version control framework (see <https://about.gitlab.com/>). It contains file server functionalities as well as member administration and therefore constitutes a versatile development tool and project administration platform.



## 3.2 User accounts

Users can sign up online on the OpenVT platform. GitLab allows three different user account privilege levels, “external,” “internal” and “admin.” On the OpenVT platform, the level “internal” is reserved for members of the VIRTUAL project partners. The “Admin” level is reserved to the persons in charge within VIRTUAL’s Work Package 1, while any user on the web can sign up for a (read-only) “external” account. In this way, the GitLab framework is ideally suited for the needs of the OpenVT platform, combining internal development and public dissemination.

## 3.3 Content visibility and project self-administration

Content is structured in Projects and Groups (where a Group is a folder-like structure containing several Projects). For each piece of content to be developed or published on the platform (e.g., a human body model or a software tool), a Project has to be created. This can be done by any “internal” user – who in consequence becomes the administrator (or Owner) of this particular project. Projects can have three different levels of visibility: Private content is only visible to the project owner and users he or she invites. An Internal Project is visible to any internal user, whereas a Public Project is openly accessible on the internet (read-only).

Projects and Groups are basically administrated by the respective Owner, who can assign different permission levels to other users. This self-administration of Projects and Groups allows the members of VIRTUAL a dynamic and collaborative development of models and tools, while at the same time the responsible persons for every task can keep a certain level of control by making use of different user privilege levels.

The Public level is the dissemination route of the OpenVT platform. Therefore, this visibility level is subject to a stricter control than the lower levels. It can only be granted by the platform admins after a careful quality check in collaboration with the project owner and possibly other VIRTUAL members. This workflow makes sure that only content meeting high publication standards (concerning, e.g., documentation, usability, stability) is released to the public. In order to save resources, the quality check can also be included in the internal review process.

Given that the requirements of a dissemination and a development platform are not necessarily the same and in some way contradictory, a platform containing both is always a trade-off between freedom in development and quality management of publication content. The two-fold approach with user-administrated Internal and Private content and supervised Public content has to be seen as an answer to this problem.

### 3.3.1 User administration and privilege levels within Groups and Projects

As part of the user self-administration concept, each Project or Group Owner is responsible for the user administration within his or her Project/Group. Other users can join the Project/Group by either requesting access (which the Owner can grant or not) or by being invited by the Owner. Either way, the Owner has to assign a privilege level to each user. This latter is independent of the global user levels (External, Internal, Admin) and only valid within the given Project/Group. There are five different privilege levels, Owner, Maintainer, Developer, Reporter, Guest. While the first two have administrator rights for content and users, Developers have the right to collaborate on content. The Reporter and Guest levels are basically read-only (apart from being able to submit requests and issues). An overview of the rights of the different levels can be found in the official GitLab documentation, <https://docs.gitlab.com/>.

## 3.4 Default platform structure

### 3.4.1 Work package Groups

After the setup of the OpenVT platform, as default structure several groups have been created by the platform admins. These correspond roughly to the structure of VIRTUAL: There is a Group for each work package which is supposed to contribute content to the platform, plus an additional “manual and guidelines” Group containing information about how to use the OpenVT platform. In Fig. 3.2, a screenshot with the overview of the default Groups is shown.

