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# ANNETTE PROJECT

## Advanced Networking for Nuclear Education and Training and Transfer of Expertise

# DELIVERABLE D 1.1

## SURVEY ON E&T AND VET IN THE NUCLEAR FIELDS IN EUROPE

| Nature of the deliverable | | |
|---|---|---|
| R | Report | X |
| P | Prototype | |
| D | Demonstration | |
| O | Other | |

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| PP | Restricted to other programme participants (including the Commission Services) | |
| RE | Restricted to a group specified by the partners of the ANNETTE project | |
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ABSTRACT:

This deliverable reports on a survey which was performed to investigate the current offer in education and training in nuclear themes and to assess the level of networking and cooperation. It consists of three chapters: 1 - the objectives for WP1, 2 - the methodology of the survey and 3 - the results of the survey. At the end, conclusions are formulated and the main results are summarized in an executive summary.

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| AAHP | American Academy of Health Physics |
| ANNETTE | Advanced Networking for Nuclear Education, Training and Transfer of Expertise |
| CPD | Continuous professional development |
| ECTS | European Credit Transfer System |
| ECVET | European Credit System for Vocational Education and Training |
| EFOMP | European Federation of Organizations in Medical Physics |
| EFTS | Euratom Fission Training Schemes |
| EHRO-N | European Human Resources Observatory for the Nuclear Sector |
| ENEN | European Nuclear Education Network Association |
| ENETRAP | European Network for Education and Training in Radiation Protection |
| EQF | European Qualifications Framework |
| IAEA | International Atomic Energy Agency |
| JRC-IET | Joint Research Centre - Institute for Energy and Transport |
| KSC | Knowledge, skills and competences |
| LO | Learning outcome |
| MoU | Memorandum of Understanding |
| MPE | Medical Physics Expert |
| NES | Nuclear energy sector |
| NJT | Nuclear Job Taxonomy |
| NQF | National qualifications frameworks |
| NSAN NS4P | National Skills Academy for Nuclear Nuclear Skills Passport |
| PETRUS | Programme for Education, Training and Research on Underground Storage |
| RPE | Radiation protection expert |
| RPO | Radiation protection officer |
| TRASNUSAFE | Training Schemes on Nuclear Safety Culture |
| VET | Vocational education and training |

# INTRODUCTION

This deliverable reports on a survey which was performed to investigate the current offer in education and training in nuclear themes and to assess the level of networking and cooperation. The survey has been set up as first action of the ANNETTE project and will provide input for the rest of the project. The deliverable consists of three chapters. In Chapter 1, the objectives for WP1 are shortly mentioned. Chapter 2 explains the methodology of the survey, including details on the design and optimization of the survey, and on the data collection process. The results are discussed in Chapter 3, which is the main chapter of this deliverable. At the end, conclusions are formulated and the main results are summarized in an executive summary. Annex 1 contains the complete set of questions of the survey.

# 1. OBJECTIVES OF ANNETTE WORK PACKAGE 1

The main objective of ANNETTE WP1 is to provide input for the coordination, design and implementation of academic nuclear education and training (E&T) and vocational learning (VET) for professionals involved in dealing with nuclear and radiation protection activities. In particular, following objectives were defined:

- Perform a survey of the state-of-the-art in education and training (E&T) and vocational (VET) learning activities in nuclear topics, highlighting potential duplications and gaps
- Define sustainable and advanced networking mechanisms in nuclear E&T and VET and transfer of expertise
- Study of tools for information exchange, with the aim to define (and implement) the optimal approach supporting advanced network mechanisms
- Exploring the possibility to improve EMSNE diffusion and to promote similar certifications in nuclear areas other than the engineering one
- Proposing quality criteria for evaluating E&T and VET activities
- Performing a survey of available nuclear facilities to support lifelong learning (LLL)

This document describes the results of the survey on academic E&T and VET activities in nuclear topics.

# 2. METHODOLOGY

## 2.1 Design and structure of the survey

### 2.1.1 Design

The survey on E&T and VET in the nuclear fields and the survey on available nuclear facilities to support Lifelong Learning (LLL) were combined into one survey, as agreed during the project kick-off meeting in Pisa on February 9-10, 2016. This document describes the results of the survey on E&T and VET in the nuclear fields. D1.8 summarizes the results on the survey on available nuclear facilities to support Lifelong Learning.

As agreed during the project kick-off meeting in Pisa on February 9-10, 2016, a first draft of the questionnaire was designed by SCK•CEN and distributed to the WP1 partners and WP leaders on February 23, 2016. Feedback was received from ENEN, JRC-ITU, JSI, UL, the JOPRAD project, UU and FuseNet.

The questions about facilities available for life-long learning, related to T1.6 of WP1, were designed by JRC (E. Kassim), task leader. Specifically for the questions about ECVET, feedback was given by EHRO-N.

Most items in the survey were formulated as questions or statements, to which the respondent could select a quantitative answer. For some questions, the respondents were asked to answer using a four point Likert-scale. For instance, the level of importance of certain items was measured on a scale ranging from not important, through less important, important, to very important. The option "no answer" or "I don't know" was allowed in selected questions. The answer categories were adjusted to the context of the statement or question. Free questions were used to allow respondents to provide more information on the given matter. Multiple choice answers were included for selected E&T domains.

### 2.1.2 Structure of the e-survey

The background information of the respondent was included at the beginning of the questionnaire. The respondents could leave their contact details for future communication but it was also possible to complete the survey anonymously. Respondents could indicate if they would like to receive the results of the questionnaire. Data confidentiality was guaranteed by the following disclaimer which was visible below the question related to personal data.

***Disclaimer:*** *The answers you will provide in this survey are being processed by the ANNETTE project partners. Your personal credentials will only be used for the communication of the results of this questionnaire. Your personal data will not be used for commercial purposes or put at the disposal of third parties. You have the right to access your personal data and the right to change them if they are not correct. You have the right to freely object to the further processing of your personal data by a simple request given by means of e-mail to annette.project@sckcen.be.*

If a respondent wanted to interrupt the completion of the survey and continue at a later time, it was possible through an intermediate save.

The main part of the survey initiated with a section containing identification of existing initiatives in E&T and VET in nuclear. Since many initiatives were already described in other projects, reference was asked to these descriptions. Throughout the whole survey a distinction was made between (academic) E&T and (vocational) VET for professionals.

The respondent was asked to select his/her main domain of expertise. At the end of the survey, the respondent was given the opportunity to answer the questions for one or more additional domains. Separate questions were provided for course organizers and end-users.

The survey was subdivided into the following subparts:

1. Introduction
2. General information
3. Profile
4. Existing initiatives in academic education in nuclear
5. Existing vocational training (VET) initiatives in nuclear
6. E-learning

7. Quality assurance in academic and vocational E&T in nuclear
8. Optimization and networking in academic and vocational learning activities
9. (Available nuclear facilities to support lifelong learning (LLL))

An overview of the questions of the survey on E&T and VET in the nuclear fields, including practical instructions for respondents are shown in Annex 1.

## 2.2 Optimization of the survey

### 2.2.1 Testing/pilot study

On March 28, 2016 a first version of the online survey was distributed to the WP1 partners for beta testing. The purpose of the beta testing was to test the technical part of the survey. Comments and suggestions were received from ENEN, JRC-ITU, CIRTEN and UU. This provided an opportunity to identify any problems respondents might have, e.g. technical problems or ambiguity in the content of the questions.

### 2.2.2 Feedback from respondents during the survey on technical issues

Feedback was received from several respondents after the survey was launched online:

- M. Palmu (Posiva, April 15, 2016): technical problems to access the survey.
    - Actions taken: These problems were investigated in detail by the ICT department of SCK•CEN but no solution could be found.
- I. Tiselj (JSI, April 15, 2016): respondent experienced the survey to be too long. After investigation it appeared that the respondent was almost at the end of the survey.
    - Action taken: The progress bar shown at the top of the page was misleading and therefore removed.
- M. Gadomska (EC, April 19, 2016): feedback on order of questions, more specifically on questions about personal details at start of survey.
    - Action taken: As the order of the questions could not be changed anymore after the launch of the survey, the questions related to personal details were made optional on April 20, 2016. Next to that, an overview of the complete survey was added in pdf format to the introductory page of the survey on April 20, 2016 to provide potential respondents with an overview of the complete questionnaire.
- J. Swehn-Gunnar (Swiss Federal Nuclear Safety Inspectorate/ENSI, May 12, 2016): only questions targeting course organizers.
    - Action taken: Analysis of the response of J. Swehn-Gunnar learned that he indicated to be a course organizer. An explanation was provided on how to get access to the questions targeting end-users.

### 2.3 Data collection and analysis

The collection of data was carried out between April 15, 2016 and December 4, 2016.

The partners in WP1 were asked for input to the distribution list of the survey. A list of 28 contacts was put together with input from UU, JSI and UPC. Next to that, the link to the online survey was distributed to all project partners in ANNETTE. The link to the survey was also distributed directly or via contact persons to ENS/Foratom, EHRO-N, ENEN, NUGENIA, ETSON, ENSTTI, CMET, NSAN (UK), ESARDA, EUTERP, BNEN, Alliance, EURADOS, NERIS, EAN and to the projects GENTLE, PETRUS III and ENETRAP III. The main course providers in Sweden were contacted by UU.

Reminder emails were sent out in the period May 4-11, 2016. Respondents that were in the progress of answering but didn't complete were also contacted.

The link to the survey was posted on several websites as well; the ANNETTE project page, the ENEN Association website, the NSAN website and the EUTERP home page. The request to complete the survey was also shared on social media via LinkedIn. Finally, the link to the survey was published in the PETRUS III and EUTERP newsletters.

The data were analyzed using the Feedback Server software present at SCK•CEN. The standard reporting features were used to summarize the data, complemented by the raw data which was analyzed for further information using Excel.

## 3. RESULTS

80 respondents completed the survey during the timeframe of data collection (April 15, 2016 and December 4, 2016). The survey was displayed 1480 times. 197 unvalidated survey entries were registered of persons who started the survey but did not complete it. These unvalidated answers were not taken into consideration.

Given the fact that this survey was publically available and due to the various communication channels, a response rate cannot be determined.

### 3.1 General information of respondents

Figure 1 shows the membership of respondents to organizations in nuclear E&T, with the largest representation of ENEN, ESARDA, NUGENIA and MELODI. 62 respondents are member of one or more of the stated networks. Multiple networks could be selected. 18 respondents (22,5%) did not answer this question.

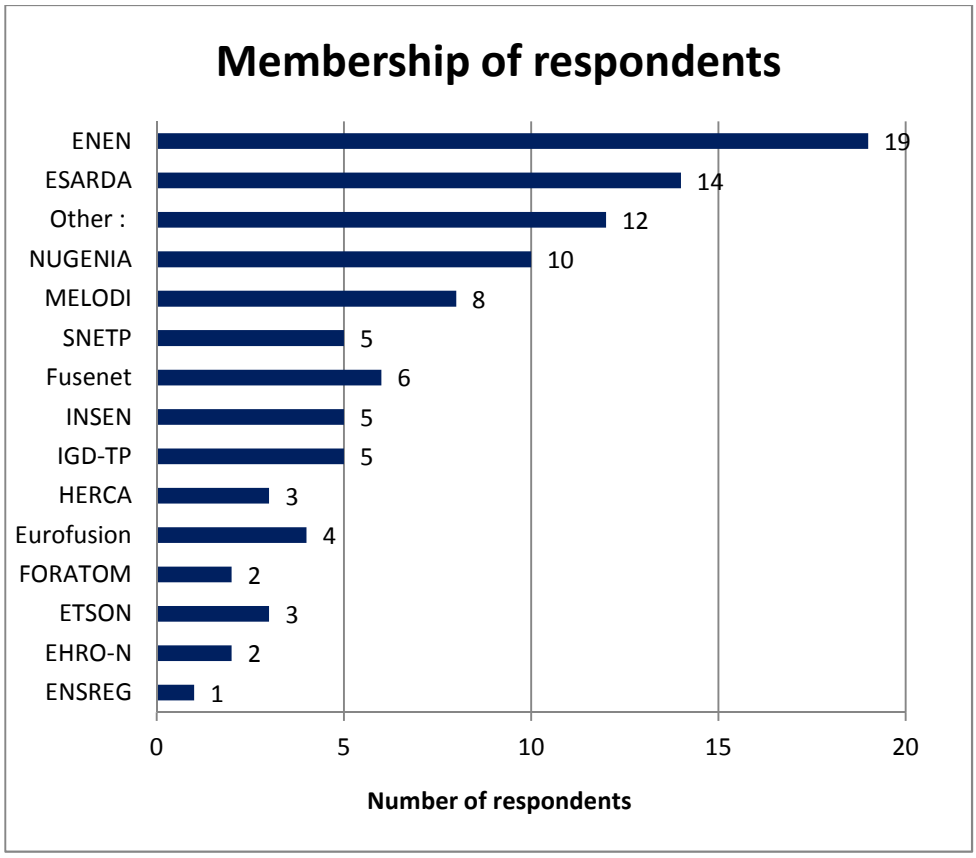



Figure 1: Membership of respondents. More than one option could be selected.

