



Dissemination and Exploitation Strategy

Virtual Campus Hub: D6.6 Strategy paper

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Dissemination and Exploitation Strategy

Virtual Campus Hub: D6.6 Strategy paper

Department of Wind Energy E Report 2013

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Preface

The research infrastructure project Virtual Campus Hub (VCH) runs from October 1, 2011 to September 30, 2013. Four technical universities in Europe, who are all active in the field of sustainable energy, form the project consortium: the Technical University of Denmark, The Royal Institute of Technology in Sweden, Politecnico di Torino in Italy, and Eindhoven University of Technology in the Netherlands. The project is partially funded by the European Commission under the 7th Framework Programme (project no. RI-283746).

This report describes the final dissemination and exploitation strategy for project Virtual Campus Hub. A preliminary dissemination and exploitation plan was setup early in the project as described in the deliverable [D6.1 Dissemination strategy paper - preliminary version](#). The plan has been revised on a monthly basis during the project's lifecycle in connection with the virtual and physical project meetings.

Roskilde, October 2013

Merete Badger
Senior Scientist

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1. Objectives for dissemination and exploitation

The terms dissemination and exploitation are closely related. According to [guidelines](#) from the European Commission, the distinction between the two is made as follows:

“...dissemination can take place from the beginning of a project and intensify as results are becoming available, but full exploitation can happen only when it becomes possible to transfer what has been learnt into new policies and improved practices. Furthermore, the project manager and all the key actors need to view exploitation as a process that reaches beyond the life of the project so that its results are sustained”.

1.1 EU’s five-stage model for dissemination and exploitation

[EU’s five-stage](#) model describes the actions required in the lifetime of a project to achieve successful dissemination and exploitation:

1. A clear rationale for and objectives of dissemination and exploitation
2. A strategy to identify which results to disseminate and to which audiences – and designing programmes and initiatives accordingly
3. Determining organisational approaches of the different stakeholders and allocating responsibilities and resources
4. Implementing the strategy by identifying and gathering results and undertaking dissemination and exploitation activities
5. Monitoring and evaluating the effects of the activity.

1.2 Rationale and objectives

In project Virtual Campus Hub the rationale of dissemination activities is first and foremost to establish contacts to potential end-users of the different elements, which are developed in the project. These elements include a technical platform as well as virtual laboratory exercises, examination tools, courses, and E-link functionalities and best practices for using these elements. Secondly, the lessons learned in Virtual Campus Hub must be fed back to the chain of E-infrastructure organizations supporting the project. Thirdly, it is important to make connections to other projects, funded by the European Commission or other sources, to ensure that synergies are exploited and overlaps avoided. In this way, the funding bodies and society as a whole will get the most out of the projects.

The rationale of exploitation activities in project Virtual Campus Hub is to ensure that end users choose to use the different elements, which are delivered as part of the project. The Virtual Campus Hub elements described above are developed with future up-scaling in mind. This means they can be applied straight away by a much larger

community; once the added value has been demonstrated successfully by the Virtual Campus Hub partners.

1.3 Dissemination strategy

Stage 2 in the five-stage model were addressed early in the project and described in the deliverable [D6.1 Dissemination strategy paper - preliminary version](#). The strategy has been revised in connection with the monthly project meetings (virtual and physical) in Virtual Campus Hub.

1.4 Stakeholders, responsibilities and resources

The stakeholders in Virtual Campus Hub can be grouped into a number of categories which have very different roles and interests in the project and its outcome. The majority of the stakeholders share a common interest in renewable energy but there is a potential for up-scaling of the Virtual Campus Hub concept to embrace other disciplines. The main stakeholder categories are shown in Table 1.

Table 1. The most important stakeholders and their role in Virtual Campus Hub

Stakeholder	Role
The European Commission	Funding agency
University students and lecturers	Users of VCH applications
Professionals from the energy industry	Users of VCH applications
Entrepreneurs and SME's	Users of VCH applications
National Research and Education Networks (NRENs)	Infrastructure providers (middleware)
International E-infrastructure organisations (Terena, Géant, eduGAIN, DANTE)	Infrastructure providers (internet backbone)
University administrations and IT departments	Potential users of the VCH concept (up-scaling)
Joint educational programmes (Erasmus Mundus, Eurotech)	Potential users of the VCH concept (up-scaling)
Strategic alliances for energy and education (SEEIT, KIC InnoEnergy)	Link the VCH objectives with overall strategies

DTU holds the overall responsibility for dissemination activities and has been allocated a budget of 5.8 person months for this task. The other partners have each been allocated 1.1 person months; this is mainly for dissemination of the applications they have developed.

1.5 Implementing the strategy and monitoring the effects

The remaining part of this report describes the stages 4 and 5 in the five-stage model. Section 2 describes the activities, which have been undertaken to implement the dissemination strategy during the 2-year project period of Virtual Campus Hub. Section 3 addresses the exploitation and sustainability of project results for each of the elements developed in Virtual Campus Hub. In section 4 a matrix of the project impact so far is given. Section 5 presents different scenarios for sustaining the Virtual Campus Hub concept as a whole beyond the project period.

2. Dissemination of project Virtual Campus Hub

Dissemination of project Virtual Campus Hub started immediately after the project kick-off and has continued throughout the project period. Exploitation of the project results has taken place during the second project year; especially in connection with nine virtual events that demonstrated very successfully the use of Virtual Campus Hub elements for real teaching and collaboration. In this section, dissemination and exploitation activities during the project period are described.

