

Erasmus + Project No 598241-EPP-1-2018-1-RS-EPPKA2-CBHE-JP  
**Strengthening Educational Capacities by Building Competences and  
Cooperation in the Field of Noise and Vibration Engineering**  
**SEN VIBE**

## **Linking stakeholders in the field of Noise & Vibration in the EU via different forms of hubs: examples of good practice**

**Activity 1.6, 1.7**

**Date: 29/10/2019**

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## 1. Introduction

The project SENVIbE 'Strengthening Educational Capacities by Building Competences and Cooperation in the Field of Noise and Vibration Engineering' (598241-EPP-1-2018-1-RS-EPPKA2-CBHE-JP):

<https://senvibe.uns.ac.rs/>

was approved for financing under the call Erasmus+ Capacity Building in Higher Education EAC/A05/2017, and will be coordinated by University of Novi Sad, Serbia during the period 15 November 2018 – 14 November 2021.

The wider aim of the SENVIbE project is to improve and build national educational capacities, cooperation and competences in dealing with environmental and occupational Noise and Vibration (No&Vib) engineering issues accordance with ongoing EU integration strategies and the needs identified in Serbia.

One of the objectives of the SENVIbE project is to establish the No&Vib Hub - a unique central unit for networking and co-operation between academic and non-academic institutions, which should ensure the creation of links and also projects between key stakeholders. The motivation for establishing a No&Vib Hub stems from examples of good practices that exist in Europe and elsewhere. This Report provides some examples of such hubs, networks or centres, with the intention to inspire the creation of similar or related activities in Serbia. The report first contains examples from England and Sweden i.e. the two partner countries in SENVIbE. Then examples from two other countries are presented.

## 2. Examples from UK

### 2.1 The UK Acoustic Network (UKAN) ([www.acoustics.ac.uk](http://www.acoustics.ac.uk))

This was launched in November 2017 being sponsored by EPSRC (the UK national body for funding research in Engineering and Physical Science research), and it is due to last for three years. It brings together primarily researchers in all areas of acoustics including vibration and structural dynamics. Its activities include publicity and training events, as well as the formation of Special Interest Groups (SIGs) to assist in collaboration, dissemination, etc. The membership of over 700 also includes acoustic consultants, government funded scientific civil service employees, instrumentation developers as well as some international members. Membership is free presently, but some of the events are organised to be self-funded or by registration whilst some funding is explicitly available for post-graduate researchers to request for attending training, conference support, etc. It publishes newsletters on its open webpages, as well as supporting advertising of positions and opportunities.

A list of potential activities, taken from their site, is given below:

- Host and co-host specialist/non-specialist meetings, workshops, training, site visits, summer schools and symposia.
- Target different levels of expertise and raise awareness of acoustics.
- Share examples of what network members do with others; promote acoustics to students and companies.
- Forge new partnerships between industry and academia, identifying problems that need solutions, road mapping and generating funded projects for innovations that would not happen otherwise.
- Create an inventory of state-of-the-art capability, identify gaps and build a picture of shared interests across the SIGs.
- Collate web-based resources to share data, codes, software and more.
- Grow the number of Network members and establish working internal and external links with other networks.
- Explore routes to more funded PhD places and/or Doctoral Training Centres/Centres of Doctoral Training.

So far two summer schools have been held covering Early Career Development (August 2018) and Machine Learning for Acoustics (August 2019). Other meetings include

numerous workshops organised by the SIGs and visits hosted by individual university research groups.

Membership of the Network is free, by applying online. Although there is a governing body who hold the EPSRC grant and are responsible for providing an audit of the accounts as well as final reporting to EPSRC at the end of the funded period.

## **2.2 The Association of Noise Consultants (ANC)**

[\(www.association-of-noise-consultants.co.uk/\)](http://www.association-of-noise-consultants.co.uk/)

The ISVR Consulting Services (ICS) is one of 110 or more members of this professional organisation organised in the UK. Some personal or company memberships exist and overall the number of acoustic consultants involved exceeds one thousand. A company needs a minimum of 50% of their staff to hold Membership of the Institute of Acoustics within their organisation to qualify. Membership is dependent upon showing professional levels of performance and technical competence. Prospective members, either personal or company membership, is via an online application. Governance of ANC is through a board of eight elected members, and the ANC holds meetings on alternate months to hear developments, network and organise an Annual Conference.

