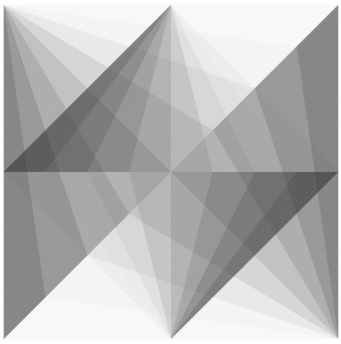

ENHAnCE

Featuring Engineering

TRAINING OVERVIEW AND MONITORING METHODOLOGY

Project Acronym: ENHAnCE	
Project full title: European training Network in intelligent prognostics and Health mAnagement in Composite structurEs	
Call: H2020-MSCA-ITN-2019	
Grant Number: 859957	
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Authored: Dr. Juan Chiachío (UGR)	**Date:** 14/07/2020
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Internally Approved: Dr. Manuel Chiachío (UGR)-Coordinator	**Date:** 28/07/2020

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Introduction

As specified in the Grant Agreement Annex 1, a Training strategy, Personal Career Development Plans (PCPD), and training monitoring methodology report will be launched as Deliverable D6.1 from the Working Package "ESR Training" led by University of Granada (UGR).

The ENHAnCE programme is designed to provide technical and professional skills training to ten Early Stage Researchers (ESRs) fully in line with the purposes and nature of the Marie Skłodowska-Curie Actions programme. The training will pursue the clear purpose of improving the creative and innovative potential of the researchers to enhance their career and to advance research based on opportunities of acquisition and transfer of new knowledge. A dedicated Training and Tutoring Committee (TTC), chaired by the Senior Training Mentor (STM) along with an industrial co-chair, ensures the efficient implementation of the training programme and will discuss training needs during the lifetime of the project.

All ESRs have an allocated budget for training each year (through their associated Research, Training and Networking [RTN] costs associated to each beneficiary budget, as per the Consortium Agreement, Attachment 5) to cover training courses, conferences as well as any equipment required for their PhD project. ESRs along with their supervisors are expected to keep track of their own spending and will be required to provide a spreadsheet detailing their spendings at the end of each year. All training will be logged by the TTC Chair to provide an evidence trail for reporting purposes.

ENHAnCE will set up a structured training program to ensure that all ESRs will obtain multidisciplinary, international and advanced oriented translational knowledge **so that they have the capacity, mind-set and experience to successfully bring ENHAnCE to the market**. Moreover, we realise that acting at the forefront of innovation is highly demanding and requires strong leadership skills. Hence, this will be complemented by network-wide training on transferrable skills to meet the objectives identified through each ESRs Personal Career Development Plan (PCDP) through specific social and economic training modules, whose purpose is to prepare the ESR for high level positions in the public or private sector and industry.

Overview of training methods

ESRs will be exposed to the following training blocks:

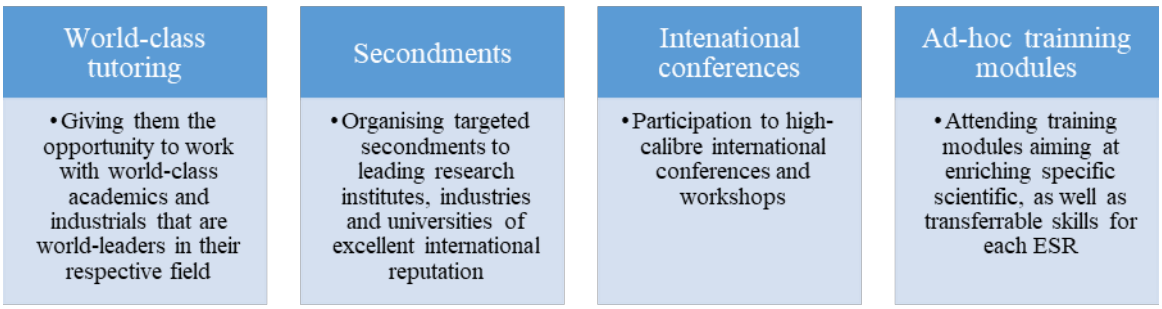

Figure 1. Training blocks

Tutoring

All ESRs will have dedicated experienced principal supervisors from their host institutions and they will also be supported by the Supervisory Board (SB). Precise work has been carried out to identify complementarities among the main supervisor and co-supervisors in order to define effective joint supervision that guarantees a unique training plan of top quality for all fellows. This synergy is assured by the mixed contribution of world-class academic experts, who will provide scientific excellence in their areas along with industrial specialist of exceptional scientific background who will ensure the required training to make the journey to ENHAnCE's Cyber-Physical System end-product development.

In particular, **the ESRs hosted by universities will have one main supervisor from the university plus two co-supervisors (at least one from a non-academic beneficiary partner** as listed in the table below, where (T) stands for Training, (B)eneficiary, (I)ndustrial guidance, (S)econdment, (C)o-supervision, and (F)acility usage. The supervision modes include supervision, co-supervision and secondments, which are highlighted in green, orange and yellow, respectively).

Table 1. Contribution of all participants to the research and training programme

Participants	ESR PhD projects									
	1	2	3	4	5	6	7	8	9	10
UGR	T	T	T	T	T	TF	CT	T	TF	TF
UNOTT	T	T	TF	T	T	T	T	TF	T	T F
TUDELFT	T F	T	T	T	TF	T	T	T	T	T
POLIMI	T	TF	T	T	T	TF	T	T	T	T
STRATH	T	T	T	TF	T	T	TF	T	T	T
DLR	TFI	TI	TI	TI	TFI	TI	TI	TI	TI	TI
CEA	TI	TI	TFI	TI	TI	TI	TI	T I	TI	ITF
CEN	TI	TFI	TI	TI	TI	T I	TI	TI	ITF	TI
FID	TI	TI	TI	TFI	TI	TI	TI	TI	TI	TI
RAM	I	I	I	I	I	I	ITF	I	I	I
ITWL	I	I	I	I	TFI	I	I	I	ITF	I
O&B	I	I	I	I	I	I	ITF	I	I	I
TUC	TF	T	TF	TF	T	T	T	T	T	T
SON	I	ITF	I	I	I	I	I	I	I	I
BRASI	T	T	T	T	T	T	T	TF	T	T

They will register for a PhD within their host institution and will be employed as MSCA Early Stage Researchers subject to all the scientific assessments valid for every PhD student. This will involve submitting progress reports on their research work, attending regular seminars, taking the required courses valid for PhD enrolment and final PhD defence. Equivalently, **ESRs hosted outside universities will be assigned an industrial main supervisor from the host organisation plus at least one co-supervisor from a doctoral school** of an academic beneficiary partner. Additionally, a local advisor has been identified for those partner organisations hosting ESRs during secondments. The progress of the fellow during these periods will be also monitored by the supervisors of the host institution through video conferencing at least once a month.

All ESRs will be involved within the research activities of their host research groups and will interact with senior researchers and specialists around, as a soft but effective way of supervision. Moreover, they will celebrate periodical meetings (e.g. weekly) with their main supervisor and co-supervisors not only for technical advice and monitor the progress of the project, but also for mentoring and exploring career prospects. Signed records (using the format from the Appendix) of these supervision meetings will be kept and shared with the TTC through the secured web space of ENHAnCE.

Moreover, the PCDP of each ESR will be evaluated twice a year by at least three people from the TTC: (1) the supervisor, (2) co-supervisor/s, and (3) the TTC Chair (who acts as training mentor by reviewing them) in order to:

§ Ensure a sound academic/industrial feedback provision to the ESRs;

§ Maintain high research standards for award of a PhD to the ESRs;

§ Identify any conflicts between academic assumptions and industrial applicability;

§ Identify project risks (including those affecting fellow's personal performance).