The abbreviations of these networks stand for:

- EHRO-N (European Human Resources Observatory for the Nuclear Sector)
- ENEN (European Nuclear Education Network Association)
- ENSREG (European Nuclear Safety Regulators Group)
- ESARDA (European Safeguards Research & Development Association)
- ETSON (European Technical Safety Organizations Network)
- Eurofusion (European Consortium for the Development of Fusion Energy)
- FORATOM (European Atomic Forum)
- Fusenet (European Fusion Education Network)
- HERCA (Heads of the European Radiological Protection Competent Authorities)
- IGD-TP (Implementing Geological Disposal of Radioactive Waste Technology Platform)
- INSEN (International Nuclear Security Education Network)
- MELODI (Multidisciplinary European Low Dose Initiative)
- NUGENIA (Nuclear GENeration II & III Association)
- SNETP (Sustainable Nuclear Energy Technology Platform)

The following other networks are mentioned:

- ALLIANCE (European Radioecology Alliance)
- CHERNE (Cooperation for higher education on radiological and nuclear engineering)
- EC (European Commission)

- EERRI (Eastern Europe Research Reactor Initiative)
- EFOMP (European Federation of Organisations in Medical Physics)
- ENETRAP (European Network on Education and Training in Radiological Protection)
- EURADOS (European Radiation Dosimetry Group)
- EUTERP (European Training and Education in Radiation Protection Foundation)
- IPEM (Institute of Physics and Engineering in Medicine)
- KIT (Karlsruhe Institute of Technology)
- National Skills Academy for Nuclear, Civil Nuclear Sharing in Growth Programme (University of Sheffield)
- NERIS (European Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery)
- NSAN (National Skills Academy Nuclear)
- NuSaSet (Nuclear Safeguards & Security Education and Training)

Figure 2 shows the country of the respondents. The largest number of respondents originates from United Kingdom (13), Germany (13), Belgium (7) and Spain (8). 21 different nationalities are identified.

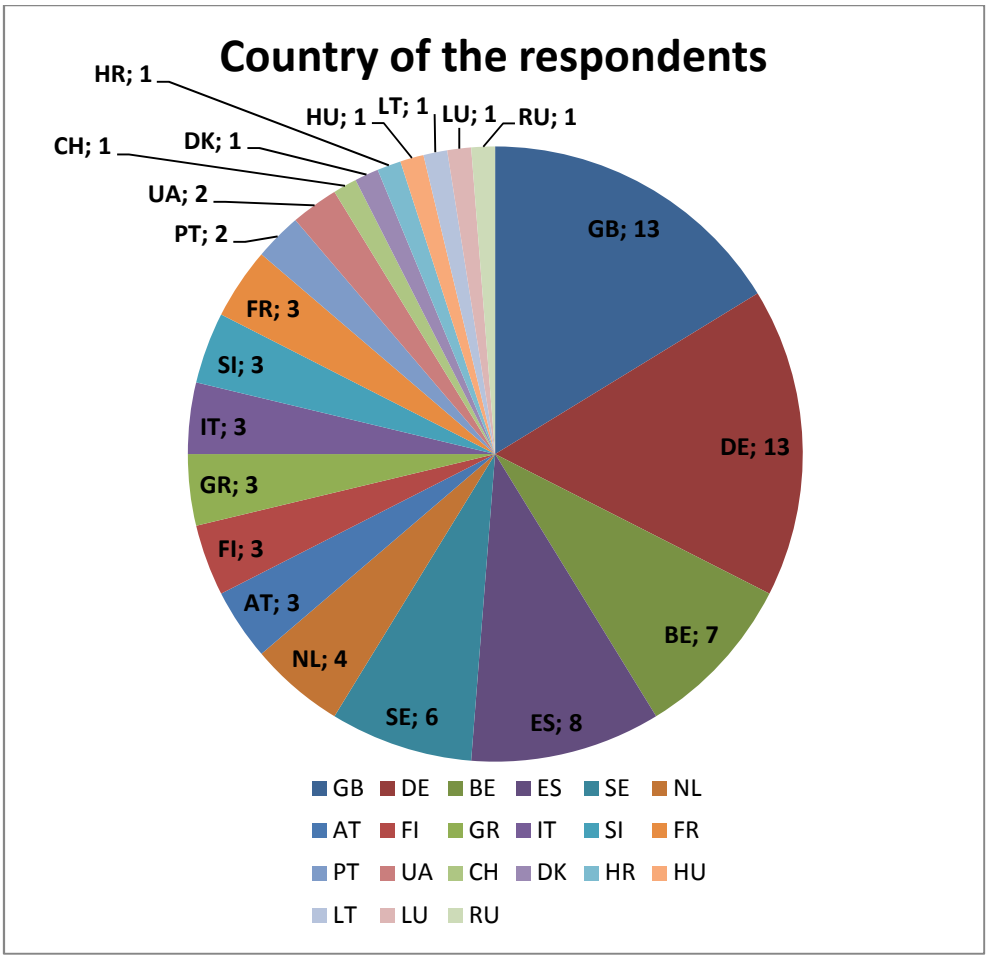



Figure 2: Pie chart showing the country of the respondents.

## 3.2 Professional profile of respondents

52 of the 80 respondents are course organizers, being lecturer (42), responsible for multiple academic E&T programs at a higher education institution (25) or responsible for multiple VET programs at a vocational training provider (10)

37 respondents are end-users of E&T and VET activities in nuclear, as researcher (18), professional in the domain (15), or policy maker (4). It was possible to complete the survey having both identities; end-user, as well as course organizer.

Figure 3 shows the main area in which the organization of the respondent is active. 6 respondents chose to answer the questions for one or more additional domains at the end of the survey. 18 respondents did not indicate a specific domain.

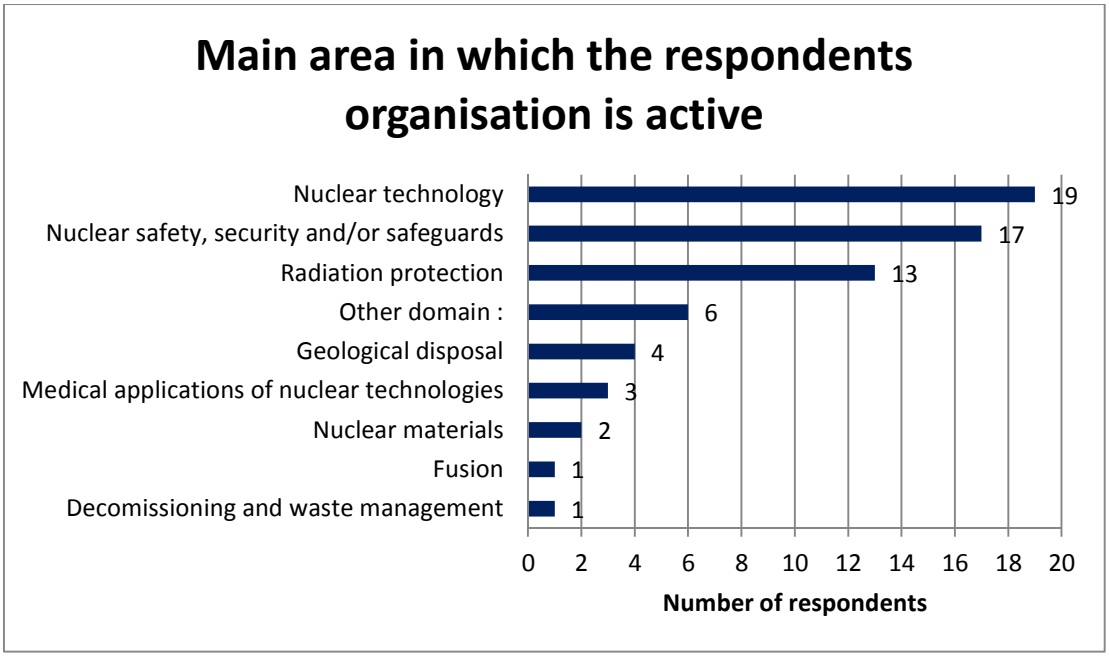



Figure 3: Main area of activity of the organization of the respondents.

Next to the domains shown in Figure 3, other domains are mentioned:

- All of the above
- Nuclear energy production (2)
- Regulatory body
- Nuclear Training
- Fluid mechanics
- Thermodynamics
- Development of standards, rules and programs relating to personnel training and licensing
- Development and maintenance of technical means training including multifunctional computer systems and simulators
- Installation of means for detection/monitoring of fissile materials and physical security upgrades.

The functions of the respondents in their respective organizations are summarized in Figure 4.

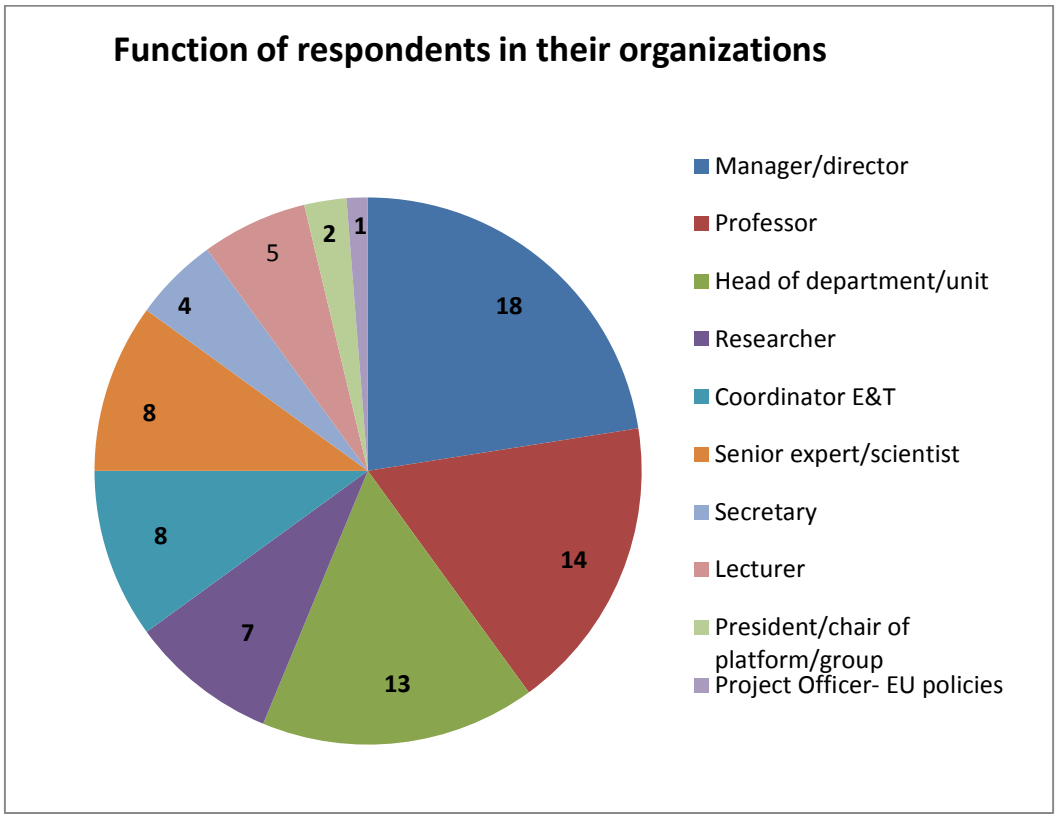



Figure 4: Functions of respondents in their organizations.

### 3.3 Existing academic E&T in nuclear

39 out of 52 course organizers (75%) offer academic courses in their domain. Figure 5 displays the change in interest in higher education over the last 10 years, as experienced by the respondents. No answers are given in the domain of decommissioning and waste. It shows an overall increase in interest in nuclear academic E&T, mainly for nuclear technology. However, in some domains the number of answers is too low to be conclusive.

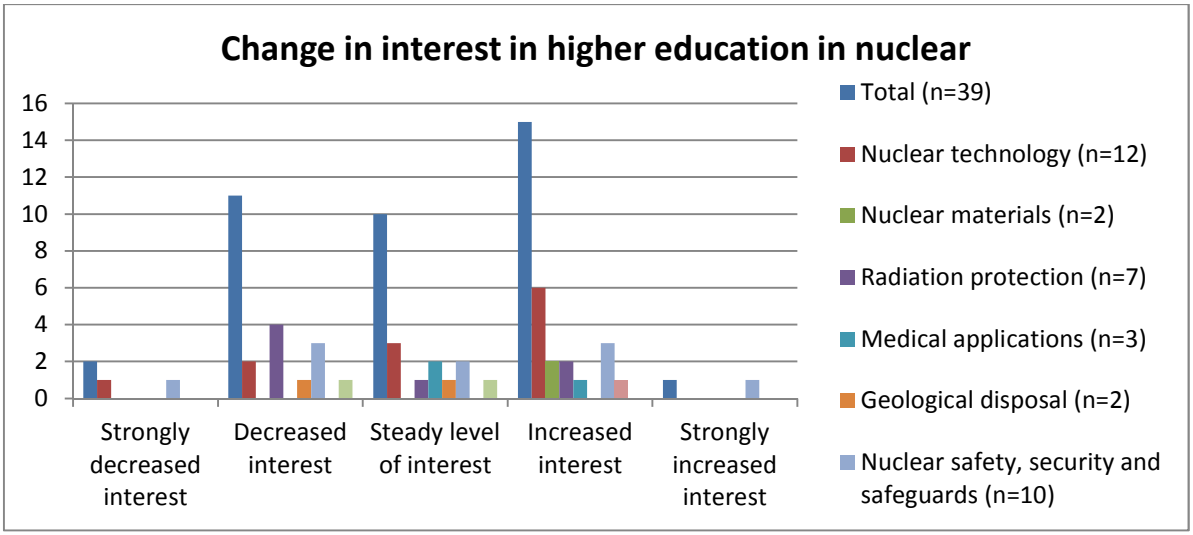



Figure 5: Change in interest in higher education in nuclear. The total statistics are depicted in blue. The other colors show the separate results for the different domains. The total number of answers n is mentioned for each domain.