The ANC activities include production of good practice guidelines, registration of the professionals to undertake certified Sound Insulation Testing and use their publicity, webpages, etc. to offer related acoustic and vibration services in all of the areas:

- Commercial
- Demolition & Construction
- Education & Health & Justice
- Industrial & Environmental
- Leisure, Entertainment & Performing Arts
- Nuisance
- Other
- Planning
- Residential
- Sound Insulation Testing
- Transportation

It is also very proactive in supporting, developing and giving STEM (Science, Technology, Engineering and Mathematics) outreach activities from their membership, as well as giving careers advice and developing STEM resources. They also respond to

Government White Papers and provide the public and government with advice and opinion on all matters relating to noise, vibration, disturbance, housing standards, etc.

From their webpages, consultants can be found from an open directory by searching by area, service/expertise or by name. They also support the development of the next generation of engineers and consultants by sponsoring awards and present these at their annual event. The awards are for projects and work that demonstrate value and quality for the client, collaboration with project stakeholders with further potential to improve future practice.

It is also very proactive in giving advice to politicians (e.g. contribution and feedback to UK Government White Papers), feedback on legislation in the area when it is out for opinion and hosts its own workshops for skills updating, share best practice, etc.

### 3. Examples from Sweden

Sweden like the UK and most developed countries have national organizations or networks for professionals also in the field of acoustics and vibrations. But since examples of such networks were given for the UK, here we will instead present examples of other types of co-operation between academy & industry. The examples will be based on KTH, i.e., The Royal Inst. of Technology, Stockholm.

The first case, which does not involve sound and vibration, is an example of a hub: KTH Innovation Hub on Industrial Digitalization. This hub is hosted by the Mechatronics and Embedded Control Systems Division at KTH and is also closely associated with the ICES centre at KTH. This Stockholm based Innovation Hub is aiming to become an active core of the Sweden innovation ecosystem related to CPS and IIoT. It is located in the intersection between industry, academic research and education, as well as a multitude of innovation actors. As part of KTH the Hub also has a large international network to leverage. For more details please refer to (Accesses 27 October 2019):

[www.kth.se/itm/inst/mmk/forskning/mekatronik-och-inbyggda-styrssystem/the-iiot-hub/about-1.802082](http://www.kth.se/itm/inst/mmk/forskning/mekatronik-och-inbyggda-styrssystem/the-iiot-hub/about-1.802082)

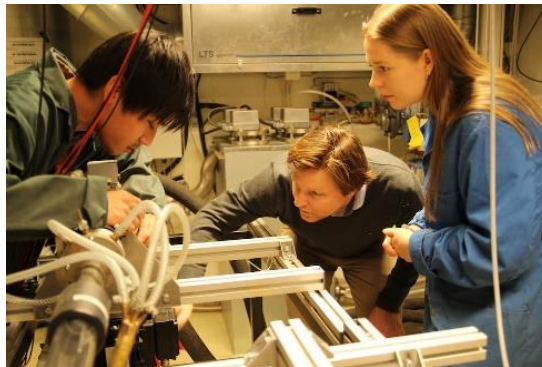
But KTH also has a number of multi-disciplinary centres *that involve noise and vibration* and other areas depending on the centre focus. These centres are financed by different government agencies and involve both academy and industry. Typically, the financing is based on the principle that all partners (academy + industry + government) contribute 1/3 of the total budget each. The government contribution is always 100% in cash, while the other partners can offer a mix of cash and in-kind contributions as specified in the consortium agreement. Typically, these centres are set up for 3-5 years after which they are evaluated and have the chance for a renewed period. The total annual budget for these centres is in the range 2-3 MEURO.

#### 3.1 Competence Centre for Gas Exchange ([www.ccgex.kth.se](http://www.ccgex.kth.se))

CCGEx focuses on research regarding gas management in modern internal combustion engines for vehicles.