Secondments

An important element of training within the project will be the opportunity to experience life in different sectors (academia, industry, government). The composition adopted for the ENHAnCE network is based on large and global universities (e.g. TUDelft, POLIMI, UGR, etc.), research organisations (CEN, CEA, FID), top government agencies (ITWL, DLR), important international companies (e.g. RAM), as well as SME (O&B). Such variety of research environment will ensure that all ENHAnCE ESRs have significant exposure to the academic, government and industrial sectors and that they spend the appropriate time in each one in order to achieve a successful training. Apart from the interaction between the different member of the consortium (ESRs, Supervisors, etc.), secondments are an important part to intensify exposure to a variety of research environment. Each ESR has a plan for secondment as per the Grant Agreement Annex 1 (Table 3.1.1.). The secondments, with a maximum of 9 months per ESR, will be carried out in two ENHAnCE institutions hence each ESR will be exposed to, at least, three ENHAnCE premises.

The plan for secondment might be subject to changes depending upon the research and training programme and always under the benefit of the ESR. *Any potential changes in secondments, possibly due to the pandemic situation, should be discussed with the TTC Chair and approved by the Coordinator after consultation with the REA.*

International Conferences

A major complementary factor contributing to the maturity and evolution of ESRs is presenting their advancements in front of technological experts and being exposed to their feedback and criticism. The results of the industrial and academic development will be disseminated in major conferences like PHM, EPHM, EWSHM, IWSHM, PSAM, ESREDA, FTC, to name but a few. At least, 3 major conferences (2 of them as speakers) as should be targeted by each ESR during his/her contract period. Conferences with no peer-review process won't be eligible unless specifically reasoned.

Ad-hoc training

The ad-hoc training programme for the ESRs will comprise a combination of taught courses and training events, as summarized in the following table.

Table 2. Ad-hoc Training

Training method	Type of training	Goal
Introductory week	Scientific and transferable	An introductory course whereby to explain the main points of the ENHAnCE project (research, communication, industry, etc.), as well as tools to successfully develop research work, including project management and conflict resolution skills.
Network-wide Training Events	Scientific and project specific	To provide basic scientific training on composites, SHM and PHM technologies as well as to enable personal development of the ESRs by reinforced synergy between the participants involved in ENHAnCE

Network-wide training through thematic training weeks

The ESRs will attend formal thematic training weeks (TWs) arranged as Network-wide Schools around a specific ENHAnCE's topic, which will have a public character and will be free to attend for all the interested scientific community. TWs will be organised and hosted by the partner beneficiaries and will bring all the ENHAnCE's researchers together for a 1 week-event at each host institution. The main aim of TWs is providing ESRs with advanced theoretical background from European experts as well as methods and tools to carry out their own research projects and to perform appropriate exploitation and dissemination on research products.

TWs will be structured with three main elements: *Core Module* (Day 1 to 3), *Communication Day* (Day 4) and *Industry day* (Day 5). This organisation allows: concentrating scientific training in the first three days of core modules (see content in the Table below); receiving visiting scientists and practitioners; concentrating the involvement of most of the consortium members, local authorities and industry partners in the last two days, therefore maximising the chance of exposure of the fellows and the presence of partners within the SB meeting.

The table below lists the *Core Modules* including a summary of their content (distributed around 20 teaching hours), hosting institution, and estimated project month when will be celebrated.

Table 3. List of core modules of the thematic training weeks available to all ESRs

	Module title	Summary of content	ECTS (if any)	Lead Institution	Project Month
1	Introductory Week	Basic training in research methods, scientific-writing, literature review, programming, laboratory methods, Project Management and conflict resolution.	2	Dept. Structural Mechanics and Hydraulics Engineering (UGR)	9
2	Introduction to Composite Science and Technology	An introduction to key composite design technologies including understanding of the principles mechanical behaviour, testing & characterisation, and manufacturing.	2 (Awarded by TUC)	Institute of Composite Structures and Adaptive Systems (DLR)	12
3	Foundations on Prognostics and Health Management	Prognostics foundations, metrics for prognostics and Bayesian methods used for prognostics.	2	Dept. Structural Mechanics and Hydraulics Engineering (UGR)	15
4	SHM methods using GWs and AE in composites	Foundations about simulation and study of GWs interaction with composite damage, as well as mixture monitoring techniques between GWs and AE.	--	List Institute research on Non Destructive Testing (CEA)	18
5	Understanding the fatigue damage in engineering materials	Fatigue quantification methods, training about laboratory experiments, design and calculation methods, latest trends for fatigue damage mitigation.	2	Dept. Mechanical and Aeronautical Engineering (TUDelf)	21
6	Numerical methods for virtual laboratory engineering	Virtual laboratory simulation and cyber-physical systems for optimisation of manufacturing processes.	--	Polymer Processes and Composites Lab. Cenaero (CEN)	24