Assuming one would try to provide an offer in the frame of a future joint programming, all respondents who organize academic courses are interested to participate.

The following topics can be contributed by the respondents (numbers between brackets indicate that answer was given multiple times):

- Nuclear engineering (6) (applied to nuclear power plants operation and research activities related with it)
- Thermal hydraulics: theory, computation, experiments (5)
- Radiation protection (5)
- Nuclear safety (2)
- Radioecology (2)
- Reactor physics (2)
- Safeguards (2) (concepts, methods and technologies)
- Alternative fusion concepts
- Analytical determinations in geological disposal
- Atmospheric radioactivity
- Basic nuclear safety
- Control of a fusion reactor
- Course modules for medical radiation physicists in radiology
- Emergency management
- Environmental radiochemistry
- Environmental impact
- Environmental radioactivity
- Environmental radioactivity waste management from non-nuclear sectors
- Fundamental physics applied and applicable to nuclear instrumentation, specific for gamma spectroscopy and alpha spectroscopy.
- Fusion on the back of an envelope
- Geological disposal
- Hands-on assignments in research projects
- Heating and diagnostics in nuclear fusion

- Horizontal subjects related to legislation, public perception of radiation protection and ethics of radioactive waste management
- Human Factors
- Innovative tools for radiological impact assessment in natural and semi-natural ecosystem
- LWR/VVER fuel optimization
- Magnetic confinement and MHD
- Materials in fusion
- Metrological and statistical aspects of safeguards verification data evaluation (non-destructive assay, destructive analysis and environmental sampling data).
- Modeling of nuclear reactors
- Nanomaterials for nuclear applications
- NORM waste
- Nuclear accident analysis
- Nuclear fuel and fuel cycle safety
- Nuclear fusion technology
- Nuclear instrumentation technology
- Nuclear material
- Nuclear physics
- Nuclear power plants
- Nuclear waste management
- Operational experience of nuclear reactors
- Physics of nuclear reactors
- Practical exercises at nuclear reactor
- Practical sessions in laboratories
- Procedures on how to use radioactive materials in research and medical labs
- Project management
- Probabilistic Safety Assessment
- Quality control and quality assurance in real world gamma spectroscopy
- Radiation protection and dosimetry of diagnostic and interventional radiology
- Radiation protection in the medical field
- Radiation protection of the environment and monitoring
- Radioactive waste management in general
- Radionuclide dispersion in the marine environment
- Radioprotection and dosimetry
- Reactor design and analysis
- Reactor kinetics
- Remote radiological impact assessment in the marine environment (satellite observations conjoint to real measurements)
- Routine environmental radioactivity monitoring
- Safety Assessment
- Safety case
- Safety culture
- Safety requirements
- Spent sealed sources management in the industry and in the medical sector
- Technological research: Provision of advanced scientific services in the domain of environmental quality assessment
- Thermodynamics

- Use of models for radiological impact on non-humans in the terrestrial environment
- Waste management and disposal.

Some respondents also provide information on the various teaching methodologies and tools they use to bring these topics, such as web-based courses combining on-site students and off-site students using an innovative pedagogical approach relying on flipped classroom, on-line quizzes, just-in-time teaching.

Others include details on the level of training they provide, going from awareness training at various levels to post-graduate level training.

18 (46%) respondents state that their academic education initiatives are listed in an online database. The online resources which provide information on these academic E&T initiatives are:

- http://130.88.20.21/uknuclear/index.php/courses
- http://bnen.sckcen.be
- http://eacea.ec.europa.eu/LLp/project_reports/documents/erasmus/CD/ECDCE/era_ecdce_518403_fr.pdf
- http://en.uniroma1.it/study-us/courses-and-programmes/second-single-cycle-programmes/english/energy-engineering
- http://enetrap3.sckcen.be/
- http://nuclearsecuritymatters.belfercenter.org/best-practices-and-training
- http://pearsonvue.com/about/release/14_3_17_wins.asp
- http://www.canberra.com/training/
- http://www.cumbria.ac.uk/Public/HWSCS/Documents/Courses/NuclearSecurityManagementCourseLeafletCaCHeT.pdf
- http://www.demokritos.gr
- http://www.din.upm.es
- http://www.enen-assoc.org/en/home/database.html
- http://www.etsii.upm.es/estudios/masteres/tecnologia_nuclear.es.htm
- http://www.fusenet.eu/coursesearch?title=&field_fusenet_member_list_value=member02
- http://www.i2en.fr/
- http://www.ipta.demokritos.gr/erl/erl.html
- http://www.mech.ntua.gr/en/studies/ugrads/studyguide/ME_EN-2013-2014.pdf
- http://www.nti.org/about/projects/wins/
- http://www.sts-nuclear.com/training-education
- http://www.uclouvain.be/prog-2014-gnuc2mc
- https://nuclearedu cationdb.org/
- https://www.iaea.org/newscenter/news/nuclear-security-gets-boost-initiative-aimed-private-sector
- https://www.wins.org/
- www.cherne@ntua.gr

18 of the 39 academic education initiatives (46%) are jointly organized or are organized in the framework of a project. The involved organizations or projects are:

- BNEN (Belgian Nuclear higher Education Network)
- Eindhoven University of Technology
- EMINE (European Master in Nuclear Energy)
- ENEN (European Nuclear Education Network Association)
- ENETRAP III (European Network on Education and Training in Radiological Protection)
- ENTECH (Master in energy technology)
- ESARDA (European SAFeguards Research and Development Association)
- GENTLE (Graduate and Executive Nuclear Training and Lifelong Education)
- Grenoble inp / Phelma
- IAEA - SGIM (Safeguards Division of Information Management)
- Imperial College London
- Master in Nuclear Science and Technology
- Master on Analytical Chemistry
- National Centre for Scientific Research "Demokritos"
- National Technical University of Athens Diploma of Mechanical Engineering
- Theoretical grounds for VVER-1000 operation with a minimal probability of accumulation of the fuel element cladding damage
- WINS Academy

7 of these academic education initiatives are organized on national level, 2 on regional level and 8 on European level.

### 3.4 Existing vocational (VET) initiatives in nuclear

18 out of 52 course organizers (35%) offer vocational (VET) initiatives in their respective domain. Figure 6 displays the change in the number of participants in their training courses over the last 10 years. An overall increased participation level is observed for VET activities in nuclear. However, in some domains the number of answers is too low to be conclusive. No answers are given in the domains of decommissioning and waste, nuclear materials and fusion.

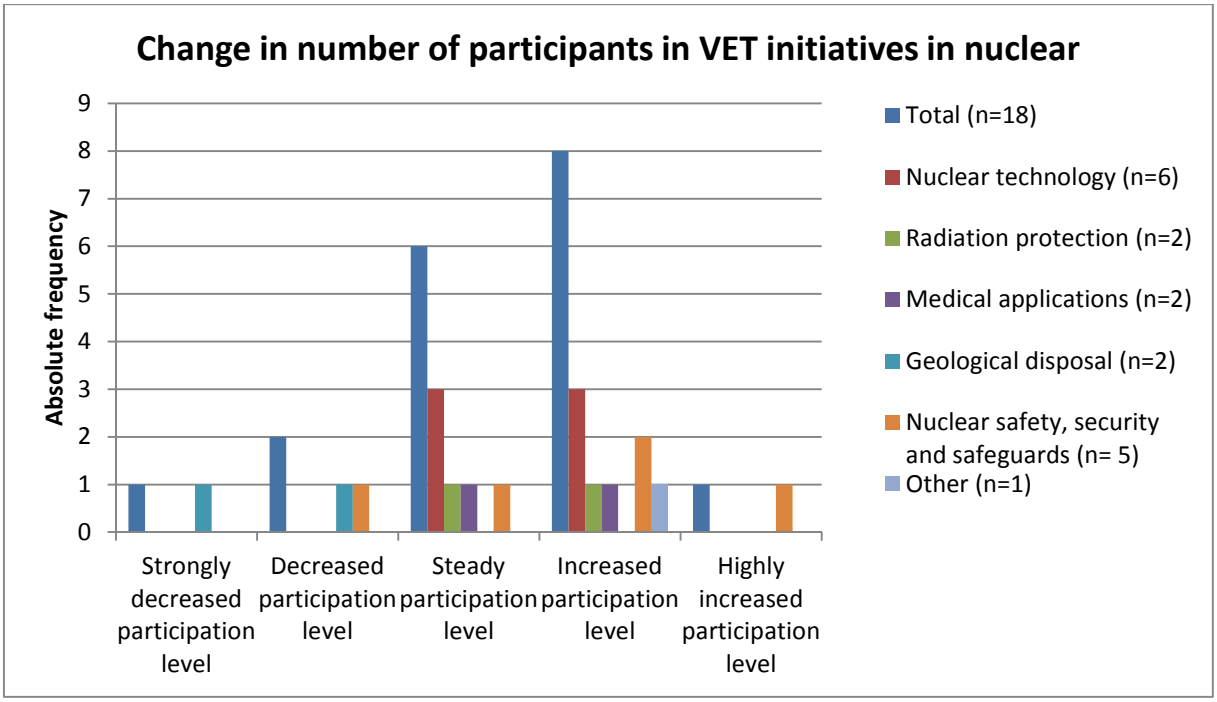



Figure 6: Change in number of participants in VET initiatives in nuclear. The total statistics are depicted in blue. The other colors show the separate results for the different domains. The total number of answers n is mentioned for each domain.

As was the case for academic course providers, a unanimous willingness to participate to a future joint programming is observed for the VET training providers.

The following topics can be contributed by the respondents:

- Nuclear engineering (3) (and design)
- Human Performance (2)
- Cladding failure in VVERs.
- Course modules for medical physics experts in radiology
- Environmental radioactivity
- Horizontal subjects related to legislation, public perception of radiation protection and ethics of radioactive waste management
- Nuclear quality.
- Leadership development
- Metrological and statistical aspects of safeguards verification data evaluation (non-destructive assay, destructive analysis and environmental sampling data)
- NORM waste
- Nuclear accident analysis
- Nuclear materials
- Nuclear physics related to nuclear instrumentation
- Nuclear power plant operation
- Nuclear safety
- Nuclear security
- Nuclear thermal hydraulics
- Operations management
- Physical protection

- Polymer degradation and ageing management (cables, seals etc.)
- Procedures on how to use radioactive materials in research and medical labs
- Quality assurance and quality control in real world gamma and alpha spectroscopy
- Radiation protection
- Radiation protection in the medical field
- Radiation protection/dosimetry of diagnostic radiology and interventional radiology
- Radioactive waste management
- Reactor physics
- Safety culture
- Spent sealed sources management in the industry and in the medical sector
- Waste management from non-nuclear sectors.

Also here, some respondents elaborate on the teaching methodology, such as a blended approach and online training.

7 of the 18 training providers of vocational training state that their VET initiatives are listed in an online database. The online resources which provide information on the VET initiatives are:

- http://c2tn.tecnico.ulisboa.pt/en/
- http://eacea.ec.europa.eu/LLp/project_reports/documents/erasmus/CD/ECDCE/era_ecdce_518403_fr.pdf
- http://enetrap3.sckcen.be/
- http://nuclearsecuritymatters.belfercenter.org/best-practices-and-training
- http://pearsonvue.com/about/release/14_3_17_wins.asp
- http://www.canberra.com/training/
- http://www.cumbria.ac.uk/Public/HWSCS/Documents/Courses/NuclearSecurityManagementCourseLeafletCaCHeT.pdf
- http://www.enen-assoc.org/
- http://www.enen-assoc.org/en/training/petrus-iii.html
- http://www.mech.ntua.gr/en/studies/ugrads/studyguide/ME_EN-2013-2014.pdf
- http://www.nti.org/about/projects/wins/
- http://www.sts-nuclear.com/training-education
- https://www.iaea.org/newscenter/news/nuclear-security-gets-boost-initiative-aimed-private-sector
- https://www.ns4p-system.co.uk/TrainingDirectory/#/trainingProviderProfile
- https://www.nsan.co.uk/news/skills-nuclear-manufacturing
- https://www.nsan.co.uk/providers/nuclear-and-manufacturing-excellence-ltd
- https://www.wins.org/

33% of the VET initiatives are jointly organized or are organized in the framework of a project. The involved organizations or projects are:

- ENEN (European Master in Nuclear Energy)
- ENETRAP III (European Network on Education and Training in Radiological Protection)
- EUSECTRA (European Nuclear Security Training Centre)
- NTUA (National Technical University of Athens - Diploma in Mechanical Engineering)
- SGIM – IAEA (Department of Safeguards - International Atomic Energy Agency)
- WINS Academy.

When developing vocational learning initiatives, several criteria are rated in importance using a scale from 1 to 4, where 1 corresponds to not important and 4 corresponds to very important. Figure 7 shows that the availability of the trainers' competence is deemed the most important, and that least importance is given to the feasibility to implement the training into e-learning.