The aim of the research is to make engines more effective and environment-friendly thus to decrease fuel consumption without losing performance, lower emissions of hazardous substances and to control sound generation and attenuation in the engine gas handling system. Gas management is defined as all handling of gases from

the air inlet to the valves of the engine block, as well as the exhaust gases from the point where they leave the combustion chamber through the exhaust valves, and then all the way through the exhaust system.



**Figure 3.1.** Research in CCGEx

The research is based on extensive knowledge of fluid dynamics, acoustics and combustion engine technology and includes both fundamental and applied experiments and simulations as well as development of methodology for such studies. The centre is a combined effort between KTH, the Swedish Energy Agency and the leading engine manufacturers in Sweden. KTH CCGEx started officially 1st of January 2011.

## **VISION**

Make possible the transition from physical to virtual development using predictive simulation tools developed on physics-based understanding of phenomena

## **GOAL**

Enable design of efficient and environmentally friendly propulsion systems by improved Gas Exchange & Turbocharging processes.

## **TOOLS**

Multidisciplinary based approach combining resources from Acoustics (FEM & Experiments), Fluid Mechanics (CFD & Experiments) and the ICE laboratory.

## **CCGEX ORGANISATION**



CCGEx is a research center according to the principles of KTH centres (administrative rules of KTH). The center-format has a well- defined organization including the centre board, operative director, Research management team and scientific council.

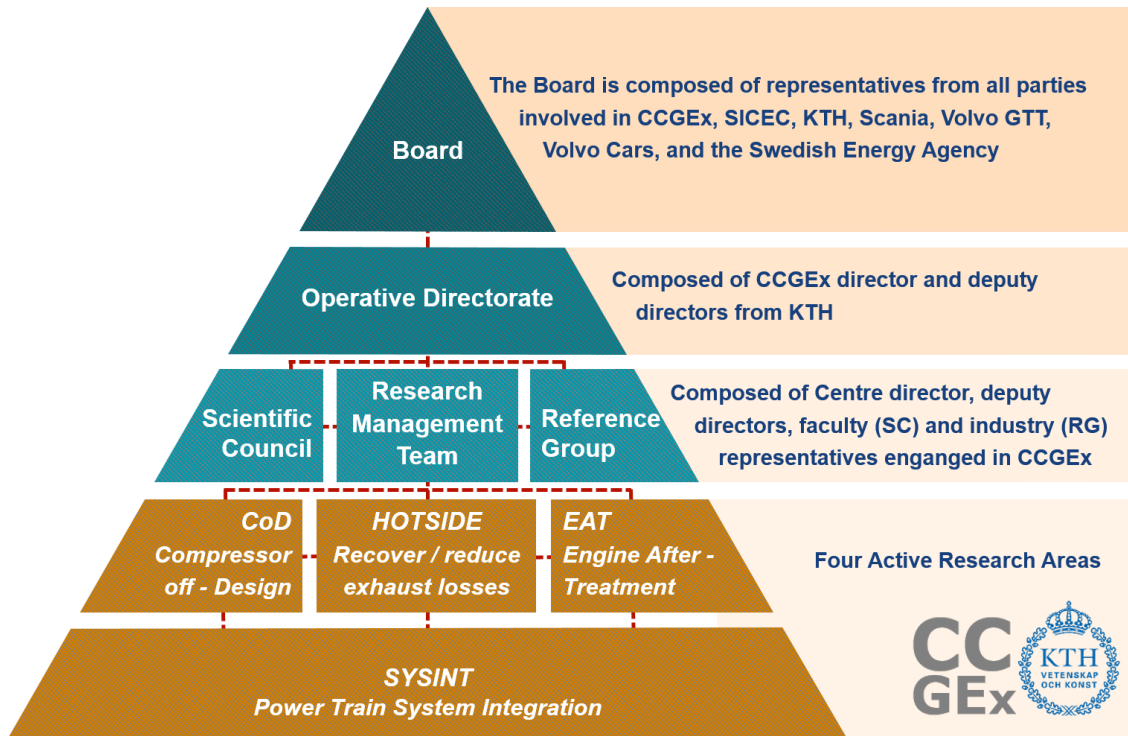


Figure 3.2. CCGEx Organisation

### 3.2 ECO2 Vehicle Design ([www.kth.se/2.19903/strategy](http://www.kth.se/2.19903/strategy))



Figure 3.3. Illustration from <https://www.kth.se/2.19903/strategy/our-focus-1.698144> (Accessed 27 October 2019)