Module title		Summary of content	ECTS (if any)	Lead Institution	Project Month
7	Latest trends in manufacturing of intelligent composites	Manufacturing engineering of composite parts with embedded sensors, monitoring of manufacturing quality.	--	R&D Department of FIDAMC	27
8	Latest trends in prognostics algorithm architecture	Up-to-date advances in algorithmic methods for computing prognostics signatures, like prognostics fusion with Artificial Intelligence methods, post-prognostics methodologies, Open-Access prognostics implementation, etc.	2	Dept. Mechanical Engineering (POLIMI)	30
9	Aerospace Structural Materials	This module considers the materials used in, the history of the development of these materials and potential materials for the future.	2	Dept. Aerospace Engineering (UNOTT)	33
10	Wind Engineering technology	Foundations of design, analysis of wind turbines. Monitoring techniques. Assembly technology and maintenance.	2	Dept. Naval, Ocean & Marine Engineering (STRATH)	36
11	Pathways to commercial end-product impact and final ENHAnCE results	Global view, foundations and pathways to allow end-user product development, business & entrepreneurial skills, and leadership. ENHAnCE results workshops.	2	Institute of Data Science and Computational Intelligent (UGR)	42

The *Communication day* will include a mandatory module about communication skills (2 hours), designed to equip ESRs with the ability to maximize their impact. Sessions will be specifically designed to promote communication, creativity and entrepreneurial skills in academic researchers (including grant proposal writing). The rest of the communication day will be devoted to dissemination and outreach for ESRs to present their on-going research projects to all other the participants of the TWs and beyond. It should be noted that the training on transferable skills will be complemented by the several presentations that the ESRs will perform on their work during participation at international conferences.

The *Industry Day* will contain contributions from experts employed by the private sector partners of each participant country, and will consist of 3 sessions: (a) *Industry seminars* (2 hours), delivered by partners from industry as well as leading local industry specialists; (b) *R&D Management workshops* (4 hours), delivered by visiting R&D Directors to provide practical guidelines on how to manage the development and transfer of intellectual assets to the *Knowledge Economy*, as well as key business feasibility questions with respect to technical and market assessment, business plans and preparation for a company spin-out; (c) *face-to-face meetings* (2 hours), whereby ESRs and industry specialists will come together to discuss recruitment, activities of potential transfer of research, entrepreneurship and exploitation of their results.

NOTES about TWs.

- The Introductory Week will be held once all ESR are recruited. Due to the COVID-19 pandemia, the Introductory Week might be delivered on-line after having discussed and approved at SB level and communicated to the REA. In such a scenario, all the required arrangements will be done in advance to deliver this training with the highest possible standards of quality.

- The training weeks "Introduction to Composite Science and Technology" (TW2) and "Latest Trends in manufacturing of Intelligent Composites" (TW7) might be fused into one single Training Week to avoid duplications and to confer a richer and wider view about composite structures to the ESRs, once discussed and approved and approved at SB level and communicated to the REA.

- The TW "SHM methods using GWs and AE in composites" might be organized as a joint event with the GW4SHM ITN network https://cordis.europa.eu/project/id/860104, (whose

coordinator already expressed his willingness to collaborate for arranging joint-training weeks) as well as with the ReMap project https://h2020-remap.eu/, which share many common research and training topics (guide-wave modelling, SHM, maintenance modelling, structural integrity, etc.). This might imply changing someway the schedule of some other training weeks since their contents might have been already covered through the join event. Changes will be discussed at SB level and communicated to the REA.