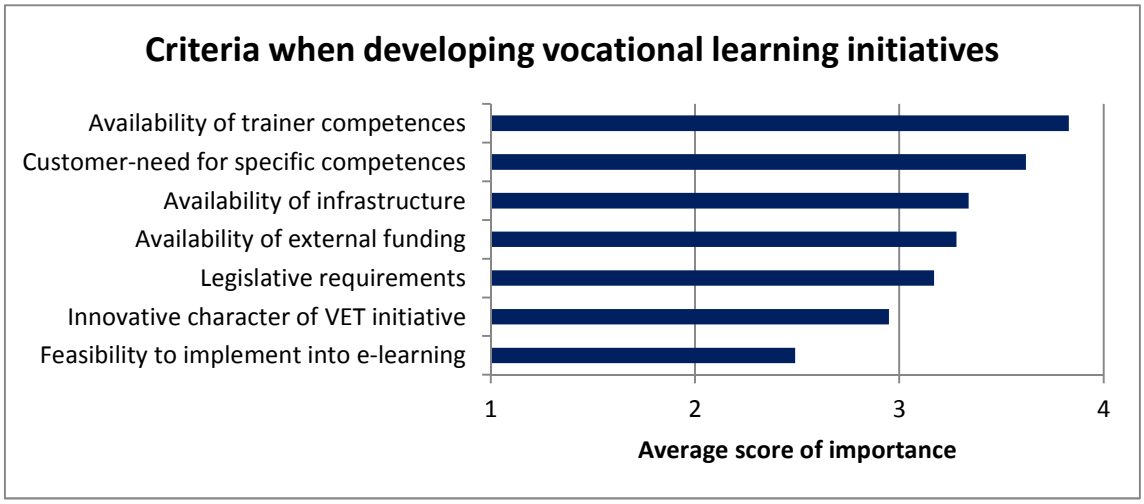



Figure 7: Relative importance of criteria when developing vocational learning initiatives, according to the course organizers of vocational learning initiatives. The horizontal axis shows the average score of importance, where 1 corresponds to not important and 4 corresponds to very important.

### 3.5 Implementation of the ECVET system

None of the VET training providers state that the ECVET system is fully implemented. Only one of the training providers indicates that the ECVET system is partially implemented, while 8 VET training providers (44%) state to have the ambition to implement the ECVET system, and 9 (50%) state that the implementation of ECVET is not planned.

The only training provider with a partial ECVET implementation has implemented the following technical components of the ECVET system:

Designing qualifications

- Qualification designed using the dedicated template which was developed by JRC-IET (see Figure 8)
- Units of learning outcomes (content and structure of qualifications)

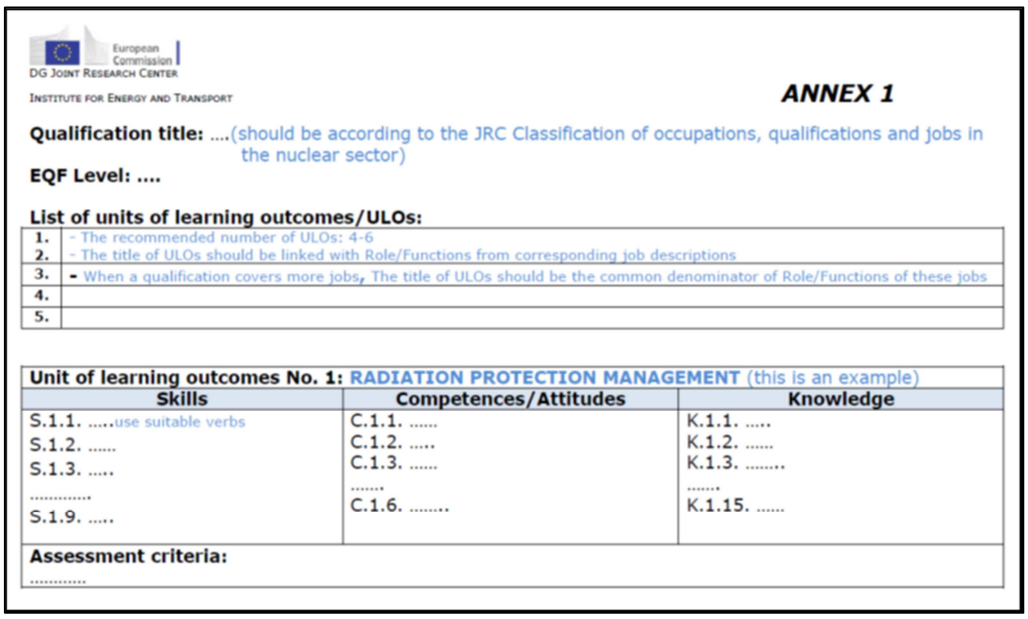
Designing learning outcomes

- Definition of learning outcomes according to Knowledge, Skills and Competences
- Assessment of learning outcomes
- Validation of learning outcomes
- Recognition of learning outcomes

Agreements

- Learning agreement
- Learners' transcript of record (individual achievement)

For this training provider, the qualifications are not linked to a specific job description from the Nuclear Job Taxonomy, as this organization is not aware of the Nuclear Job Taxonomy as developed by JRC-IET. Also, credit points (relative weight unit relative to the size of the qualification) are not attributed to these qualifications, and a memorandum of understanding (as a partnership between the training provider and the requesting organization) is not implemented.



European Commission
DG Joint Research Center
Institute for Energy and Transport

**ANNEX 1**

**Qualification title:** ....(should be according to the JRC Classification of occupations, qualifications and jobs in the nuclear sector)

**EQF Level:** ....

**List of units of learning outcomes/ULOs:**

| | |
|---|---|
| 1. | - The recommended number of ULOs: 4-6 |
| 2. | - The title of ULOs should be linked with Role/Functions from corresponding job descriptions |
| 3. | - When a qualification covers more jobs, The title of ULOs should be the common denominator of Role/Functions of these jobs |
| 4. | |
| 5. | |

**Unit of learning outcomes No. 1:** RADIATION PROTECTION MANAGEMENT (this is an example)

| Skills | Competences/Attitudes | Knowledge |
|---|---|---|
| S.1.1. .....use suitable verbs<br>S.1.2. .....<br>S.1.3. .....<br>.....<br>S.1.9. ..... | C.1.1. .....<br>C.1.2. .....<br>C.1.3. .....<br>.....<br>C.1.6. ..... | K.1.1. .....<br>K.1.2. .....<br>K.1.3. .....<br>.....<br>K.1.15. ..... |

**Assessment criteria:**
.....

Figure 8: Dedicated template for qualification design, developed by JRC-IET.

All training providers have rated the technical components to be developed in the ECVET system according to the perceived level of difficulty. Figure 9 provides the average score of difficulty of each of the components to be developed in agreements (red), learning outcomes (green) and qualification design (blue). In the first category, the memorandum of understanding seems most difficult to implement. Validation and recognition of learning outcomes are perceived to be rather difficult to implement whereas defining the learning outcomes according to the knowledge, skills and competences seem rather easy.

Although the majority of components of the ECVET system is perceived to be relatively easy to implement according to the results in Figure 9, almost no effective implementation of the ECVET system is observed currently.

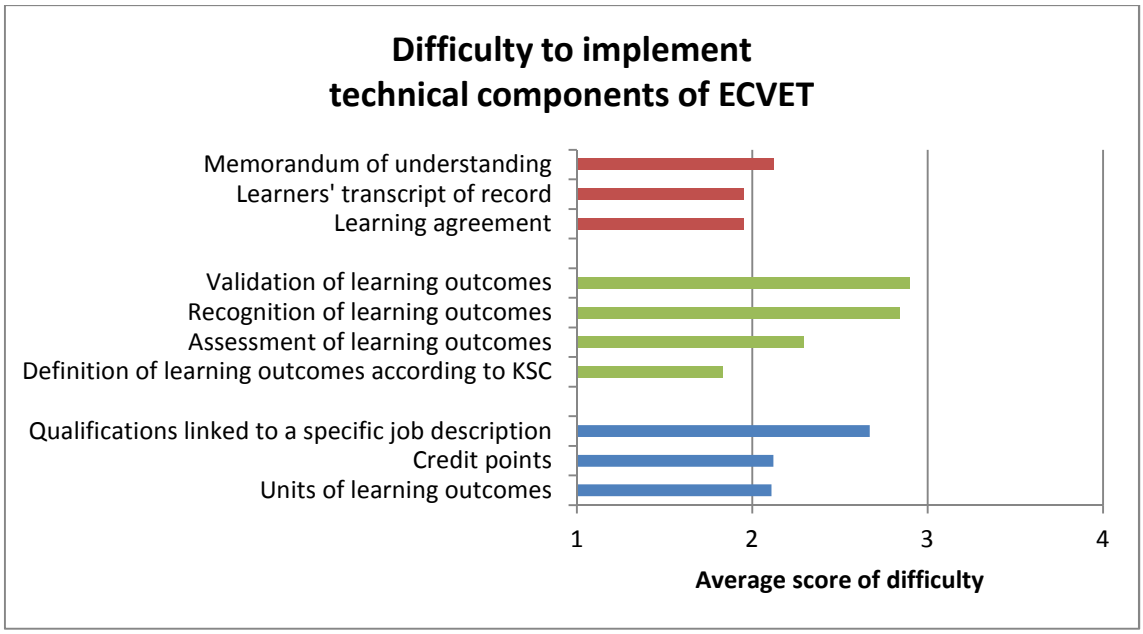



Figure 9: Difficulty to implement ECVET technical components related to agreements (red), learning outcomes (green) and qualification design (blue). The horizontal axis shows the average score of difficulty, where 1 corresponds to not difficult and 4 corresponds to very difficult.

With respect to the qualification design, EFOMP created a board to declare credit points for medical physics experts. It is not a tradition in the medical field to use the ECVET system, according to one respondent.

The following aspects are deemed essential to implement ECVET, according to the VET training providers who did not implement ECVET (yet):

- Commitment from all parties (interest and support) (13; 33%)
- Legislative and regulatory framework (recognition) (8; 21%)
- Learning outcomes approach (assessment, validation, recognition, units) (8; 21%)
- ECVET added value (5; 13%)
- Qualification frameworks (3; 8%).

2 respondents indicate other reasons that are necessary to implement the ECVET system:

- *ECVET was deemed not applicable for the training for medical physics experts, since the training is performed at EQF level 8.*
- *Funding and extra administrative work.*

Figure 10 shows where the VET training providers see the most added value in implementing the ECVET system. All mentioned aspects are deemed almost equal in usefulness, where transparency of qualifications seems most useful. The transparency is also repeated in the individual comments of the respondents.

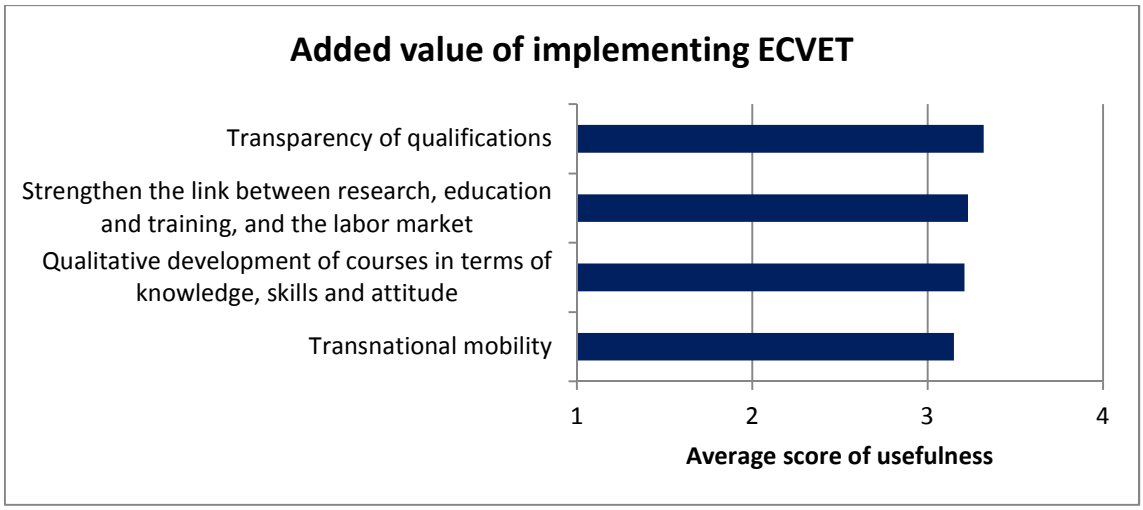



Figure 10: Added value of implementing the ECVET system in vocational learning initiatives. The horizontal axis shows the average score of usefulness, where 1 corresponds to not useful and 4 corresponds to very useful.

15 of the 18 VET training providers (83%) see benefit in linking ECTS to ECVET. The following approaches are proposed by the respondents:

- *EFOMP has a document that lists KSC. That document could be completed with ECVET, but the medical community may not want to do so. So we would need a person convincing us.*
- *Have recognition of points relevant to both.*
- *Harmonization of educational/training metrics.*
- *As close as possible 1:1.*
- *1 ECTS = ECVET.*

One of the respondents that did not see benefit in linking ECTS to ECVET, states that this is currently not a requirement from any of the customers.

The following suggestions are made to involve major stakeholders (in particular nuclear regulatory bodies) in the implementation of ECVET:

- Face-to-face meetings (9; 50%)
- Organizing customized seminars/workshops for interested stakeholders (7; 39%)

Two other suggestions are made:

- *An EC funded project covering radiation protection training for all people using radiation in the hospital may be of help.*
- *Presence at conference.*

12 respondents (67%) state that other credit systems apply to their vocational initiatives, such as the NSAN NS4P credit system, Fit4Nuclear, AAHP Continuing Education Credits system (USA), EFOMP CPD accreditation and certifications delivered by the IAEA.

Only 3 VET training providers (16%) indicate that there is a certification from a governmental institute for their vocational learning initiatives. AAHP Continuing Education Credits system is mentioned, as well as IAEA and the national implementation of the ECVET program in Portugal.

### 3.6 E-learning

25% (13 of the 52 respondents) of the course organizers indicate to offer online learning activities. 25 (48%) course organizers do not offer online courses, but have the ambition to develop this in the future. The remaining 14 (27%) do not plan to develop online learning activities in the future.