This centre engages in multi-disciplinary and multi-vehicular research to find solutions to cross-functional conflicts that exist at many levels of the broader vehicle system. To

accomplish this it brings together research expertise from academia and industry in aerodynamics, acoustics, vehicle dynamics, lightweight structures, life cycle analysis, sustainability, system science, modularisation, and more. ECO<sup>2</sup> Vehicle Design has identified that resolving these conflicts is critical to achieving resource efficient vehicles and a sustainable Sweden.

ECO<sup>2</sup> Vehicle Design have adopted a distributed management model – robust, multi-disciplinary and integrative – being central to our operations. The ECO<sup>2</sup> Vehicle Design management model aims to efficiently promote the implementation of the centre strategy and its connected, interdependent and emergent research. This means that there is a high degree of connectivity between all of the centre's organizational units.

### **CENTRE BOARD**

The board of the centre consists of representatives from the main industrial and governmental partners as well as from KTH, both as adjunct as well as ordinary member.

### **CENTRE MANAGEMENT GROUP**

The Centre Management Group (CMG) is a distributed leadership unit that manages the daily operation, initiation of new research projects, organisation of meetings, and communication with partners. The distribution of the management roles within the CMG is continuously revised, prioritized, and rotated once a year.

### **CENTRE COORDINATION GROUP**

The Centre Coordination Group (CCG) is vital in the generation of new, needs-driven projects, serving as the partners' main connection point, and being responsible for the project generation process. It is instrumental in transferring and sharing research knowledge and results, combining them with product development and societal needs, as well as the cross-applicability of technologies between vehicle types, in order to initiate new research activities.

### **PARTICIPATING PARTNERS**

The ECO<sup>2</sup> Vehicle Design partners is forming the core of the centre, with representatives participating at all levels of the centre organization.

## 4. Other examples

The two examples in this section describe cases where one university has created a network in sound and vibration.

### 4.1 MAKUNET-Danish network for machinery acoustics

([www.vibroacoustics.m-tech.aau.dk/makunet/](http://www.vibroacoustics.m-tech.aau.dk/makunet/))

MAKUNET ("Maskin Akustisk Netværk") is a network of academic and industrial partners focused on the field of sound and vibration led by Aalborg University.

The network serves as a platform for knowledge exchange, problem solver, as well as an interaction element between the students and industry (in a form of project proposals).

Few times a year seminars are organized. At this seminars a talk is given by an expert from the field of sound and vibration which is followed by a discussion session.

### 4.2 The Vibro-Acoustic Consortium (VAC) – University of Kentucky, US

(<http://vac.engr.uky.edu/>)

The VAC are companies committed to the use of software for noise and vibration modeling, prediction, and control. The Consortium helps members understand and more effectively use vibro-acoustics software for the design of quiet products.

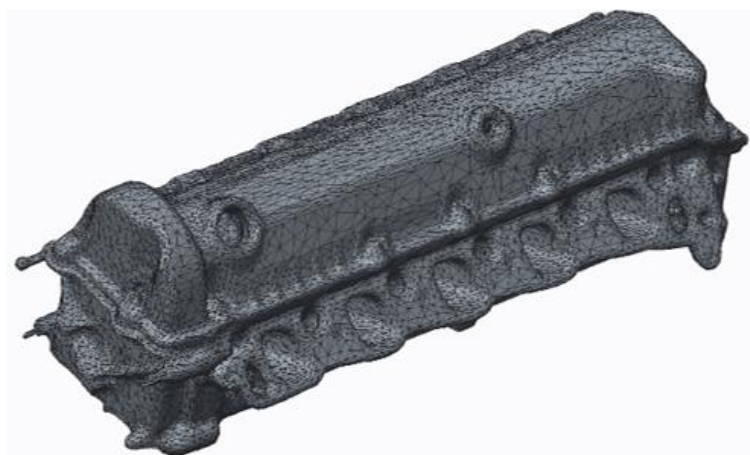


Figure 4.1. Model from <http://vac.engr.uky.edu/> (Accessed 27 October 2019)