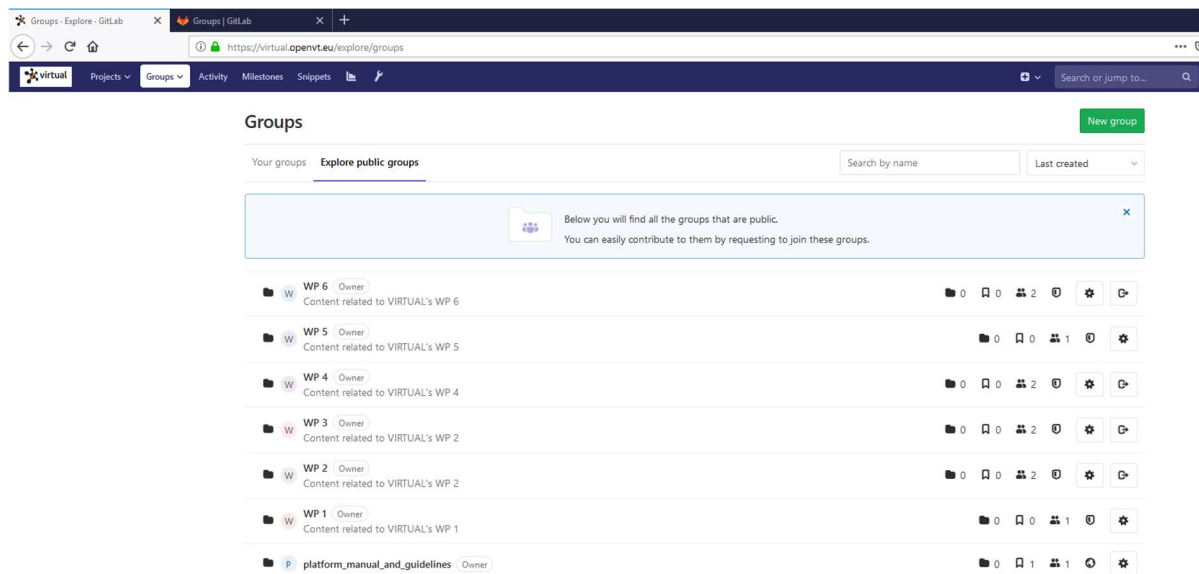


Figure 3.2 Screenshot of the “explore groups” view of the OpenVT platform with an overview of the default work package groups.

The respective work package leader (or who else is in charge of the content development in that group) has been appointed as Owner and other work package contributors have been granted Maintainer or Developer access. In the following active project phase, it is the respective group Owner who will be in charge of future user administration in each group.

### 3.4.2 Public projects

There are several VIRTUAL deliverables and milestones which consist in content (models, software, experimental data) which are supposed to be both developed and published on the OpenVT platform. These contents will be developed as internal projects in the respective work package group. Once a certain content is ready to be published, it will be evaluated by the responsible developers, work package leaders and platform admin in order to make sure that it meets the dissemination standards of VIRTUAL. If there is a VIRTUAL-internal review process scheduled for the content under consideration, this evaluation can also be integrated into this review process. After successfully passing the evaluation, a new Project outside of the work package Groups will be created on visibility level Public. This workflow assures that the content published on the OpenVT platform is on highest standards concerning documentation, usability and scientific quality while still allowing to efficiently disseminate project results and to reach out to potential users outside of VIRTUAL.



## 3.5 Implementation, evolution since the start and time line

After the decision of the Project Assembly to run the OpenVT platform as a self-hosted GitLab server, a web server running GitLab EE v. 11.6.3.-ee was set up. The storage is secured by a RAID system – a more sophisticated backup system is planned and will be implemented soon. After a phase of internal testing, the server has been online since December 4, 2018 and can be reached on <https://virtual.openvt.eu/>.

The GitLab platform was presented and promoted project-wide on several web conferences. Additionally, in February 2019, an online workshop open to all VIRTUAL members was organised in collaboration with the project partner TU Graz.

Since its start, the number of registered users and content has grown steadily. As of May 17, 2019, there are 45 users registered (17 of which are External) and 13 Projects available. The first Human Body Model has been uploaded on March 21 (see also Chapter 5).

### 3.5.1 Time line

- Server was set-up, internal testing: November 2018
- Go live on December 04, 2018
- Ready to be used December 06, 2018
- First contents uploaded on February 15, 2019
- First HBM uploaded on March 21, 2019

## 4 Guidelines for content quality

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### 4.1 Quality criteria and application

As a final output, the VIRTUAL project does not only aim at scientific advances, but also at the creation of a set of tools and models, which can readily be applied by a user community in research and industry. The quality and usability of these output products are therefore of crucial significance for the overall success of the project and are thoroughly monitored and controlled throughout the project (cf. quality assurance plan). In consequence, already when setting up the OpenVT platform, mechanisms and guidelines have to be implemented to make sure that already during the development phase the uploaded content meets certain quality criteria.

At the same time, these mechanisms have to be a well-balanced trade-off between a number of conflicting requirements:

- **Quality of output and usability:** as described above.
- **Fast dissemination:** In order to dynamically represent the advances of VIRTUAL on the OpenVT platform, it is desired to have project results online as early as possible.
- **Creativity:** scientific work and software development are processes which highly rely on creativity and inventiveness of the involved persons, and these should therefore not be overly restricted.

After all, these points are equally important for the overall success of the project, and possible regulations and guidelines have to take that into account.

In order to find a balance between these concerns, a set of quality guidelines has been defined. These guidelines set requirements how dissemination content should be presented and documented, The main requirements are:

- Each file should have a **header**, making the file as self-explanatory as possible.
- Public content must have a defined **License agreement** (see also separate chapter of this report).
- All content must be **documented** in a way that an external user can readily apply it. For this purpose, README files and GitLab's Wiki functionality should be used.