The following types of online learning activities are provided:

- Video lecture (7; 32%)
- MOOC (Massive Open Online Course) (3; 14%)
- Animations (3; 14%)
- E-books (2; 9%)
- PODcast (1; 5%).

No online training providers state to offer serious games or virtual reality activities. Other online activities which are mentioned by individual comments are: *Moodle (3), online computer simulation activities, powerpoints, eLearning via Pearson online learning platform, Adobe Connect.*

Figure 11 displays different aspects which are identified to inhibit the development of online learning activities, mentioning an average score of inhibition. Funding is indicated to be the major factor that inhibits the development of e-learning activities, whereas a lack of technical competence or the limited evaluation possibilities do not seem to be very inhibiting.

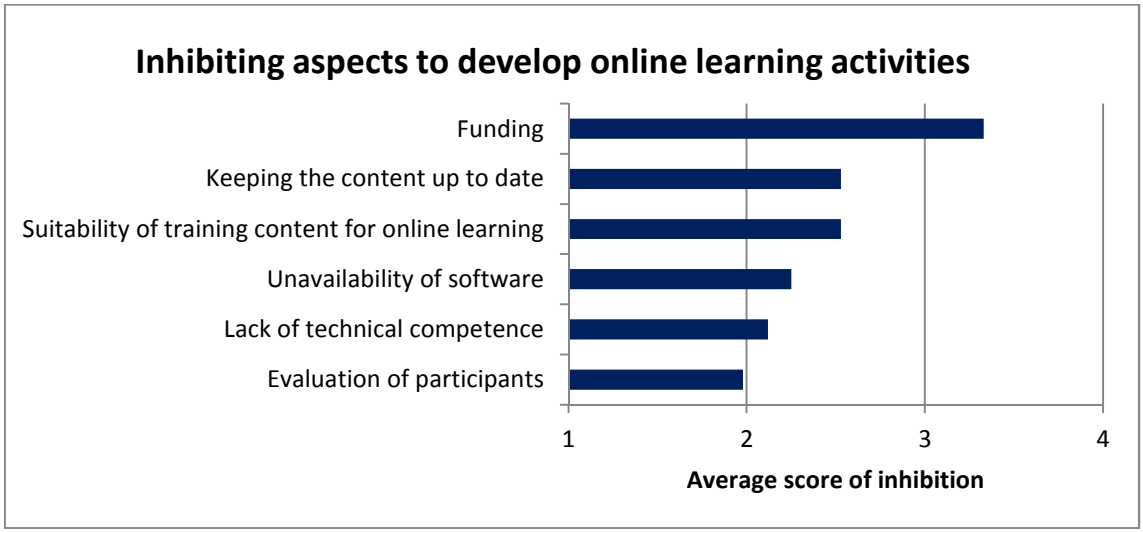



Figure 11: Aspects that could inhibit course organizers to develop online learning activities. The horizontal axis shows an average score of inhibition, where 1 corresponds to not inhibiting and 4 corresponds to very inhibiting.

Other factors which are mentioned in individual comments, are:

- *Lack of time (3)*
- *Lack of manpower (2)*
- *Lack of training for lecturers (2)*
- *Convincing the full staff of teachers to make the effort of going online with lectures.*
- *Lack of financial resources.*
- *Non recognition by the specific recognition bodies and certificate without practical value.*

Several comments relate to the concept of online-learning in relation with face-to-face training:

- *Face-to-face lectures in a classroom are completely different to online courses.*
- *I believe that the primary requirement within the industry relates to behavioral change: There is too much focus on 'tick-in-the-box' initiatives which get people pieces of paper but do not successfully change the industry behaviors. Face-to-face training, with the ability to adapt and be proactive with the audience is very important in my view.*
- *Exercises are needed in several disciplines; important to have this with personal exchange.*

Two comments are related to the technical support:

- *Harmonization of set-ups is important, technical support should allow not deviating from focus by lectures on contents itself.*
- *The university has a technical department ready to help in the development of online learning courses.*

### 3.7 End-users

End-users of academic learning initiatives were asked to rate the relative importance of criteria when searching for academic learning initiatives. 30 out of the 37 end-users answered this question, and are assumed to be end-user of academic learning initiatives. Figure 12 displays these criteria using an average score of importance, where 1 corresponds to not important and 4 corresponds to very important. The practical applicability seems to be the most important aspect when end-users search for academic learning initiatives. In terms of accessibility the cost of the E&T activity seems to be a major factor. For certification and accreditation, a certification by a competent authority seems most important.

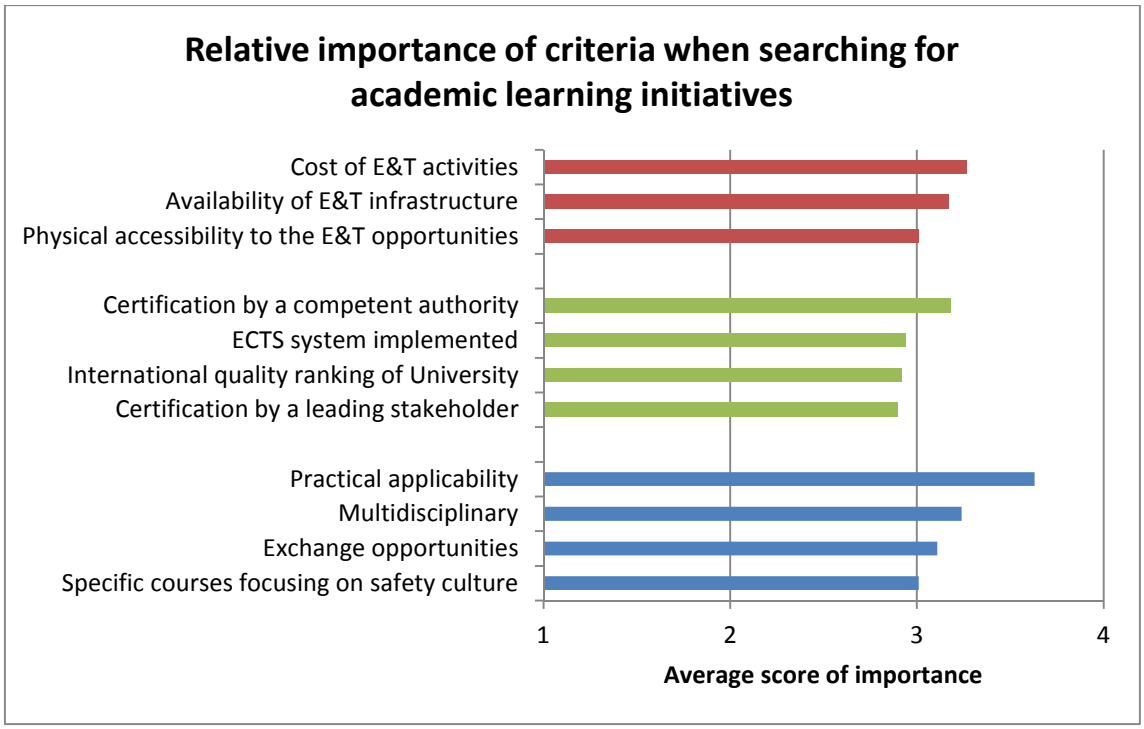



Figure 12: Relative importance of criteria when searching for academic learning, related to accessibility (red), certification and accreditation (green) and content and E&T approach (blue), as rated by end-users. The horizontal axis shows the average score of importance, where 1 corresponds to not important and 4 corresponds to very important.

The following individual comments are formulated:

- *I see all of these as being important, so it was a little hard to differentiate between them. In an ideal world, they would all be "very important". That said, I have highlighted multidisciplinary knowledge/skills, certification, and labs/infrastructure because I believe these are critical areas in the nuclear industry.*
- *Cost is dependent on level of a course:*
    - *If basic training, should be fairly cheap, major role for remote initiatives*
    - *If advanced course, probably some employer may contribute to cost; access to facilities/codes/experienced people is primordial.*
- *Availability of concrete "in the field" expertise, and multidisciplinary aspects are key.*
- *Academic learning initiatives need to have a strong connection to the real world and to the real problems in need of solutions, therefore, involvement with recognized institutions in the field, besides academia, it is of paramount importance. Students must see in the involvement in E&T activities, applications of the knowledge received in future jobs and research. For the tutors, it is also important to contribute to develop future workers with skills and competences that are disappearing now and in urgent need to be reinforced. The ECTS system is very important but the implementation of the ECVET system is fundamental for the future work market.*

End-users of VET initiatives were asked a similar question of which Figure 13 shows the results. A total of 19 respondents of the 37 end-users answered this question, and are assumed to be end-user of vocational learning initiatives. As is the case with academic learning activities, the practical applicability seems to be the most important aspect when end-users search for vocational learning initiatives. In terms of accessibility the cost seems to be an important factor. For certification and accreditation, a certification by a competent authority seems most important, as is the case in academic learning initiatives. In terms of approach to E&T, continuing professional development courses (CPD) rather than basic training courses are important, as well as exchange opportunities, next to the practical applicability.

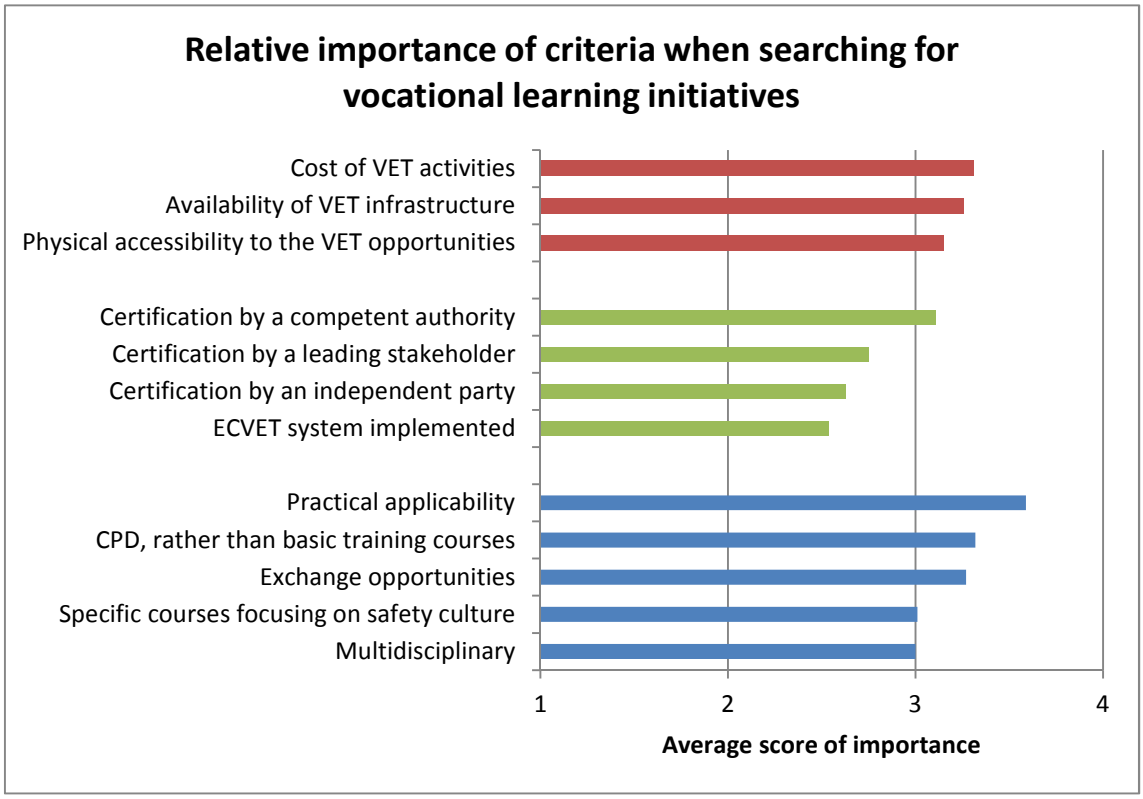



Figure 13: Importance of criteria when searching for vocational learning initiatives related to accessibility (red), certification and accreditation (green) and content & E&T approach (blue), as rated by end-users. The horizontal axis shows the average score of importance, where 1 corresponds to not important and 4 corresponds to very important.

All end-users were asked to indicate in which domain their organization is attending courses, either organized by a university or organized by a professional training provider. The results are summarized in Figure 14. End-users indicate that courses are most difficult to find in decommissioning and waste, geological disposal and nuclear safety, security and safeguards. Currently, courses in nuclear technology and fusion are mainly attended at universities, while courses in nuclear safety, security and safeguards are attended mainly at professional training providers. Courses in other domains are spread almost equally over university and professional training providers.