## MISSION

The mission of the Vibro-Acoustics Consortium is threefold:

- Training to help members use software tools more effectively
- Software verification and qualification
- Software/tools enhancement

The mission is accomplished through focused projects, formal workshops, and informal one-on-one sessions working with software

## PROJECTS WITH A PURPOSE

Projects are initiated with specific objectives in mind, for example, to determine the best combination of software tools for designing enclosures for products, or the most accurate method for estimating the noise radiated by a vibrating part or component. Projects are short-term, lasting one to six months, with objectives that can be confirmed with experimental results. Recent projects include:

- Interior noise prediction
- Design of enclosures
- Software for radiation prediction
- Evaluation of SEA software
- Use of sound absorbing materials
- Comparison of direct and indirect BEM
- Evaluation of infinite elements
- Rayleigh integral assessment

## HOW THE VAC WORKS

At twice-yearly meetings, VAC members help define and review projects of mutual interest. These meetings are also opportunities for VAC members to network about software, modelling techniques, and experimental methods. Between meetings, engineers and graduate students carry out project objectives that are reported at the next VAC meeting.

## REALITY CHECK: EXPERIMENTAL FACILITIES

Projects that have an experimental component are a VAC specialty. Test apparatus has been designed and built to evaluate SEA parameters, to verify software for modeling of partial enclosures, and to compare with software results for interior noise.

Other projects with a strong experimental flavour include comparison of Rayleigh integral and BE results for engine noise prediction, measurement of transmission and insertion loss of muffler components, and the experimental determination of the propagation and attenuation constants of porous materials.

Experimental facilities include:

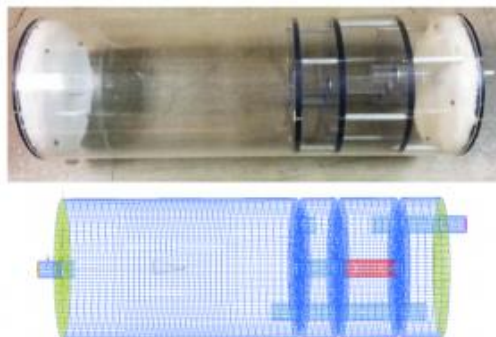
- 60 m<sup>2</sup> hemi-anechoic chamber
- 250 m<sup>2</sup> modal analysis laboratory
- 175 m<sup>3</sup> reverberation chamber
- Material characterization facility
- Muffler transmission loss facility
- Chassis dynamometer
- Shaker capability up to 1000 lbs

### WORKSHOPS AND TRAINING

The VAC sponsors events that help members keep abreast of new technology in noise and vibration control. Recent training activities include:

- Mini-Symposium on Flow Acoustics
- Materials for Noise Control
- Numerical Methods for NVH
- Introduction to SEA
- Interior Noise Prediction using FE

In addition to focused training activities, the VAC sponsors the highly successful NPS Workshops every other year.



**Figure 4.2.** Model from <http://vac.engr.uky.edu/> (Accessed 27 October 2019)

## **COMMERCIAL SOFTWARE**

To support projects and training activities, the VAC maintains a suite of software for vibro-acoustics modeling and prediction. A partial list includes SYSNOISE, AutoSEA, ANSYS, NASTRAN, AKUSMOD, MECOSA, SEADS, I-DEAS and Pro/Engineer. Software is available for one-on-one training and demonstration.

## **COST AND BENEFITS OF MEMBERSHIP**

Members benefit from a number of VAC features and services including:

- Evaluation of vibro-acoustic software
- Demonstration projects
- Access to VAC software
- Networking with peers in other industries
- Access to students for hiring
- One-on-one training
- VAC workshops and training sessions
- Access to facilities
- Measurement of material properties

Memberships in the VAC is \$8,000 per year. Member companies may send up to two individuals to all VAC meetings, workshops and training activities. Informal visits are also encouraged for one-on-one training for reviewing software and for consultation.

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