2.1 Project logo

The project logo for Virtual Campus Hub follows the design template of projects in the “Explore Energy” project family as illustrated by the following examples:



[Explore Energy](#) is a network of projects and activities, which support a common vision of establishing a “Virtual World Energy University” using a wide range of virtual elements developed in different projects as stepping stones towards the vision. Virtual Campus Hub builds upon experiences from the two related projects [Explore Energy Virtual Campus](#) (EEVC, 2010-12) and [Select CD](#) (2010-12). Synergies with these projects are described in the deliverable [D6.7 Final report on the Virtual Campus Hub concept](#). The E-learning platform [CompEdu](#) holds a large amount of the learning material from all of these projects including KTH’s contributions to Virtual Campus Hub.

A series of educational programmes are linked to the Explore Energy network and its projects. These include the Erasmus Mundus M.Sc. SELECT, THRUST, and ME3 programmes, the Erasmus Mundus Ph.D. programme SELECT+, and the Swedish joint M.Sc. programmes “Sustainable Energy Engineering” and “Distance Sustainable Energy Engineering”.

2.2 Project web site

A project web site has been setup at www.virtualcampushub.eu. The site has been maintained by DTU throughout the project period. For example, news stories about the project have been published here. Publicly available project deliverables have also been uploaded to the site.

A brief description of Virtual Campus Hub can be found through the Explore Energy Gateway at www.exploreenergy.eu (see “Partners/Projects”). A brief project description is also given at EU’s Community Research and Development Information Service (CORDIS) site.

2.3 Social media

News about Virtual Campus Hub has been distributed through two different social media:

- Facebook at <https://www.facebook.com/VirtualCampusHub>
- Twitter at <https://twitter.com/virtualcampushu>

The number of followers is limited to 14 on Facebook and 13 on Twitter. The lesson learned from this type of dissemination is that most potential stakeholders are reluctant to follow because social media are largely associated with private rather than professional activities. The consequence of mixing these two spheres is unclear to many. LinkedIn might be a more suitable platform for dissemination of professional content.

2.4 Conferences and workshops

The project team has participated actively in 11 international conferences and workshops throughout the project period and participation in two additional events is planned. An overview of the events is given in the deliverable [D6.5 Virtual Campus Hub conference](#). Papers presented at the conferences are listed in Appendix A of this report.

A mini-conference was held in connection with the final project meeting of Virtual Campus Hub where stakeholder representatives were invited to comment on the project outcome and relevance.

In addition to the international conferences and workshops, the project team has participated in 20 workshops and meetings with stakeholders at the national level. These events are listed in the deliverable D6.3 Virtual Campus Hub workshops and meetings. Table 2 gives a quantitative measure of all the dissemination activities described above.

Table 2. Dissemination activities during the project lifetime of Virtual Campus Hub

Media	Communication	Number
Web site	News stories	18
Facebook	Likes	14
	Posts by VCH	20
	Posts by others	0
Twitter	Followers	13
	Tweets by VCH	17
	Retweets by others	0
International conferences and workshops	Oral presentations	13
	Posters	1
Publications	Conference papers	6
	Reports	13
	Other publications	2

2.5 Virtual Campus Hub virtual events

Nine virtual events have taken place where the different elements in Virtual Campus Hub, including both the technical and the pedagogical aspects, have been used in real teaching and collaboration situations. The virtual events are listed in the deliverable [D6.4 Virtual Campus Hub virtual events](#) and their outcome is described in [D3.4 E-learning programmes and courses evaluation report](#). The virtual events have been extremely important for getting in contact with different groups of stakeholders in the project and for building up a community of people with common interests around the project.

2.6 Project reports

A series of reports, which describe the outcome of the project at different stages have been delivered in Virtual Campus Hub (Table 3). The majority of the reports (9 of 13) are made publicly available through the project web site (see appendix B). The project

partners have also distributed the reports within their networks and via their own web sites and library systems.

Table 3. List of reports published in project Virtual Campus Hub.

Title	Work package	Dissemination level	Due Date
D5.1 Preliminary technology survey report	WP5	PP	31-Dec-2011
D5.2 Technical concept and recommendations	WP5	PP	31-Mar-2012
D2.1 Interim report on pedagogical improvement	WP2	PP	30-Sep-2012
D4.1 Interim e-Link evaluation report	WP4	PP	30-Sep-2012
D6.1 Dissemination strategy paper	WP6	PU	31-Mar-2012
D1.1 Mid-term report	WP1	PU	31-Aug-2012
D2.3 Report on pedagogical improvement	WP2	PU	31-Mar-2013
D5.4 Virtual Campus Hub technology evaluation report	WP5	PU	31-Mar-2013
D3.4 e-Learning programs and courses evaluation report	WP3	PU	31-Jul-2013
D1.2 Final report	WP1	PU	30-Sep-2013
D4.3 e-Link evaluation report	WP4	PU	30-Sep-2013
D6.6 Strategy paper	WP6	PU	30-Sep-2013
D6.7 Final report on the Virtual Campus Hub concept	WP6	PU	30-Sep-2013

2.7 Publication in international journals

The project team is planning to publish at least one paper about the Virtual Campus Hub concept in an international peer-reviewed journal by the end of 2013. Three journals, which all publish manuscripts in the field of engineering education, are being considered for this publication. These are listed in Table 4.

Table 4. Journals considered for a publication about the Virtual Campus Hub concept.