The final scheduling of Training Weeks will be as follows:

#	Module Title	Lead Institution	Initial Project Month date	Rescheduled Project Month date		Notes
1	Introductory week	UGR	9	10	October 2020, once all ESRs are on-board	By teleconferencing,
2	Introduction to Composite Science and Technology and latest trends in manufacturing of intelligent composites	DLR and FIDAMC	12 & 27, respectively	15	March 2021	In-person, location to be determined (Germany or Spain)
3	Foundations on Prognostics and Health Management	UGR	15	18	June 2021	
4	SHM methods using GWs and AE in composites	CEA	18	21	September 2021	To be celebrated jointly with the GW4SHM-ITN project
5	Understanding the fatigue damage in engineering materials	TUDelft	21	24	December 2021	-
6	Numerical methods for virtual laboratory engineering	CENAERO	24	27	March 2022	-
7	Latest trends in prognostics algorithm architecture	POLIMI	30	30	June 2022	Without changes
8	Aerospace structural materials	UNOTT	33	33	September 2022	Without changes
9	Turbine blades design and technology	STRATH	36	36	December 2022	Without changes
10	Pathways to commercial end-product impact and final ENHAnCE results	UGR	42	42	June 2023	Without changes

Besides the thematic training weeks, the ESRs will be enrolled in the graduate schools of their host organisations, which all offer flexible training opportunities including annual retreats, meet-the-expert sessions and courses covering transferable skills. In particular, all the ESRs will be encouraged to join the *RRI* on-line training (https://www.rri-tools.eu/), the Marie Curie Alumni Association (MCAA) Academy (https://www.mariecuriealumni.eu/mcaa-academy), the Euraxes PIPERS tools (https://euraxess.eventiotic.com/piperstool/), as well as the University of Granada's flexible research training programme (http://investigacion.ugr.es/ugrinvestiga/pages/iiplanpromocionugr/), which will be opened to all ENHAnCE's participants. There is a choice of over 20 short courses, which the ESRs can choose to undertake for their personal development. Most of these courses are also available as online-taught modules, which can be very practical to follow for the ESRs. These courses depend on the annual training programme, and typically includes:

Table 4. List of training courses aiming at transferable skills development

Course		Learning outcomes
1	Open Science: Open Access and Open Data	To help researchers acquire core skills and knowledge relating to planning and conducting a research project that involves external organisations
2	Research writing	Overall organisation and organisation of particular sections. Appropriate academic style. Presenting extended argument. Synthesising sources critically. Writing progress reports, journal articles, conference papers and abstracts.
3	Intellectual property right protection	To develop an understanding of the implications of intellectual property for the planning, conducting, presenting and possible commercial exploitation of original research.
4	Presentation skills for researchers (Science & Engineering)	Discussed what makes an effective presentation; discussed how to prepare and give a talk; considered the needs of the different audiences of research; deliver presentation in front of a small group of students and a facilitator; received feedback on the content and delivery; present in seminars.
5	How to write a MSCA-IF	Provides knowledge, feedback and tips for successful writing of a MSCA-IF, which will enable the participants boosting their career within the H2020 environment.
6	Creative Thinking applied to the research	Understand how to apply a cycle of phases to maximise research creativity, focus on and analyse workplace problem, use a wide range of tools to help increase and improve creativity; etc.
7	Pathways to entrepreneurship	Performance management; delegation; communication; developmental feedback; team building; develop an action plan to use and develop these skills to run a start-up.
8	How to exploit your research	Examine and use the techniques of 'visioning' and gap analysis to exploit the research potential; utilise straight forward tools and techniques to help boosting research dissemination; explore performance indicators etc.

Appendix

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 859957.

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DATE:
SHEET No.:
ESR NAME:
ESR SURNAME:
DATE NEXT REVIEW:

OVERVIEW

PROGRESS AND COMMENTS (To be filled by the supervisor)

AGREED OBJECTIVES

SIGNATURE (ESR)

SIGNATURE (SUPERVISORS)