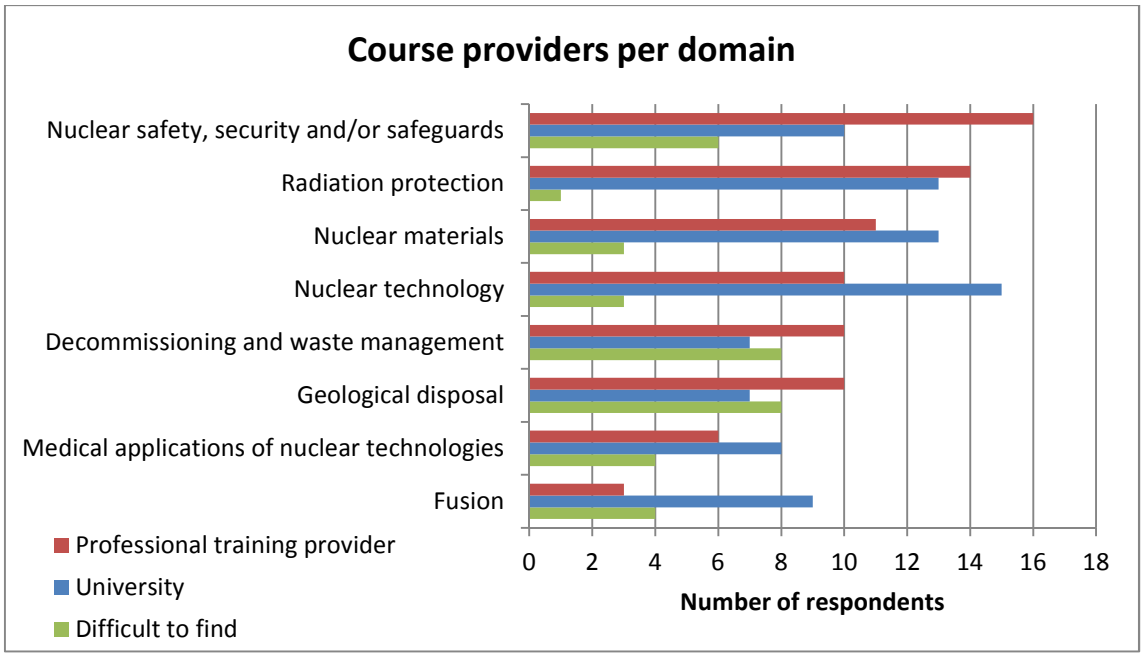



Figure 14: Overview of courses that are attended by the organizations of end-users, per domain. Courses organized by universities are shown in blue, while professional training courses are shown in red. Green bars represent specific courses that are difficult to find.

Only two of the end-users (5%) are currently in need of a specific course that is not available in their opinion. The details of these courses are summarized in Table 1.

Table 1: Details of courses that are needed by end-users but currently not available (in their opinion).

| | | |
|---|---|---|
| **Topic** | Social issues, communication, safety culture and ethics in radiological protection and waste management | Nuclear Decommissioning |
| **EQF level** | Level 7 (Master or postgraduate equivalent) | Level 7 (Master or postgraduate equivalent) |
| **Preferentially organized by** | University | Professional training provider |
| **Target audience** | Qualified students for the medical and industrial sectors. | All stakeholders in the nuclear field. |
| **Comment** | Courses should involve universities, professional E&T organizations and other stakeholders and should provide the student with the tools needed to increase mobility among EU. | / |

### 3.8 Quality assurance in academic and vocational learning in nuclear

Respondents were asked to indicate which measures are taken currently to assure the quality of their academic and vocational learning initiatives. The results are shown in Figure 15. The following differences are observed between academic and vocational E&T:

- Aspects of documentation and archiving seem to be more present in VET, whereas a learning management system is more frequently implemented in academic E&T.
- Course providers seem more to be evaluated, internally as well as externally in academic E&T.
- The evaluation of the learning activity at higher levels seems to be more present in VET initiatives.
- The evaluation of the lecturer/trainer in VET initiatives seems mainly focused on the validation of professional experience in the topic, and the requirement to follow a train-the-trainer, whereas in academic learning a didactic degree is required and external assessment is more present.

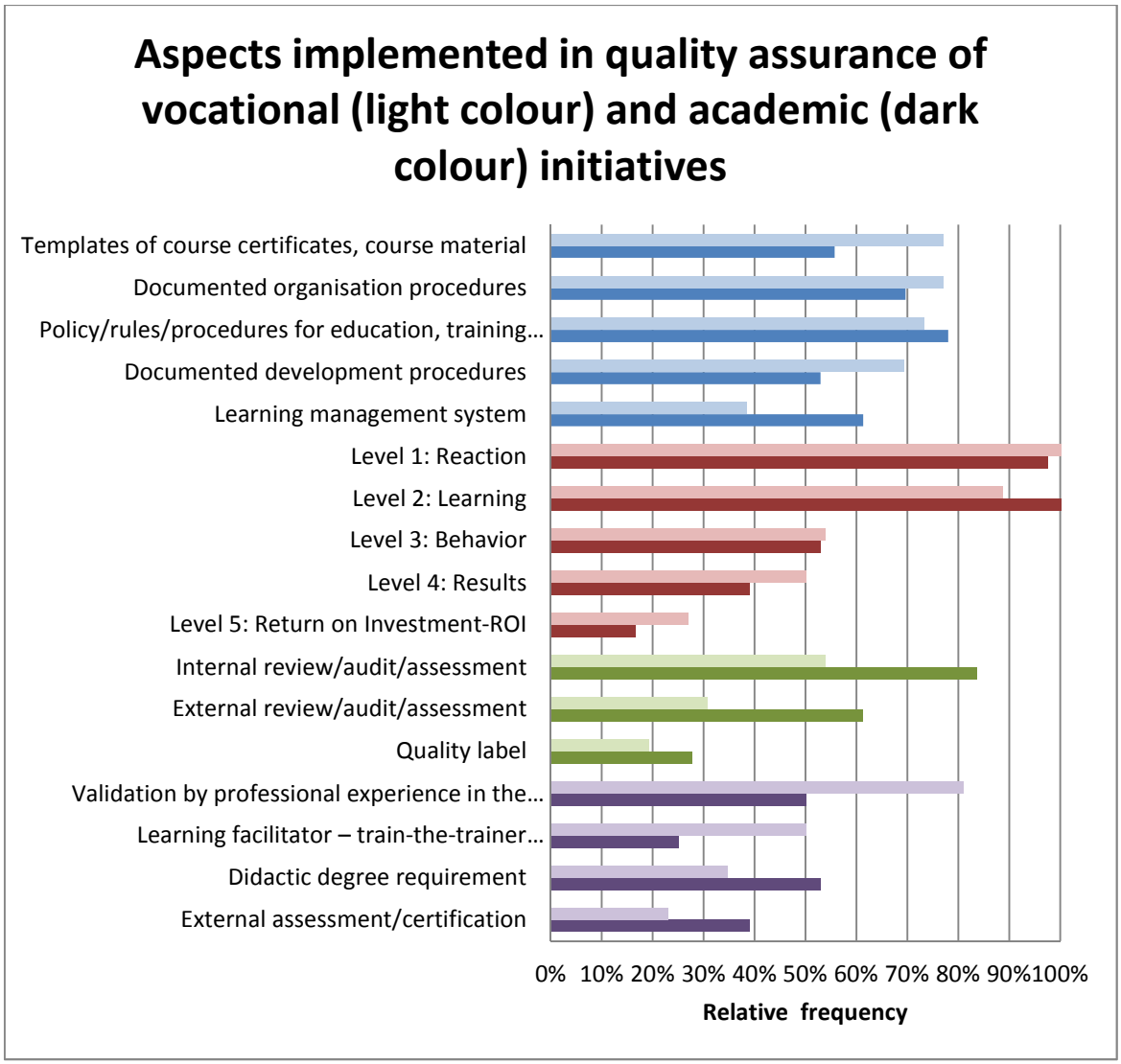



Figure 15: Quality assurance items present in vocational (light color) and academic (dark color) initiatives. Items are grouped in four categories i.e. documentation and archiving (blue), course evaluation (red), independent evaluation of course provider (green) and evaluation of lecturer (purple).

The following quality labels are mentioned by the respondents:

- *National Agency for Quality in Education*
- *NSAN High Quality Training Provider*
- *ISO 9001 and ISO 29990 certifications*
- *AAHP Continuing Education Credits*
- *European Institute of Innovation and Technology for Master EMINE*
- *CTI*
- *VLIR*
- *By recognized national bodies*
- *Dutch-Flemish Academic Accreditation Body NVAO*

Next to the quality assurance items in Figure 15, other measures are currently taken to assure the quality of the learning initiatives:

- *Web conference with an educational support team, project coordinator and the module leaders. Aim: to discuss the participant surveys and the feedback of the module leaders.*
- *3 monthly meetings with the consortium to discuss different aspects of the total project.*
- *Educational workshops organized at that point in time.*
- *Outline of the modules, assessment, etc... reviewed by an educational support team that then interacts with the teachers.*

Respondents judge all four categories to be almost equally relevant to enhance the quality of their courses, as shown in Figure 16, with course evaluation pointed out as being most relevant. No significant differences exist between vocational and academic learning.

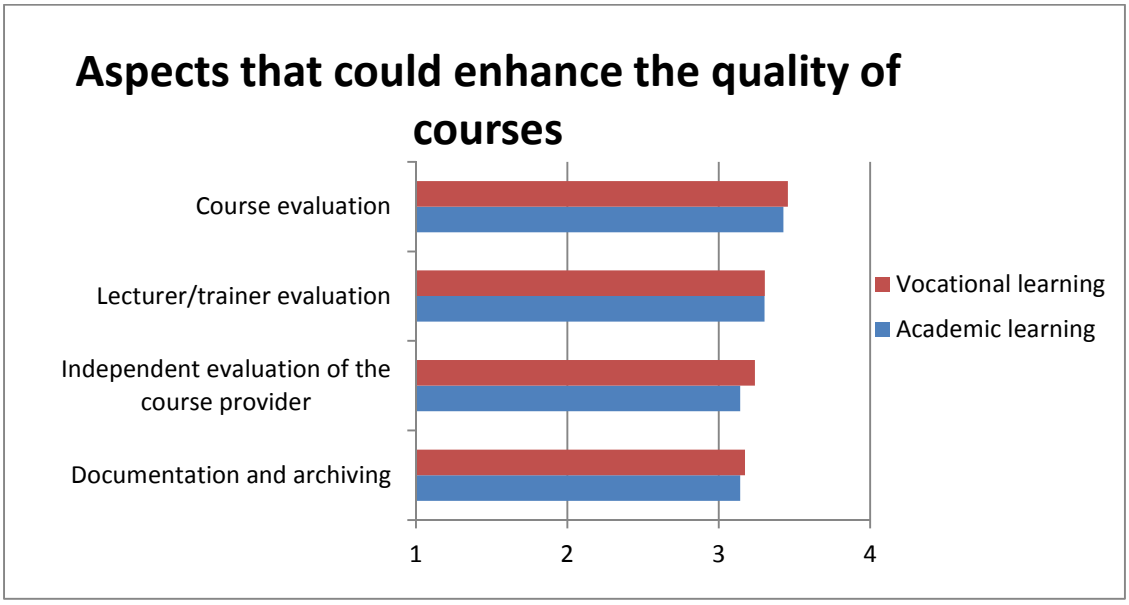



Figure 16: Aspects that could enhance the quality of vocational (red) and academic (blue) initiatives. The horizontal axis shows the average relevance score, where 1 corresponds to not relevant and 4 corresponds to very relevant.

Other ideas to enhance the quality are:

- *The period in which we are teaching is difficult for the adverse environment in which we operate. It is an objective demotivation for Teachers and for young generations' people to become Teachers.*
- *The course itself should be rigorously examined internally and externally before even being considered. But more importantly, the delivery of the course is where things can quickly go wrong!*
- *Selection of lecturers by independent committees*
- *Evaluation of the lecturers on the basis of the trainees feedback*
- *Practical knowledge of the lecturer, not necessarily based on his academic grade*

- *Meet with colleagues and discuss the experience, exchange of ideas, ..; try to get to a common type of (new) course.*
- *Matching the student profiles/background/level to the course.*
- *It is not about the evaluation, but about implementation improvement plans, that are the result of the evaluation.*
- *Involvement of professional stakeholders.*
- *International students give some good internal/external review of our courses and are then encouraging academic quality.*
- *Professional experience of tutors.*
- *Having very clear definition of the expected outcomes (Objectives) of the training intervention is essential. The outcome should avoid the simplistic one of "increase* understanding of topics x,y,z".
- *Have possibility for laboratory work (e.g. for radiation protection).*

### 3.9 Optimization and networking in academic and vocational learning activities

Figure 17 shows a list of difficulties currently occurring in academic E&T and VET activities, according to the respondents. Lack of structured funding is the most frequently occurring problem in academic learning activities and vocational learning.