Journal	ISSN	Online available (y/n)	Impact factor (ISI)	BRI level (2/1)
Journal of Engineering Education	1069-4730	Yes (FT fra 1993 ff)	Yes	2
European Journal of Engineering Education	0304-3797	Yes (FT fra 1975 ff)	/	2
International Journal of Engineering Education	0949-149x	Yes (FT fra 1994 ff)	Yes	2

2.8 Popular science communications

The NRENs have contributed to dissemination of the project results to a wide audience of users and stakeholders. An article called [International students get single sign-on for](#)

[wind energy training](#) has been published in WAYF's annual fact sheet (no. 4, 2013). SURFnet has produced a web story and a video called [Practical example involving Eindhoven University of Technology \(TU/e\)](#). A press release and an infographic about Virtual Campus Hub are in preparation at SURFnet. A web article is in preparation at DTU.

Different publications and web sites have been prepared by the partners to present or advertise the specific E-learning tools or processes and the best practises established in the project. These are described in the following section.

3. Exploitation of project results

This section describes for each of the elements developed in Virtual Campus Hub the dissemination activities carried out in the project, a sustainability plan, and a cost estimate for sustaining the elements beyond the project lifetime.

3.1 Remote laboratory exercises

The remote laboratory exercises developed by KTH include a remote cascade lab, a pressure measurement lab, and a flutter lab. Students can take control over the laboratory experiments as if they were inside the laboratory room. The remote lab exercises have been thoroughly tested through the virtual events carried out in the project. These events have been excellent for introducing the new E-learning tools to students and lecturers.

The main advantage of the remote laboratories, which is highlighted in the dissemination of the tools, is that students all over the world can access equipment that would be too costly to have at each local university. Further, sharing of lab exercises between institutions is expected to free resources for other activities in the longer term. This can be exploited in connection with joint educational programmes.

Dissemination activities

KTH has setup a [web site](#) which presents the remote labs, the exercises, and the results of testing in Virtual Campus Hub. The remote laboratory exercises will continue to be promoted through KTH's large network of students and lecturers; especially in the field of thermal turbomachinery. The E-learning tools have been presented at the XXI Biannual Symposium on Measuring Techniques in Turbomachinery, March 22, 2012 and another conference contribution has been accepted for the ASME TurboExpo in Dusseldorf, June 16-20, 2014.

Sustainability plan

The remote laboratory exercises are already being used in several university courses at KTH and also in joint educational programmes with external students (Erasmus Mundus [SELECT](#) and [THRUST](#)). As the knowledge about the new E-learning tools and the best practices for using them gets disseminated further, the use of the tools is expected to increase.

Associated cost

Whereas the cost of designing remote labs is high, the cost of operation is limited. Any future expenses related to the remote labs will be absorbed by the income that KTH generates from university courses.

3.2 Online examination tools

The online examination tools developed by KTH have been designed to show that online tools for correction of exams can be as objective as human correction. There is a significant potential for large-scale implementation of the online examination tools. They can be applied to a wide range of disciplines as they work independently of the topic. The tools can therefore be promoted as one of the most scalable outcomes of project Virtual Campus Hub.

Dissemination activities

The performance of two new types of tools - Multiple choice questions (MCQs) based on a large pool of questions and calculation exercises with "Twin-tracking Method" - has been demonstrated to lecturers at KTH and the partner institutions through a web site with real examples. They have also been tested in connection with nine different university courses at KTH during the project period.

Sustainability plan

The online examination tools have already been implemented in connection with several courses at KTH and the use of the tools is expected to continue and spread beyond the end of Virtual Campus Hub. Procedures for setting up new online exams have been established and documented in Virtual Campus Hub so the use of resources for online examination in the future is mostly related to the development of new exam questions.

Associated cost

Any expenses related to the use of online examination tools will be absorbed by the income that KTH generates from university courses.

3.3 Online courses in wind energy

DTU has developed an online course based on an existing course in the Wind Atlas Analysis and Application Program (WASP). The course is designed mainly for

continued education of experts from the wind energy industry but the long-term goal is to also integrate the course in university programs and courses. Over the last 20 years, a community has developed around the software WAsP and the WAsP courses held by DTU. This global community of WAsP users is an excellent starting point for dissemination of the new online version of the WAsP course.

Dissemination activities

The WAsP E-learning course has been tested twice in connection with the Virtual Campus Hub virtual events. The experience gained from these trial runs was very good and has inspired others at DTU Wind Energy to develop online courses that follow a similar format. Another impact of the trial runs has been that representatives from the wind energy industry have had the opportunity to try the course. Good recommendations from these participants may attract new participants from the industry.

A team of teachers and sales assistants is already established around WAsP activities at DTU. This team holds a vast experience in dissemination and has an extensive global network within the wind energy industry, which has been utilized for dissemination of WAsP E-learning courses. For example, DTU Wind Energy has a stand at the major wind power conferences and WAsP E-learning courses are advertised several times per year from this platform:

- EWEA by the European Wind Energy Association
- EWEA by the European Wind Energy Association
- AWEA by the American Wind Energy Association
- China Wind Power Conference

The first commercial run of the WAsP E-learning course has been advertised in the magazine [Wind Power Monthly](#) (including a banner at the magazine web page). The course has also been advertised at DTU's own site www.wasp.dk and through [DTU's course data base](#) (course no. 1227).