More details and the latest version of the guidelines (which are still evolving along with the project) can be found on [https://virtual.openvt.eu/platform\\_manual\\_and\\_guidelines/manual\\_and\\_guidelines](https://virtual.openvt.eu/platform_manual_and_guidelines/manual_and_guidelines).

#### 4.1.1 Step-wise application of guidelines

The points "fast dissemination" and "creativity" require that the project members can upload and share content fast and without greater restrictions. This is accounted for by making use of GitLab's visibility levels. The Public level is intended as the dissemination level of the OpenVT platform: any content that is released as Public has to strictly meet the guidelines, which is controlled by both project owners and platform administrators. As opposed to that, on the Private level also content can be uploaded which does explicitly not meet the guidelines yet (e.g. for fast sharing of ideas and drafts). In between those two is the Internal level, where the content guidelines should be met, but are only controlled and enforced by the project owner. This step-wise application of the guidelines assures that the usability of the OpenVT platform as a development tool is not suffering from overly strict application of quality control.



### 4.1.2 Workflow for Public projects

In order to assure that Public content meets the quality guidelines, the Public visibility level is locked, so it cannot be assigned by Internal or External users and can only be granted by the platform administrators. Furthermore, any content which is intended to be set to Public has to go through a review process. Once a development content is ready to be published, it will be at first evaluated by the Owners/Maintainers of the corresponding Project or Group (who should ideally already have imposed the quality guidelines during the development process). Afterwards, the content is reviewed by the responsible work package leaders and the platform admins. If there is a VIRTUAL-internal review process scheduled for the content under consideration, this evaluation can also be integrated into this review process. After successfully passing the evaluation, a new Project outside of the work package Groups will be created on visibility level Public. This workflow assures that the content published on the OpenVT platform is on highest standards concerning documentation, usability and scientific quality while still allowing to efficiently disseminate project results and to reach out to potential users outside of VIRTUAL.

## 4.2 Open Source licences

Even though “Openness” of contents and results is a key element of Project VIRTUAL, that does not necessarily mean that the researchers and authors of the content give up any right and influence on their intellectual property. From the early days of the Open Source movement onwards, developers were aware of the risk of possible abuse – particularly the “harvesting” of open contents by the software industry (for a history overview, see Weber (2004)). The answer to this problem were software licences which allow sharing software open source and free of charge while still offering a certain level of protection against abuse. Today, a large number of different open source licences exists. These range from extremely open public domain licences (which allow the user to use and copy the content without any restriction) over licences which require attributing the copyright owner of a content (so-called attribution licences) to the rather restrictive copyleft licences. The latter, the prototype of which is the GNU General Public License (Free Software Foundation, 2007), grant the user the right to use, copy, modify and redistribute the content, provided that any copy and redistribution is subject to the same licence (copyleft principle).

The project partners of Project VIRTUAL have different backgrounds from academia to industry: therefore, there are diverging interests when it comes to how strictly the open source contents, particularly Human Body Models, should be protected. Consequently, there was a longer project-internal debate about which open source licences to apply by default to newly developed contents. Particularly concerning the licences of Human Body models, the opinion of academic and industrial project partners were quite diverse, so a compromise had to be negotiated. At the General Assembly in May 2019 in Ljubljana, all project partners agreed on a solution which provides a sufficient level of copyleft protection while still being applicable for industry partners. Depending on the type of content, it was agreed to use the following license:

- Human Body Models: **LGPL v.3**
- Any other software: **GPL v3 or LGPL v3** (at the choice of the developers)
- Written text and images: **CC BY 4.0**
- Data: **ODC BY 1.0**
- 

It should be stressed that this set of licences by default only applies to new content developed from scratch within project VIRTUAL. Contents which are based on existing open source projects in some cases “inherit” a licence from the older content – this is a typical effect of the open source development workflow. If this is the case, those contents can still be uploaded to the OpenVT platform in spite of their licences diverging from the default set.



## 5 Milestones M 1.1 and M 1.2

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### 5.1 Milestone M 1.1, “OpenVT platform available”

Subject of this Milestone is the planning and implementation of the OpenVT platform. The Milestone report is basically a short summary of the present Deliverable, available to VIRTUAL project members; see Keller & Schmitt (2019). Therefore, we do not cite larger parts of the report here.

