

Engineering Data Science Working Group (EDSWG)

1 TECHNICAL AREA COVERED BY THE GROUP

The NAFEMS Engineering Data Science Working Group (EDSWG) advocates the use of data science, including machine learning (ML), Artificial Intelligence (AI) and optimisation methods to improve product design process and draw meaningful insights from data to support product design decisions.

The working group is a vendor neutral, cross-industry, international body of experts operating in the area of Engineering Data Science (EDS).

NAFEMS was formed in the early 1980s when industry was starting to solve practical engineering problems using finite element analysis techniques. The UK Government setup a project to investigate issues related to the accuracy of the methods that were being employed. Out of this project the “National Agency for Finite Element Methods and Standards”, quickly shortened to NAFEMS, was founded as a special interest group. The organisation has grown over the subsequent decades and today is an independent not-for-profit company, owned by its members involved in many different types of engineering simulation covering both products and processes.

Characteristics of the Engineering Data Science problems and how they differ from Data Science as applied in the other fields:

- A lot of data is contained within 3D geometry data and engineering models. As such the data is not readily available in tabular format as required by machine learning methods.
- Data originating from simulations often requires up-front investment to create or extract attributes and there may be fewer data points than that from other fields.
- For the EDS the Use Interface/coding tools should be designed for users with a background in a variety of engineering fields, not just computer science.
- The number of outputs to predict are significantly larger than in the other fields.
- In many cases, engineers know the underlying physical laws and the data science process would benefit from making use of this information to reduce the number of data required and to train more accurate predictive models.
- The EDS is often linked to simulation and in many cases the responses are generated via intensive simulations from tabular inputs. These tabular inputs are often arranged using Design of Experiments (DOE). DOE can be adaptive to perform active and potentially incremental learning.

Topics of interest for the EDSWG include but are not limited to:

- Appropriate verification & validation approaches to build engineering machine learning models
- Integration of data based and physics informed approaches
- Usage of variable fidelity data (e.g., simulations and physical experiments), accounting for uncertainty of such data

- Efficient coupling of optimisation with machine learning methods
- Application of machine learning for small amount of data
- Providing guidance on how to get started by sharing success stories, communicating best practices
- Identifying the barriers standing in the way of EDS adoption
- Current challenges
- Synthetic data generation
- Working with geometric data
- Machine Learning model update: keeping track of data and model history, model deployment

2 AIMS

EDSWG aims to provide guidance to the product design and operation teams in the use of data science to improve processes and support design and operation decisions. This will be achieved by sharing experiences, following the developments in this field, connecting people in this field for discussions and promoting best practices.

In a longer term EDSWG could work towards proposing standards for machine learning applied to simulations.

Investigate/Follow:

- Challenges in EDS
- New developments in other fields that can benefit EDS

Promote and Develop:

- Guidelines on how to get started in EDS
- Best practices on how to conduct studies in EDS

Communicate and Share:

- EDS best practices through whitepapers, presentations, booklets, panel discussions:
 - When to use
 - How to get started
 - Steps of the process
- Success stories through whitepapers, presentations
- Identify the barriers standing in the way of EDS adoption
- Ease of use of EDS tools for variety of engineering backgrounds

3 STRUCTURE OF THE WORKING GROUP

The members of the EDSWG are experts in the area of Engineering Data Science who contribute their time and knowledge on a voluntary basis. The outputs of the EDSWG are created by both current working group members and external experts from the wider community. Where an output is produced by an external expert, the EDSWG is responsible for ensuring that the output is technically accurate and relevant to the NAFEMS membership.

4 EDSWG BYLAWS

4.1 EDSWG

- The number of the EDSWG members should ideally range from between 10-20.
- Members of the EDSWG are listed on meeting minutes as present, or sent apologies.
- If a member of the EDSWG does not contribute for more than 9 months, they will be warned that their membership of the working group may be terminated. An individual's membership of the EDSWG may be terminated after 12 months of non-contribution, at the discretion of the Chair.
- Working group members must have attended a minimum of 50% of working group meetings over the last 12 months in order to be eligible to participate in group votes.
- At the discretion of the EDSWG chair participation may be shared between two individuals from the same member organization to reduce the workload on individuals.
- The EDSWG should aim to meet at least 9 times a year but not less than 6 times a year.
- The primary method of meetings will be via a web-based platform to enable international involvement in the group. The EDSWG is encouraged to take advantage of major NAFEMS or industry events to meet in person. Where a physical meeting is scheduled, attempts should be made to provide a web-based connection to the meeting to allow participation of those who are not able to attend the meeting in person.
- Minutes will be taken for all meetings and actions will be identified. The minutes should normally be circulated within a month (ideally less) of a meeting date.
- At least two-thirds of the entire EDSWG membership should represent an organisation which has an active membership with NAFEMS.