Additional dissemination activities have been carried out to reach stakeholders at the university. Presentations about the WAsP E-learning course have been given at workshops and networking meetings for lectures; primarily at DTU. The Learning Lab at DTU has been vital for spreading the awareness of WAsP E-learning and other online teaching initiatives at DTU. At the international level, the WAsP E-learning course has been presented at the conference EDULEARN and at workshops organised by the strategic energy alliance [SEEIT](#) (see also [D6.5 Virtual Campus Hub conference](#)).

Sustainability plan

The WAsP E-learning course is already being offered on commercial terms to the wind energy industry. The first course was launched in early September 2013 with 16 paying participants. Two annual course runs are planned for the future and the launch of two additional E-learning courses (WAsP Engineering and HAWC2) is planned for the beginning of 2014.

Connection of the cloud service 'itslearning' as a SP has been achieved via SURFconext in the Netherlands. This solution is temporary and limited to the duration of the project. It will be replaced as soon as the Danish federation WAYF is ready to publish service provider metadata to eduGAIN. The sustainability plan for the connection of 'itslearning' is to setup a national connection to WAYF to be used until WAYF is fully eduGAIN ready.

Associated cost

A business plan has been developed for the WAsP E-learning course based on a business canvas model. The resources required for running the course have been estimated on the basis of experiences from the two trial runs in Virtual Campus Hub. The following resources are needed to sustain the WAsP E-learning course runs:

- License fee for the LMS 'itslearning' (1350 EUR per 100 users per year)
- Administration (10 man-hours per week for 9 weeks)
- E-moderating (10 man-hours per week for 9 weeks)

Based on these figures, it has been decided to charge participants a sum of 1,500 EUR for a WAsP E-learning course. This is 2/3 of the course fee for the three-day WAsP courses that are held physically at DTU.

3.4 E-link functionalities

StartApp is an interactive tool developed by Polito for support of start-up businesses. The application facilitates the initial steps of developing a business plan for a new idea (the pre-incubation phase) and seeks to establish a new link between education and innovation.

Dissemination activities

The real incubator I3P in Torino has assisted in the formulation of end user requirements as well as in testing of the E-link functionalities developed in Virtual Campus Hub. I3P and their network of entrepreneurs and SMEs are thus the most important stakeholders and end users of the E-link functionalities. The partners in Virtual Campus Hub have also been invited to test the StartApp on their own projects.

Altogether, the testing performed in Virtual Campus Hub is an excellent starting point for dissemination of the application.

Sustainability plan

Polito is in dialogue with I3P about the sustainability plan for StartApp but no decisions have been made at present.

Associated cost

The cost of sustaining the StartApp beyond the project period depends on the ambitions for how to use the tool and is unknown at present.

3.5 Collaboration environment - MS SharePoint

For Virtual Campus Hub, TU/e has connected a pilot configuration for MS SharePoint to SURFconext and eduGAIN, the configuration consisting of 2 ADFS servers and a SharePoint server. In addition, a plugin for external group management, provided by SURFnet, has been used to be able to make SharePoint available for external users without having to create accounts for these users in SharePoint itself. The information on how to make the connections and how to configure the plugin for group management are publicly available through SURFnet's OpenConext Wiki¹.

Dissemination activities

The use of the collaboration environment has been demonstrated to the Virtual Campus Hub partners via a migration of the project team site from DTU to the connected site at TU/e. The collaboration environment has also been used in connection with a virtual event in the project where 15 students were working on projects on entrepreneurship with supervisors and clients from industry (see [D6.4 Virtual Campus Hub virtual events](#)).

Sustainability plan

While the collaboration environment for TU/e is a pilot environment, which will be discontinued at the end of 2013, TU/e is considering possibilities to use the same setup to provide document sharing and other collaboration facilities for the Eurotech Universities consortium (DTU, TU/e, TUM Munich and EPFL Lausanne).

In addition, MS SharePoint is a core part of TU/e's education portal, where it provides professional collaboration facilities for all students and teachers. Therefore, TU/e will use the results from Virtual Campus Hub to work out a concept for opening up its

¹ Connecting MS Sharepoint:

<https://wiki.surfnetlabs.nl/download/attachments/22413486/SURFconext+for+SharePoint+2010+Setup+guide+version+2.pdf>

Group management plugin for MS Sharepoint:

<https://wiki.surfnetlabs.nl/display/surfconextdev/Microsoft+SharePoint+as+a+group+consumer>

education portal to the outside world, i.e. to external users (such as potential students and partners from industry) and to partners in collaboration initiatives (such as joint programs).

Associated cost

The cost of developing and maintaining the MS SharePoint environment with federated logon via eduGAIN (internal costs TU/e, production environment integrated with the TU/e SharePoint farms) are:

- Setup: €3000,-
- Maintenance: €500,- per year
- Backup: €0,70 per GB per month

Note there is a difference in cost for the “proof of concept” setup for Virtual Campus Hub, in which 4 separate servers (at €200,- per month) were needed because the Virtual Campus Hub setup was not part of the production environment.

3.6 Collaboration environment - unified communications hub

The close collaboration between TU/e and SURFnet in connection with Virtual Campus Hub had led to the idea of setting up a pilot with a unified communications hub. A concept has been designed to realise this but in the end, the plan for a pilot with unified communications across borders turned out not to be feasible, as the companies indicating that they might be willing to participate chose otherwise. However, the analysis made to do this pilot, has clearly indicated a number of barriers that need to be overcome before online collaboration activities can become easy-to-use, efficient and reliable.