Other difficulties indicated by the respondents, include:

- *Too rigid academic approach to modern nuclear technologies and no budget according to this rigidness.*
- *Nuclear facilities at universities diminish; little chance for quick revival in Belgium.*
- *Lack of certification opportunities.*
- *In an area where getting students interested in the subject is increasingly difficult (because of the political situation around nuclear power in Europe), allowing using virtual learning environments mixing on-site and off-site students should be given top priority, so that the educational programs at various institutions in Europe can remain open.*
- *Access to training reactors is very limited.*
- *There is a huge experience gap due to the long period since the UK supply chain has been involved in nuclear build and the impact of this knowledge gap is still underestimated.*
- *Also in the UK there is a lack of decision making in the nuclear world and this is leading to uncertainty and reducing commitment to E&T to nuclear vocations which is disappointing as it was increasing.*

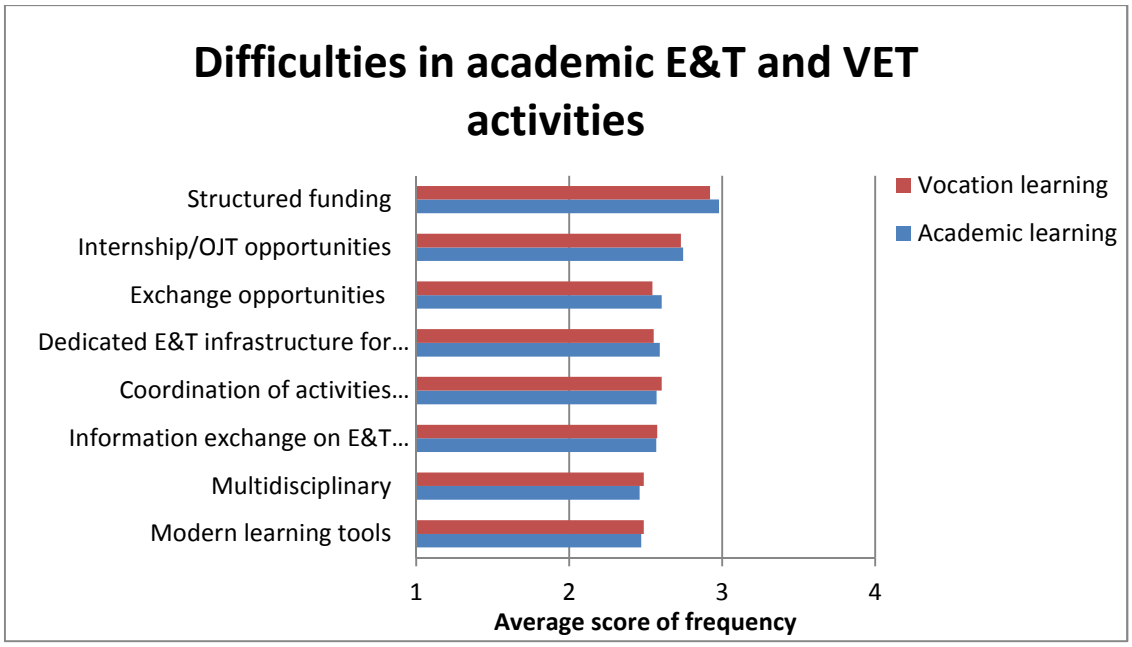



Figure 17: Difficulties in E&T and VET activities, ranked by how often they appear currently according to the respondents. A distinction is made between vocational learning initiatives (in red) and academic activities (in blue). The score on the horizontal axis represents the frequency of occurrence of the difficulties, with 1 corresponding to never occurring and 4 corresponding to always occurring.

Aspects that could have a positive impact on the difficulties in academic E&T and VET mentioned in Figure 17, are shown in Figure 18. A common database with available academic E&T and VET opportunities, modern learning tools, European certification by leading organizations and a coordinating network are rated as most relevant. Outreach activities are deemed to be much more important for academic learning than for vocational learning.

Next to the aspects shown in Figure 18, other aspects are brought up:

- *HERCA (and its members, of course) recognizing that medical radiation physicists have completed all our training modules successfully.*
- *Approach the general public as soon as possible after primary school. Nuclear is always political, clearance of social behavior must be based on knowledge in early ages.*

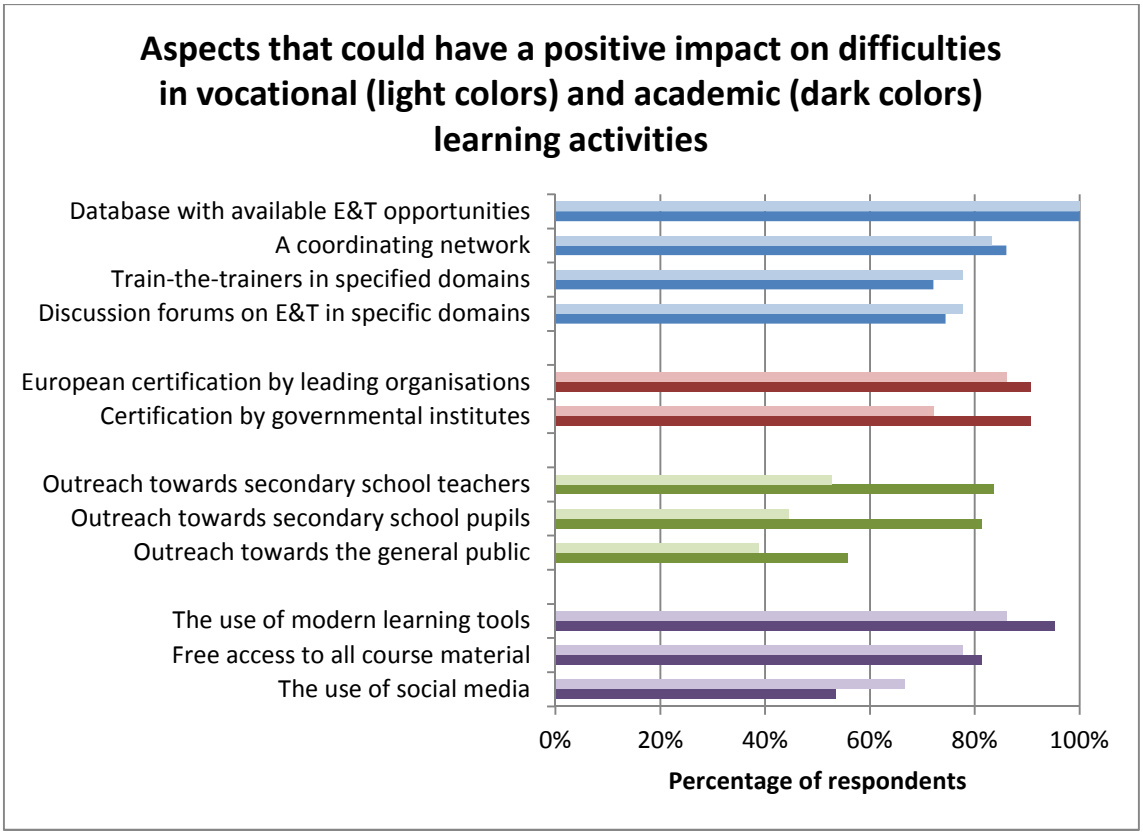



Figure 18: Aspects that could have a positive impact on the difficulties in E&T and VET, mentioned in Figure 17. The scale on the horizontal axis corresponds to the percentage of respondents. A distinction is made between vocational (in light colors) and academic learning initiatives (in dark colors). Items are grouped in four categories i.e. cooperation (blue), recognition (red), outreach activities (green) and accessibility (purple).

When specifically asked, the majority of respondents (57 out of 62; 92%) judge a coordinating network to be well-suited to contribute to one or more of the identified issues. Only 5 respondents do not think a coordinating network is relevant. The arguments for these answers are:

- *Most of the VET courses will be followed in the own language, in our case Dutch. So the coordination needs to be on national level and in that case coordination is not needed, since we do know each other.*
- *There are many available networks already that could be used in a more efficient way.*
- *Each country has a very specific need, which is difficult to coordinate.*
- *If there is no general strategy behind, networking is good to meet other people, but not very useful in setting up an e-learning course!*
- *I can only speak for the medical field where I cannot see such a network being feasible.*

Figure 19 lists possible tasks of such a future advanced network, ranked according to an average score of relevance, where 1 corresponds to not relevant an 4 to very relevant.

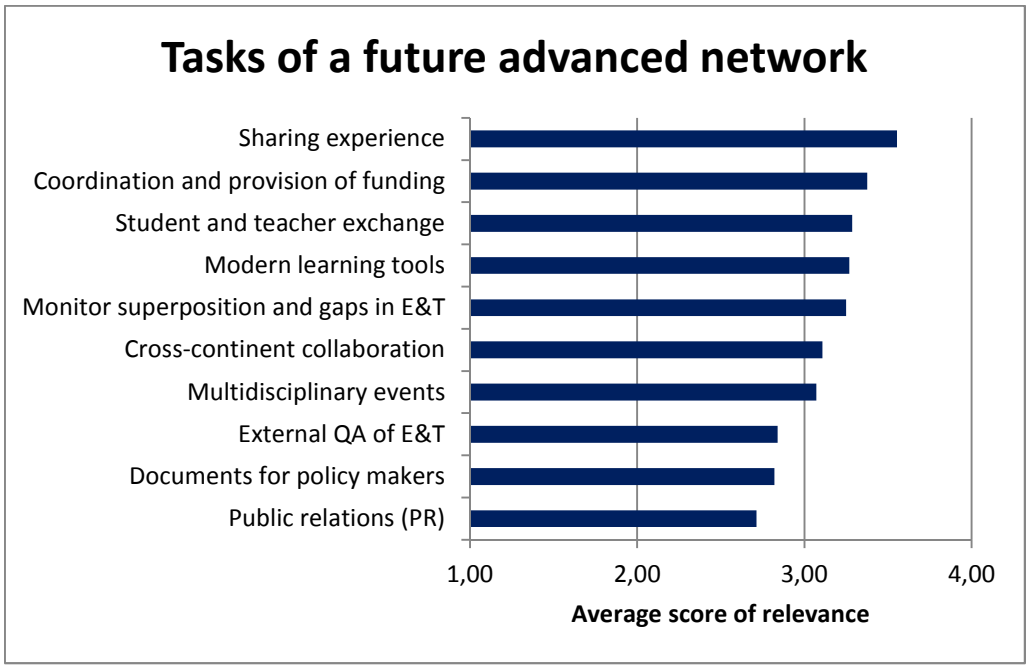



Figure 19: Tasks of a future advanced network, ranked according to the average score of relevance, where 1 corresponds to not relevant and 4 to very relevant.

Other tasks for this network are mentioned as well:

- *International recognition (3)*
- *Optimization of E&T costs and required time for training/education (2)*
- *Timely information about training needs and most suitable offers, about any difficulties encountered and options to overcome them (2)*
- *Starting with an early bourgeois education, concerning the nuclear issues, both in dangerous and civil ecological issues; that means change of a curriculum. Meaning that we have to form a new approach to a nuclear curriculum taking into account the modern technology and consequent power consumption - meaning quality of life for everybody.*
- *Re-enforcement of outputs involving multidisciplinary contents and approaches that both the academic and vocational E&T allow.*
- *Preserving advanced courses usually attracting very few on-site students by offering these courses to off-site students*
- *Innovation in technological research and applications of advanced scientific tools*
- *Enlargement of student opportunities*
- *Coordinating efforts in different sectors will save time and money to and will result more effective.*
- *An advanced coordinating network such as the one suggested could act as a "go to" training course/qualification directory specific to the nuclear industry, which could be accessed by Training Coordinators and the Learning and Development departments of business' operating within the nuclear industry. This would enable a business to source accredited and fit for purpose training quickly, thus allowing any urgent training needs to be addressed in a timely fashion.*

- *A robust structure of academic courses including laboratory exercises has to be established. Two months per year vocabulary practicals are also necessary. A six months dissertation at the end of the program has to be included. Finally, a strong recognition by an ECTS system have to be attached to the program. A one-year mobility of students and teachers has to be prepared requesting funding from appropriate projects.*
- *Benchmarking of techniques and technologies.*
- *Identification of high quality training providers.*
- *Provision of basic knowledge for teaching in the various academic levels*
- *Memoranda of Understanding and Learning Agreements.*
- *The existing networks (ENEN and FuseNet) should play the role of coordinating the efforts from different groups and also in the relations already established between them. In order to do this, they should be better supported at EC level and become the reference organizations for E&T activities in the nuclear fields in Europe.*

Finally, respondents identified existing groups or activities in academic and/or vocational E&T that could be conveniently coordinated in an advanced networking approach:

- ENEN (http://www.enen-assoc.org/)
- IAEA (https://www.iaea.org/)
- EU (http://ec.europa.eu/)
- All actions of ETKM groups of platforms (SNETP, MELODI, IGD-TP, ENS/FORATOM)
- The UK National Skills Academy for Nuclear (https://www.nsan.co.uk/)
- Group on Science and technology of advanced nuclear fission systems (http://www.upm.es/observatorio/vi/index.jsp?pageac=fichaGrupo.jsp&id_articulo=337&id_tipo_articulo=6&idGrupo=217)
- ALLIANCE European Radioecology (http://www.er-alliance.eu/)
- CORONA II project (http://corona2.eu/)
- Master program in Material Science for Nuclear Energy and European Master in Nuclear Energy (http://phelma.grenoble-inp.fr/manuen/manuen-materials-science-for-nuclear-energy-br-emine-european-master-in-nuclear-energy-366640.kjsp?RH=PHELMA_EN)
- All associations working at radiation safety in medicine with teaching activities: ESTRO, ECR (and its subcommittees), EFOMP, ESMP, ICTP, IAEA,..
- The Nuclear Advanced Manufacturing Research Centre (http://namrc.co.uk/)
- NTUA. Nuclear Engineering Department (http://nuclear.ntua.gr)
- UK Nuclear Network (http://uknuclear.net/)
- World Institute for Nuclear Security (www.wins.org).
- Cooperation for higher education on radiological and nuclear engineering (CHERNE) (https://www.upv.es/cherne/).

# 1 CONCLUSION

A survey was performed to investigate the presently available academic and vocational learning initiatives in nuclear and to assess the level of cooperation among these initiatives. The respondents were also questioned about the implementation of the ECVET system, the use of e-learning, aspects to assure quality in learning initiatives, and difficulties in nuclear E&T.

The survey was made available on a website and was distributed to potential respondents by contacting platforms, organizations and projects in nuclear. Because of this methodology, where the link to the survey could be forwarded to other interested parties, a relative response rate cannot be determined. 80 respondents completed this survey, which is substantial, compared to similar studies performed in the framework of past projects.

The main results of this survey are summarized in the executive summary. These results provide valuable input for all the Work Packages of the ANNETTE project. Specifically, they will be used for the remaining tasks to be done in WP 1 of the ANNETTE project. The results in Section 3.9 and specifically the fact that 92% of the respondents judge a coordinating network to be relevant, provide an incentive to proceed with Task 1.2 where possibilities for the implementation of sustainable advanced networking mechanisms will be explored. The suggestions made by the respondents for tasks of such a network, will serve as inspiration. Next to a coordinating network, a common database, the use of modern learning tools and European certifications are evaluated by the respondents to be most relevant to have a positive impact on difficulties in nuclear E&T. This will be further developed in Tasks 1.3 and 1.4.