### 5.2 Milestone M 1.2, “First HBM uploaded on platform and interaction with technical users”

#### 5.2.1 Background and motivation

Milestone M1.2 is scheduled mostly as a test run for different functionalities of the platform. Furthermore, it aims at pushing an attractive content to the platform which is interesting to technical and scientific users from outside of the project. Therefore, the Milestone consists of two fundamental steps:

1. Upload a Human Body Model (HBM) to a suitable container on the OpenVT platform,
2. Have the model and the platform functionalities (upload, download, version control etc.) tested by users inside and outside of VIRTUAL.

As generic test-HBM, the VIVA Human Body Model (Östh et al. 2017) was used, which is intended to serve as basis for all further HBM developments within VIRTUAL. VIVA is an open source model of the mechanics of the Human body, designed according to the anthropometrics of the 50<sup>th</sup> percentile Female. It was validated for low-severity frontal, rear-end and roll-over impacts and has been released under the terms of the GPL v3 license agreement.

#### 5.2.2 Implementation: upload of the HBM files

After internal discussions between work packages 1 and 2 and tests of different code packages variants both at Chalmers University and AGU Zürich, it was decided to upload a package consisting of (i) the VIVA HBM as such, (ii) the rear impact validation scenario (Östh et al., 2017), containing the HBM and a simple seat and seat belt model, as a running example.

On the OpenVT platform, a new Project has been created and the files of the two model packages have been uploaded. The repository can be reached on <https://virtual.openvt.eu/wp-2/viva-hbm> and is accessible via the usual Git/GitLab mechanisms. A README has been added describing how to get started and how to get the model to run. The documentation will be completed further as new versions of the HBM are uploaded in the future.

As of now, the VIVA-HBM repository on the OpenVT platform is available only as “internal” project. That is, for the moment the content can only be accessed by users who have (i) signed up for the platform and (ii) have been assigned the status of “internal” users by the platform admins. The reason for this is an on-going debate within project VIRTUAL about which open source licences to use for the VIRTUAL project results – the GPL licence used until now by the VIVA HBM might be too restrictive to promote the use of the model in the automotive industry. Conclusive results of this debate are



expected until May 2019. Afterwards, it is planned to provide the model as public content accessible to any user on the internet.

### 5.2.3 Test of model and platform

After the initial upload, both the HBM/ load case scenario and the repository including upload and download functionalities were tested internally by users at the project partners AGU Zürich and Chalmers University. Subsequently, more tests were performed by members of the Institute of Engineering and Computational Mechanics, University of Stuttgart.

During the tests it turned out that all the platform mechanism including download and version control worked flawlessly and can without problems be used with the command line Git tool on Linux as well as on Microsoft Windows using TortoiseGit as Git client. Also upload, download and file editing via the GitLab web interface worked perfectly.

The actual HBM embedded in the rear impact scenario was tested on several different machines and platforms (Windows, Linux) and with a number of different solver versions, terminating normally on all runs. Feedback of the test participants was implemented in a number of changes on the repository in order to fix some minor bugs and to improve the user friendliness.

### 5.2.4 Timeline

- Finished evaluation of different HBM versions for upload: March 18, 2019
- Created repository on OpenVT platform and uploaded files: March 21, 2019
- Updates documentation, internal test of functionalities: March 26, 2019
- Tests in collaboration with external test users finished and feedback included: April 4, 2019



## 6 Summary and outlook

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The OpenVT platform is intended to be both, a basis for collaborative development of open content within the project and a dissemination route for VIRTUAL's project results.

After evaluation of necessary features and requirements, it was decided to run the platform as a GitLab server hosted by the project partner Dynamore Nordic. This server has been operational since December 2018. The user and content administration system of GitLab is ideally suited to solve the trade-off between dynamic development and quality management of publication content.

Since the start, the platform has seen a fast growth in number of users and content, with the first Human Body Model uploaded as of March 2019 (Milestone M 1.2).

So far all content are only available on visibility level Internal. The reason for this was mainly an on-going debate about an appropriate set of open source licences to be applied to the results of VIRTUAL. This debate was concluded at the VIRTUAL general assembly in May 2019. Therefore, as a first content on visibility level Public, the results of Milestone M 1.2 will be made available within short. With the upcoming Milestones M 1.3 (May 2019), also a post-processing tool will be publicly available soon.

The OpenVT platform is meant to stay alive also beyond the active phase of project VIRTUAL, so the results are available to the users and can be developed further. The concept how this will be organised is not fully clear yet. However, a number of ideas for this are already available and a separate sub-task in work package 1 is dedicated to this question.



## 7 References

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