Dissemination activities

A demo platform for unified communications with the potential to be integrated into both the TU/e infrastructure and the Virtual Campus Hub platform (federated logon, eduGAIN) has been tried out in connection with a virtual event in the project.

Sustainability plan

TU/e will use the analysis done for this pilot to identify gaps in its own communications infrastructure and make a plan how to fill these gaps with respect to its international collaboration initiatives in research and education.

Associated cost

It is difficult to say something about cost, as the products offered by the companies contacted for a pilot were new and were not complete solutions. The costs were expected to be in the few tens of thousands of euros, depending on the setup requested.

3.7 IdP connections

The identity provider (IdP) connections and service provider (SP) connections achieved in Virtual Campus Hub represent the “Virtual Campus Hub technology”. The following IdPs have been connected to the Virtual Campus Hub (see also Figure 1):

- Eindhoven University of Technology (TU/e) – through SURFnet (NL)
- Royal Institute of Technology, Stockholm (KTH) – through SWAMID (SE)
- Technical University of Denmark (DTU) – through WAYF (DK)
- FEIDE OpenIdp (NO) for guest accounts
- OneGini for access through social network accounts (Google, Facebook, Twitter and LinkedIn)
- SURFguest (NL) for guest accounts
- SURFnet (NL) for testing purposes
- GARR (IT) for testing purposes

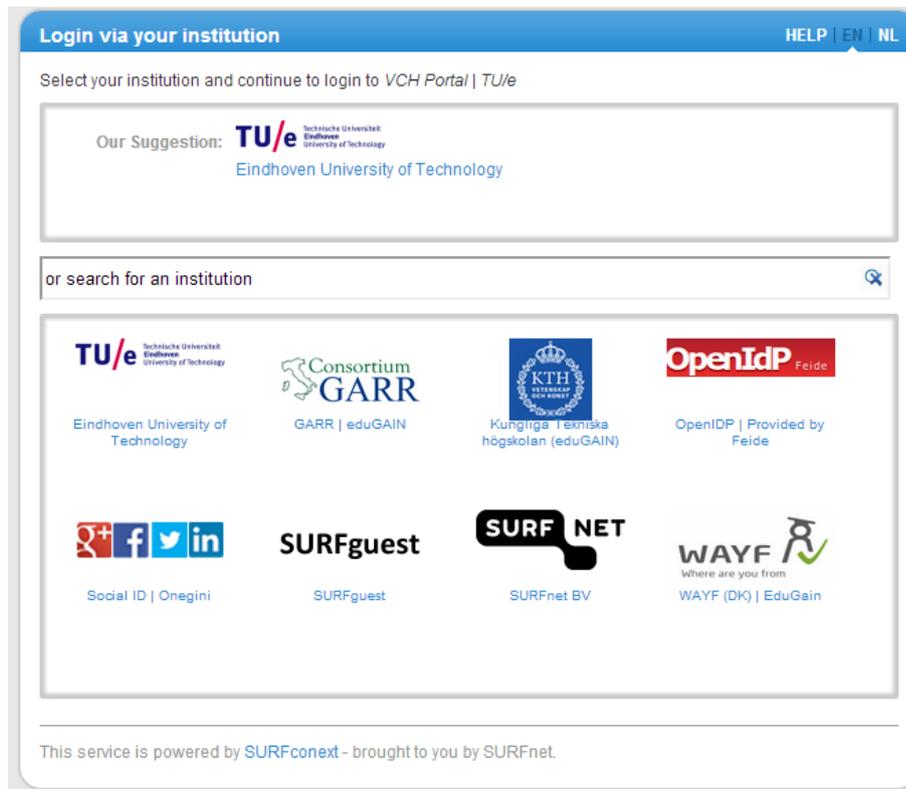


Figure 1. Login screen from the Virtual Campus Hub portal. The connected IdPs can be selected via their icons.

Dissemination activities

The IdP connections have been tested thoroughly amongst the partners. For example, a virtual event has been organised where representatives from each partner tried to login to the wind energy course in ‘itslearning’ with the user ID from their local university.

The test participants provided their feedback to login procedure as compared to the standard itslearning login procedure. Another test example is the use of federated authentication to access the project team site in MS SharePoint.

The technical concept of Virtual Campus Hub has been presented at several international conferences where stakeholders from the international E-infrastructure community (Terena) or from the educational community were present (see [D6.5 Virtual Campus Hub conference](#) and Appendix A).

Sustainability plan

For these IdPs to be available to the Virtual Campus Hub, the metadata for all these IdPs needed to be published to eduGAIN. As a result, any service (application) connected to a federation that is member of eduGAIN is able to pick up these metadata and thus to connect one of these IdPs to their service (mutual agreement is needed as well, of course). This means that this result of the VCH project – making a number of IdPs available through eduGAIN – will remain available, even if the VCH portal and its applications are discontinued.

Associated cost

No cost is foreseen for sustaining the IdP connections established in Virtual Campus Hub.

3.8 Virtual Campus Hub portal

The Virtual Campus Hub portal at <https://vch.tue.nl> is a simple website with (single sign-on, IIS) deeplinks to the services (applications) provided by the VCH project:

- DTU's course in wind energy (itslearning):
<https://www.itslearning.com/elogin/autologin.aspx?CustomerId=1956>
- TU/e collaboration environment (MS SharePoint):
<https://vchcollaboration.tue.nl>
- KTH remote cascade lab:
<https://egiswamid.egi.kth.se/secure>
- Polito StartApp:
<http://toce.polito.it/vchub/>

- My Virtual Campus Hub group memberships (SURFnet)²:
<https://teams.surfconext.nl/teams/home.shtml?view=gadget>

All of these services can exist independently of the portal, incl. the federated login (if they have been connected to the Virtual Campus Hub infrastructure). In fact, if a user goes directly to the URL belonging to a service, the same federated logon procedure will be used as when logging on to the portal. What the portal does is to present all links on one page, so a user does not need to search for all these links. The single sign-on feature is provided by SURFconext and is not part of the Virtual Campus Hub portal itself.