4.2 JOINING THE EDSWG

- Potential new members should submit a curriculum vitae to the NAFEMS Technical Working Group Manager (TWGM) highlighting their role, knowledge and experience in the area of EDS.
- This submitted information will be reviewed by the current EDSWG members and if approved, the person will be invited to attend meetings and participate. It is expected that all EDSWG members hold a senior technical position and have significant expertise in the area of EDS.
- It is expected that all EDSWG members commit to participating in EDSWG activities to best of their abilities.

- The criteria for member selection is based on experience, commitment and influence.
- New member applications will normally be reviewed twice a year (December and May)
- All accumulated CVs will normally be reviewed 1 month prior. Each committee member will rank applicants. The candidates with the best ranking will be accepted.
- Not more than 2 members will be accepted from the same organization. Substitutes are possible with EDSWG majority agreement/approval.
- If there are more than 25 qualified members, EDSWG will discuss starting a new related WG

4.3 LEADERSHIP ROLES

- The position of EDSWG Chair is open for review every three years on the anniversary of the initial appointment. There is no requirement for the role to be rotated. Only current members of the EDSWG may vote. Only current EDSWG members can be nominated for the EDSWG chair role.
- The Chair of the EDSWG should ideally be an industrial user of EDS technology.
- The position of EDSWG Vice Chair is open for review every three years on the anniversary of the initial appointment. There is no requirement for the role to be rotated. Only current members of the EDSWG may vote. Only current EDSWG members can be nominated for the EDSWG Vice Chair role.

4.4 DECISION MAKING

- Where a vote is required it will be carried out via email or a web based survey tool to the TWGM.
- Only eligible members of the EDSWG are permitted to vote (see section 4.1).
- Each organisation that has a representative in the working group will have one vote. If an organisation has more than one person participating in the working group, the vote will be shared between the participants.
- If required, the casting vote will be held by the Chair.

4.5 COMMUNICATION

EDSWG communication should be carried out using the relevant group email address. The current communication addresses can be found in Addendum 1.

It is the responsibility of the NAFEMS TWGM to ensure that the EDSWG email distribution list is current. Personal distribution lists are discouraged as they require constant updates.

5 RESOURCE REQUIREMENTS

The EDSWG is administered by the TWGM.

Logistical support for the group, consisting of providing a web-based meeting platform, scheduling meetings and web-hosting of working group output is provided by NAFEMS.

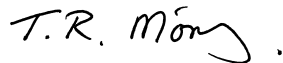
Funding is available from NAFEMS to support the development of working group outputs. This funding can take the form of contracts for authors, contracts for the individuals tasked with reviewing. Applications for funding should be made to the NAFEMS Technical Officer.

6 DURATION

The EDSWG will continue in perpetuity until terminated by the NAFEMS CEO.

7 APPROVAL

CEO, NAFEMS



Date 01 / 02 / 2022

Revision History

<u>Date</u>	<u>Revision</u>	<u>Description</u>	<u>Author</u>
05/01/2022	1.0	Initial Draft	EDSWG
28/01/2022	2.0	Approved ToR	Ian Symington

ADDENDUM 1

• WORKING GROUP EMAIL ADDRESSES

- EDSWG Email Address - edswg@nafems.org

• ROLES AND RESPONSIBILITIES

EDSWG Members

Responsible for:

- identifying the outputs and directing the activities of the working group
- ensuring that EDS output is technically accurate and relevant to the NAFEMS membership
- regularly contributing to EDSWG activities. Contributions can include:
 - attending and actively participating in working group meetings;
 - participating in topic discussions and activities between meetings, whether individually or as part of a focus team;
 - sending relevant comments or reports on agenda items to the Chair in good time for the meeting;
 - volunteering for and carrying out actions arising from the meetings including developing outputs, reviewing EDS resources, authoring invitations to tender etc.

EDSWG Chair

Responsible for:

- providing leadership to the EDSWG
- acting as the focal point for the EDSWG
- ensuring that meetings are run effectively

EDSWG Vice Chair

Responsible for:

- supporting the Chair of the EDSWG
- chairing the EDSWG in the absence of the Chair.

NAFEMS Technical Working Group Manager

Responsible for:

- acting as the primary point of contact between the EDSWG and NAFEMS
- EDSWG meeting logistics, processing new member requests
- producing the minutes for EDSWG meetings

NAFEMS Technical Officer

Responsible for:

- acting as the NAFEMS point of contact for EDSWG funding
- acting as the NAFEMS point of contact for approving EDSWG output

NAFEMS CEO

Responsible for:

- providing the authority to terminate or request a change of scope for the EDSWG