Dissemination activities

The Virtual Campus Hub portal has been used in virtual events and presented together with the Virtual Campus Hub technology as described for the IdP and SP connections in section 3.7.

Sustainability plan

The Virtual Campus Hub portal will not be of added value after this project has ended and will therefore be discontinued. However, it speaks for itself that future collaboration initiatives would need a similar kind of portal webpage, or even a professional portal product, to make their different services available to their members. The setup is then comparable and as such, the Virtual Campus Hub portal concept will be sustainable for the future.

Associated cost

The cost of the simple portal for Virtual Campus Hub was low: €200,- per month for the web server (internal cost TU/e) and some cost for developing the webpage. A professional portal product is much more expensive, but also offers more functionality of course.

4. Impact of Virtual Campus Hub

Impact can be interpreted as the sum of the outreach and the significance of a given activity:

$$\text{Impact} = \text{outreach} + \text{significance}$$

² The technical information on connecting this IIS website as service provider to SURFconext can be found at <https://wiki.surfnet.nl/display/surfconextdev/Get+Conexted>.

In order to measure the impact of project Virtual Campus Hub, a matrix has been set up to monitor a series of measurable parameters during the last six months of the project. Some of the parameters address the outreach (e.g. the number of users, publications, or followers on social media). The significance is addressed through targeting of dissemination activities towards the most important stakeholders (e.g. by attending the conferences and meetings where these stakeholders are present). For this the dissemination strategy is vital.

4.1 Impact matrix for the Virtual Campus Hub applications

The plots in Figure 2 show that the number of users has increased over time for all of the applications developed in Virtual Campus Hub. The total number of users has reached 1175 by the end of the project period. Note that the effective number of users is lower because some groups of university students have used more than one application. The number of unique users is not easily identified but it is estimated to be around 500.

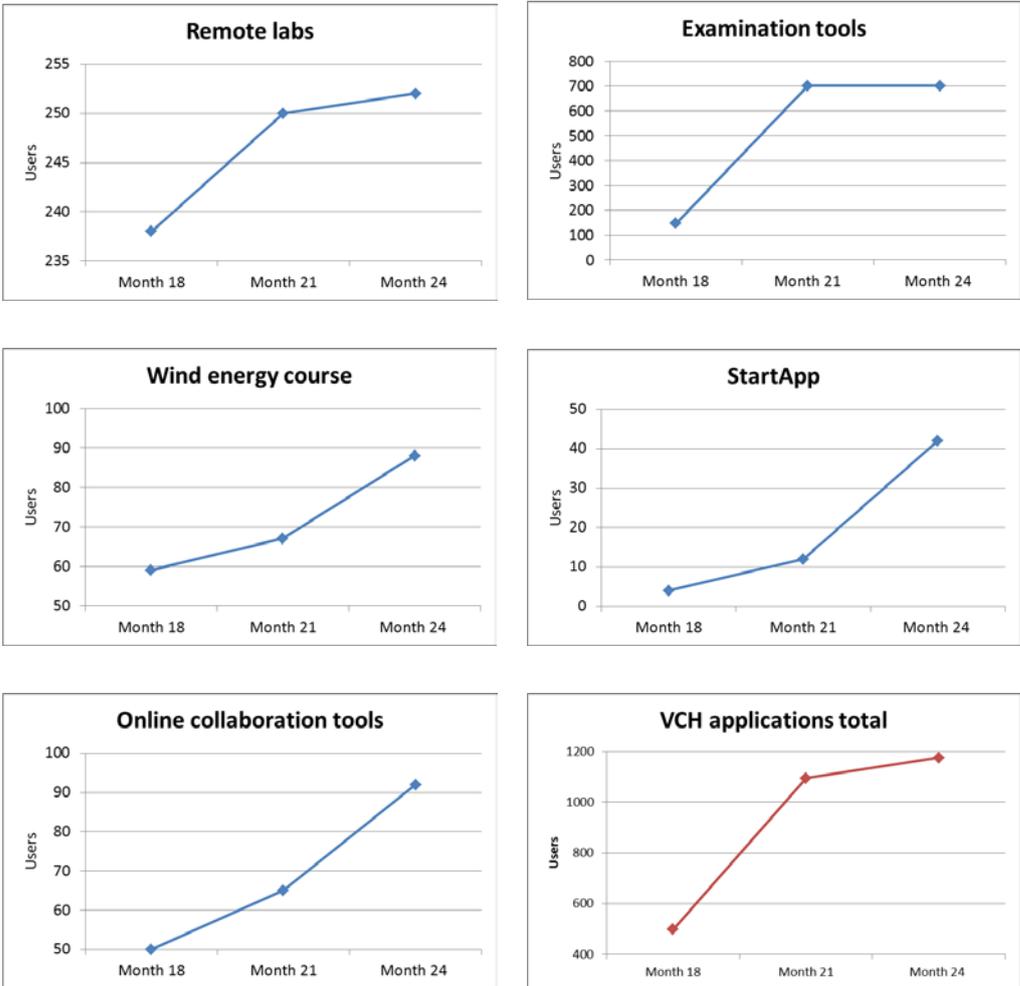


Figure 2. Plots showing the number of users for the different Virtual Campus Hub applications during the last six months of the project (month 18, 21, and 24).

The Virtual Campus Hub virtual events have turned out to be one of the most important channels for dissemination of the project foreground. The virtual events have demonstrated the use and the potential of Virtual Campus Hub's applications very clearly to a relatively large community of relevant users. Presentations of the applications at conferences and workshops targeted at the key stakeholders have also been important. Finally, the publication of best practices for designing and using the E-learning applications are expected to have a significant impact.

4.2 Impact of the Virtual Campus Hub technology

The most important impact of the Virtual Campus Hub technology developed in this project is that the connection of IdPs and SPs across institutional and national borders has been demonstrated for the first time. The lessons learned from this work have been documented and disseminated to the E-infrastructure community at the national and international level. It can be used in the further advancement of the concept.

Project reports, conferences, workshops and meetings have been the most important dissemination channels when it comes to the Virtual Campus Hub technology. The connection of IDPs and SPs and the Virtual Campus Hub portal were realized during the last six months of the project period. A couple of virtual events were able to take advantage of the new technical concept and demonstrate its use for real teaching and collaboration. The outcome was very promising but perhaps mostly relevant for the relatively small amount of users involved. A total of 37 users have tried the single sign-on system through the Virtual Campus Hub portal in order to access some of the Virtual Campus Hub applications.

4.3 Key facts and figures from Virtual Campus Hub

In the following, some key facts and figures from the project are given based on data from the impact matrix:

- 1175 users have tried the E-learning applications from Virtual Campus Hub.
- 16 university courses have made use of E-learning applications from the project.
- 25 university teachers have been involved in online teaching and/or development of online teaching material.
- 60 members of staff from enterprises have been involved as users of Virtual Campus Hub applications.
- 8 IdPs and 4 SPs have been connected to the Virtual Campus Hub environment.

- 37 users have registered at the Virtual Campus Hub Portal for single sign-on to Virtual Campus Hub applications.
- 4 technical universities and 4 NRENS from 4 European nations have exchanged requirements and experiences.
- 3 core disciplines have been integrated in Virtual Campus Hub: Education, research, innovation.
- 3 levels of renewable energy education have been addressed: Master, Ph.D., continuous education (life-long-learning).
- 5 scientific fields have been engaged: Wind power meteorology, aeroelastic design, turbomachinery, entrepreneurship, E-infrastructure.

4.4 Overall impact of the project

Virtual Campus Hub has led to significant advances in the use of European research infrastructures across institutional and national borders and the Virtual Campus Hub demo platform has already inspired other consortia to get connected in a similar way (e.g. the Eurotech partners: DTU, TU/e, TUM Munich, EPFL Lausanne). The user requirements and the remaining barriers for fulfilling these have been identified through the project and communicated back to the NRENS and to other E-infrastructure organisations at the international level (Géant, Terena) throughout the project.

Virtual Campus Hub has boosted the use of state-of-the-art E-learning tools and the sharing of resources for teaching and collaboration at the partner universities. The good examples of E-learning in Virtual Campus Hub have already sparked an interest for developing new E-learning applications at the partners. The use of such applications is beginning to penetrate into university programs and courses as a result of dissemination activities in Virtual Campus Hub.

Virtual Campus Hub has identified new ways of achieving a further integration of research, education, and innovation. For example, participants in the WAsP E-learning course were a mixture of university students and staff and people from the wind energy industry. This was an excellent networking experience for all. The StartApp is another example of the integration of businesses in the university world.

5. Sustainability of the Virtual Campus Hub concept

For the Virtual Campus Hub concept as a whole, different business model scenarios have been discussed. A final decision regarding the sustainability of the Virtual Campus Hub concept has not yet been taken. Different scenarios for the future are:

- Once the Virtual Campus Hub concept has been described in detail through the project deliverables and the demo portal, it is openly available to other users who wish to collaborate with each other (e.g. universities in joint educational programs). It is then up to the users, together with their local federations and service providers, to set up and operate a system similar to Virtual Campus hub.
- The project team of Virtual Campus Hub and the federations involved in the project continue to offer their services via the Virtual Campus Hub infrastructure and help new users to connect for a fee (up-scaling). The up-scaling is not limited to educational purposes, as the Virtual Campus Hub concept could just as well be used by research projects and, possibly, innovation (requires easier access for industry partners). Federations and eduGAIN are now widely implemented around the world so the collaboration could be extended to the global scale.
- The project team looks for a start-up company (SME) who is willing to run and develop the Virtual Campus Hub concept further. KIC InnoEnergy would be the perfect access point for realizing such as public-private partnership. The project team is in dialogue with KIC InnoEnergy about the possibilities.
- The European Commission has already expressed some interest in supporting the sustainability of Virtual Campus Hub via European infrastructure resources – a dialogue with DANTE could be initiated to find out more about possibilities for realizing this scenario.

The project reports of Virtual Campus Hub can be downloaded from the project web site at www.virtualcampushub.eu. These reports document in great detail the E-learning tools and E-infrastructure technologies developed in the project as well as the recommended best practises for using them. The thorough documentation of the project activities and outcomes ensures that the knowledge gained from Virtual Campus Hub is sustained regardless of the strategy chosen for sustaining and developing the Virtual Campus Hub demo environment in the future. It should thus be possible for any consortium who wishes to collaborate across institutional and national borders to setup a similar environment with the help of the relevant NRENs and service providers.

The Virtual Campus Hub consortium is currently looking for new opportunities to continue their successful collaboration and build upon the work achieved in the project. In preparation for the upcoming Horizon 2020 calls for proposals, the consortium is preparing a roadmap for the further requirements of a working Virtual Campus Hub environment that links to Virtual Campus Hub's vision of sharing resources for education at the European and the global scale. The roadmap will also be linked to overall strategies for energy education (the SET-plan) and for E-infrastructure in Europe.

Appendix A Virtual Campus Hub conference papers

This appendix lists the full references to conference proceedings papers and abstracts about Virtual Campus Hub. The publications can be found through the conference organisers.

- Badger, M., Badger, J., Berg, J., Bingöl, F., Cronin, T., Gryning, S.-E., Hansen, B.O., Jørgensen, H.E., Karagali, I., Kelly, M.C., Larsen, S.E., Mortensen, N.G., Nielsen, R., Peña, A., Rathmann, O., Monty, A. Online training in WAsP for wind energy professionals. *Proceedings of RÜZGEM 2013 Conference on Wind Energy Science and Technology*, October 3-4, 2013, Ankara, Turkey (extended abstract + oral presentation).
- Badger, M., Monty, A., Badger, J. Berg, J., Bingöl, F., Cronin, T., Gryning, S.E., Hansen, B.O., Jørgensen, H.E., Karagali, I., Kelly, M.C., Larsen, S.E., Mortensen, N.G., Nielsen, R.A., Peña, A., Rathmann, O., Stenbæk, L. (2013). Community building and cross-border collaboration through online courses in wind energy. *Proceedings EDULEARN13*, July 1-3, 2013, Barcelona, Spain (abstract + full paper + oral presentation)
- Badger, M., Vercoulen, F., Monaco, L., Farinetti, L. Virtual Campus Hub: a single sign-on system for cross-border collaboration. *Abstracts EDULEARN13*, July 1-3 2013, Barcelona, Spain (abstract + oral presentation).
- Monaco, L., Vogt, D.M., Bergmans, J., Fransson, T.H. (2014). A Remotely Operated Aeroelastically Unstable LPT Cascade for Turbomachinery Aeromechanics Education and Training – Remote Flutter Lab. *Proceedings of ASME TurboExpo 2014*, June 16-20, 2014, Dusseldorf, Germany, GT2014-27170 (full paper + oral presentation).
- Monaco, L., Vogt, D.M., Fransson, T.H. (2013). A New Linear Cascade Test Facility For Use in Engineering Education. *Proceedings of XXI Biannual Symposium on Measuring Techniques in Turbomachinery*, March 22, 2012, Valencia, Spain (full paper + oral presentation).
- Vercoulen, F. Virtual Campus Hub: Toward a concept for international collaboration in education. *Abstracts 19th EUNIS Congress*, June 12-14, 2013, Riga, Latvia (extended abstract + oral presentation).

Appendix B. Deliverables of Virtual Campus Hub

This appendix shows the project deliverables of Virtual Campus Hub. The red links can be used to access the publicly available (PU) deliverables via the project web site.

Management of the Consortium

[D1.1 Mid-term report \(PU\)](#)

[D1.2 Final report \(PU\)](#)

E-learning Tools

D2.1 Interim report on pedagogical improvement

[D2.2 Implementation of e-Learning tools \(PU\)](#)

[D2.3 Report on pedagogical improvement \(PU\)](#)

E-learning Programs and Courses

D3.1 Prototype implementation of e-Learning tools and incubator processes

[D3.2 Trial implementation and test of two e-Learning tools \(PU\)](#)

[D3.3 Trial implementation of two incubator processes \(PU\)](#)

[D3.4 e-Learning programs and courses evaluation report \(PU\)](#)

E-link Innovation for Decision Makers

D4.1 Interim e-Link evaluation report

[D4.2 e-Link functionality integrated into the VC hub \(PU\)](#)

[D4.3 e-Link evaluation report \(PU\)](#)

Virtual Campus Hub Technology

D5.1 Preliminary technology survey report

D5.2 Technical concept and recommendations for the specifications of the VCH inventory and demonstrator

[D5.3 Virtual Campus Hub technology \(PU\)](#)

[D5.4 Virtual Campus Hub technology evaluation report \(PU\)](#)

Dissemination and exploitation

[D6.1 Dissemination strategy paper - preliminary version \(PU\)](#)

[D6.2 Virtual Campus Hub website \(PU\)](#)

D6.3 Virtual Campus Hub workshops and meetings

[D6.4 Virtual Campus Hub virtual events \(PU\)](#)

[D6.5 Virtual Campus Hub conference \(PU\)](#)

[D6.6 Strategy paper \(PU\)](#)

[D6.7 Final report on the Virtual Campus Hub concept \(PU\)](#)

DTU Wind Energy is a department of the Technical University of Denmark with a unique integration of research, education, innovation and public/private sector consulting in the field of wind energy. Our activities develop new opportunities and technology for the global and Danish exploitation of wind energy. Research focuses on key technical-scientific fields, which are central for the development, innovation and use of wind energy and provides the basis for advanced education at the education.

We have more than 240 staff members of which approximately 60 are PhD students. Research is conducted within nine research programmes organized into three main topics: Wind energy systems, Wind turbine technology and Basics for wind energy.

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