Next to that, the results in Section 3.7, showing the needs and expectations of the end-users in nuclear, can be taken into account in the development of courses in the framework of WP 2, 5 and 6. However, the number of respondents representing the domain of fusion (addressed in WP6) was very low. The results on the implementation of the ECVET system in nuclear (Section 3.5) provide direct input for Task 4.1 of WP 4. Also, the need for exchange opportunities in academic E&T and VET initiatives, expressed by the end-users (Figure 12 and 13), will be addressed by WP4.

# 3 EXECUTIVE SUMMARY

ANNETTE aims to promote a better coordination of academic and vocational learning initiatives in the nuclear fields in Europe, in order to achieve a higher level of networking and cooperation. In order to investigate the existing initiatives in nuclear themes and probe the current level of coordination, a survey was developed as first task of WP1. The survey was distributed to course providers and stakeholders from all domains within the nuclear sector and was open for answers between April 15, 2016 and December 4, 2016.

The survey addressed six main topics: existing academic and vocational initiatives, the implementation of the ECVET system, the implementation of e-learning, the needs of end-users, quality assurance and optimization and networking in nuclear E&T. The survey was dynamic; the number of questions and their content was adapted depending on the profile of the respondent.

In total **80** respondents completed the survey, mainly members from ENEN, ESARDA, NUGENIA and MELODI. **52** of the respondents indicate to be **course organizers** and **37** respondents are **end-user** of E&T activities. The main areas of activity of the organizations of the respondents are nuclear technology, nuclear safety, security and/or safeguards, and radiation protection.

*Existing academic and vocational initiatives in nuclear E&T*

Of the 52 course providers, 39 offer **academic** courses and **18** organize **vocational** learning initiatives in their respective domain. The minority of these academic (46%) and vocational (39%) initiatives are listed in an online database. 46% of the academic courses and 33% of the vocational training courses are jointly organized or are organized in the framework of a project. For both academic and vocational learning, an **overall increase in interest** is observed. All academic and vocational training providers are **interested to participate in a future joint programming** with various topics to contribute.

When training providers are developing new vocational learning initiatives, the availability of the trainers' competence and the customer-need of specific competences are seen as most important. The feasibility to implement the training into e-learning is not considered to be important.

*Implementation of the ECVET system in nuclear E&T*

Although the majority of components of the ECVET system is perceived to be relatively easy to implement, only one of the VET training providers states that the ECVET system is partially implemented. 8 out of 18 training providers (44%) state to have **the ambition to implement the ECVET system**. Commitment of all parties (in terms of interest and support) is deemed very important in order to implement ECVET. The VET training providers who have the ambition to implement the ECVET system, see the **transparency of qualifications as the biggest added value**. The majority of the VET training providers (83%) see **benefit in linking ECTS to ECVET**. Face-to-face meetings and the organization of customized workshops are seen as good ways to involve major stakeholders in the implementation of ECVET.

12 out of 18 VET training providers state that other credit systems are in place for their vocational initiatives. Only 3 VET training providers have a certification from a governmental institute for their initiatives.

*Implementation of e-learning in nuclear E&T*

Online learning activities are offered by 13 out of 52 course organizers, mainly through video lectures, MOOCs, animations and e-books. **Funding is indicated to be the major factor** which inhibits the development of e-learning activities, but also a **lack of manpower, time and support for the lecturers** is inhibiting.

*Needs of end-users in nuclear E&T*

The questions for **end-users** focused, among others, on important aspects when searching for learning activities. For both academic and vocational learning, the **practical applicability of the learning activity** seems to be the most important aspect. Also **certification by a competent authority** seems very important, next to the **cost of the activity**. For vocational learning, c**ontinuing professional development (CPD) courses rather than basic training courses** are also important**, as well as exchange opportunities**.

End-users indicate that courses **are most difficult to find** in decommissioning and waste, geological disposal; and nuclear safety, security and safeguards. Currently, courses in nuclear technology and fusion are mainly followed at universities; while courses in nuclear safety, security and safeguards are followed mainly at professional training providers. Courses in other domains are spread almost equally over university and professional training providers.

*Quality assurance in nuclear E&T*

In terms of **quality assurance**, several **differences between academic and vocational learning** can be observed. Aspects of **documentation and archiving** seem to be more present in vocational training, whereas a **learning management system** is more frequently implemented in academic E&T. Academic training providers report to be evaluated more, internally as well as by an external party. The **evaluation of the learning activity** seems to be more present in VET initiatives. The **evaluation of the lecturer/trainer** in VET initiatives is mainly focused on the validation of professional experience in the topic and the requirement to follow a train-the-trainer, whereas in academic learning a didactic degree is required.

*Optimization and networking in nuclear E&T*

**Lack of structured funding is the most frequently occurring issue** in academic learning and vocational learning. A **common database with available academic E&T and VET opportunities**, modern learning tools, European certification by leading organizations and a coordinating network are rated as most relevant to have a positive impact on the difficulties in E&T mentioned. Outreach activities are deemed to be much more important for academic learning than for vocational learning.

57 out of 62 (92%) respondents judge a **coordinating network to be well-suited to contribute** to the identified issues. Sharing of experience, coordination and provision of funding, facilitation of student and teacher exchange and modern learning tools are indicated to be the most relevant tasks of such a future coordinating network.

## Annex 1: Overview of the questions of the survey, including practical instructions for respondents

### 1. Introduction about this survey

This document contains all the questions that are present in the ANNETTE survey in order to provide an overview. The answers to the questions must be submitted online (https://survey.app.sckcen.be/fs.aspx?surveyid=c66e3aa1e3a4468ab3daadcd9d8a18d).

This survey is dynamic; depending on which answers are provided, the number of questions and their content will be adapted. The numbering of the questions in this document does not correspond to the online version. The following color code is used: questions to be answered by all respondents are indicated in blue, questions in red are only for end-users. Other questions are only for course organisers.

Intermediate save is possible in this survey: you can complete it at your own available time. It is possible to complete only parts of the survey. The answers will only be validated after 'submit' is clicked on the last page of the survey.

If you have any questions regarding this survey, please contact annette.project@sckcen.be.

#### Overview of main sections in the ANNETTE survey

1. Introduction
2. General information
3. Profile
4. Existing academic education in nuclear
5. Existing vocational training (VET) initiatives in nuclear
6. E-learning
7. Quality assurance in academic and vocational E&T in nuclear
8. Optimisation and networking in academic and vocational learning activities

### 2. Introduction

ANNETTE is a European Project funded under Horizon 2020 and coordinated by the European Nuclear Education Network, ENEN. With this project, ENEN and its partners in ANNETTE aim to promote a better coordination of E&T and VET activities in the nuclear fields in Europe, in order to achieve a higher level in networking and cooperation. Information on the project can be found at http://www.enen-assoc.org/en/training/annette.html.

The objective of this survey is to identify efficient networking mechanisms in order to favor coordination, synergies and “cross-pollination” of E&T and VET initiatives among the nuclear safety/engineering, the radiation protection and the waste management and geological disposal communities, and E&T domains beyond these fields.

This survey comprises questions on course organisers/providers, academic and vocational education, certification and credit system and networking/coordination. Central to some of these areas are the following concepts:

• The European Qualifications Framework (EQF) is a translation tool that helps communication and comparison between qualifications systems in Europe. Eight common European reference levels are included, described in terms of learning outcomes on knowledge, skills and competences. (more information on the different levels)

• ECTS, the European Credit Transfer System, is a credit system and a central tool in the Bologna Process, which aims to make national systems more compatible. ECTS credits represent the workload and defined learning outcomes ("what the individual knows understands and is able to do") of a given course or programme. 60 credits are the equivalent of a full year of study or work. (more information)

• ECVET, the European credit system for vocational education and training (VET) promotes borderless mobility and lifelong learning. It creates the potential to recognise, accumulate and transfer work-related skills and knowledge acquired during a stay in another country or in different situations, so that these experiences contribute to building up recognised vocational qualifications. (more information)

## 3. General information

### 3.1 Are you a member of one of the following platforms, organisations, networks or working groups in nuclear E&T?

- ENEN
- SNETP
- IGD-TP
- MELODI
- EHRO-N
- ENSREG
- HERCA
- FORATOM
- NUGENIA
- ETSON
- Fusenet
- Eurofusion
- ESARDA
- INSEN
- Other (please specify)

### 3.2 Country

### 3.3 Personal and institution details:

- Name and surname
- Organisation
- Function
- Email address

Disclaimer: The answers you will provide in this survey are being processed by the ANNETTE project partners. Your personal credentials will only be used for the communication of the results of this questionnaire. Your personal data will not be used for commercial purposes or put at the disposal of third parties. You have the right to access your personal data and the right to change them if they are not correct. You have the right to freely object to the further processing of your personal data by a simple request given by means of e-mail to annette.project@sckcen.be.

## 4. Profile

### 4.1 Are you a course organizer?

- Responsible for multiple E&T programmes at a higher education institution (university – or equivalent)
- Responsible for multiple VET programmes at a vocational training provider
- Lecturer (academic, researcher, professional or other)
- No, I do not organise E&T and VET activities

**4.2 Are you an end-user of E&T and VET activities in nuclear?**

- Professional in the domain
- Researcher
- Policy maker
- No, I am not an end-user

**4.3 Please select the main area in which your organization is active. Note: At the end of this survey, you will get the opportunity to answer similar questions for other domains.**

- nuclear technology
- nuclear materials
- radiation protection
- medical applications of nuclear technologies
- decomissioning and waste management
- geological disposal
- nuclear safety, security and/or safeguards
- fusion
- other

The chosen category is displayed permanently during the rest of the survey for the questions under 3-5 related to this category.

**5. Existing initiatives in academic education in nuclear**

**5.1 Do you offer (academic) courses in the selected domain, which are open for an international audience? (At a later stage you will get the opportunity to provide details on these courses.)**

Yes-no

If no: please refer to next section.

**5.2 In the last 10 years, have you experienced a change in interest in higher education (on your topic) among young and upcoming scientists and engineers? Please rate.**

(5-point scale: Strongly decreased interest, decreased interest, steady level of interest, increased interest, strongly increased interest)

**5.3 Assuming one would try to provide an offer in the frame of a future joint programming, are you interested to participate?**

Yes-no

If yes, what do you think you can contribute? Please provide details.

**5.4 Are your academic education initiatives listed in one or more online databases?**

Yes-no

If yes, please provide the references (URL).

**5.5 Are the academic education initiatives in your domain part of a single organization/platform/project?**

Yes-no – Do not know

If yes, please provide the references

- Name:
- Website:

- Contact person:
- On which scale is this initiative organised?
    - National
    - Regional
    - European

**5.6 As an end user, please rate the following criteria when searching for academic learning initiatives.**

(4-point scale: very important, important, less important, not important)

5.6.1 Content and E&T approach

- Practical applicability to the working environment
- Multidisciplinary
- Exchange opportunities
- Specific courses focusing on safety culture

5.6.2 Certification and accreditation

- ECTS system implemented
- International quality ranking of University
- Certification by a competent authority
- Certification by a leading stakeholder in the domain

5.6.3 Accessibility

- Cost of E&T activities
- Physical accessibility to the E&T opportunities (e.g. distance-learning)
- Availability of E&T infrastructure (e.g. laboratory, reactor,…)

Comment (please specify)

## 6. Existing vocational training (VET) initiatives in nuclear

**6.1 Do you offer vocational training initiatives in your domain, which are open for an international audience? (At a later stage you will get the opportunity to provide details on these courses.)**

Yes-no
If no: please refer to next section.

**6.2 In the last 10 years, have you experienced a change in the number of participants in your training courses (on your topic)? Please rate.**

(3-point scale: Lower participation level, steady level of participants, higher participation level)

**6.3 Assuming one would try to provide an offer in the frame of a future joint programming, are you interested to participate?**

Yes-no
If yes, what do you think you can contribute? Please provide details.

**6.4 Are these vocational training initiatives listed in one or more online database?**

Yes-no
If yes, please provide the references:

### 6.5 Are the European vocational training initiatives in your domain coordinated by a single organization/platform/project?

Yes-no – Do not know
If yes, please provide the references

- Name:
- Website:
- Contact person:
- On which scale is this initiative organised?
    - National
    - Regional
    - European

### 6.6 Please rate the following criteria when developing vocational learning initiatives?

(4-point scale: very important, important, less important, not important)

- Customer-need for specific competences
- Legislative requirements
- Availability of external funding
- Availability of infrastructure
- Availability of trainer competences (expertise)
- Innovative character of VET initiative
- Feasibility to implement into e-learning
- Other criteria when developing vocational learning initiatives (please specify)

Intro ECVET:

ECVET, the European credit system for vocational education and training (VET) promotes borderless mobility and lifelong learning. It creates the potential to recognise, accumulate and transfer work-related skills and knowledge acquired during a stay in another country or in different situations, so that these experiences contribute to building up recognised vocational qualifications. It is meant to operate in coordination with other European tools. A well-functioning European credit system requires to be embedded in a qualifications framework. National qualifications, to follow ECVET principles, need to be described in terms of units of learning outcomes, defined as 'a coherent set of knowledge, skills and competence that can be assessed and validated with a number of associated ECVET points'.

*(More information about ECVET)*

### 6.7 In these vocational training initiatives: is the ECVET system implemented?

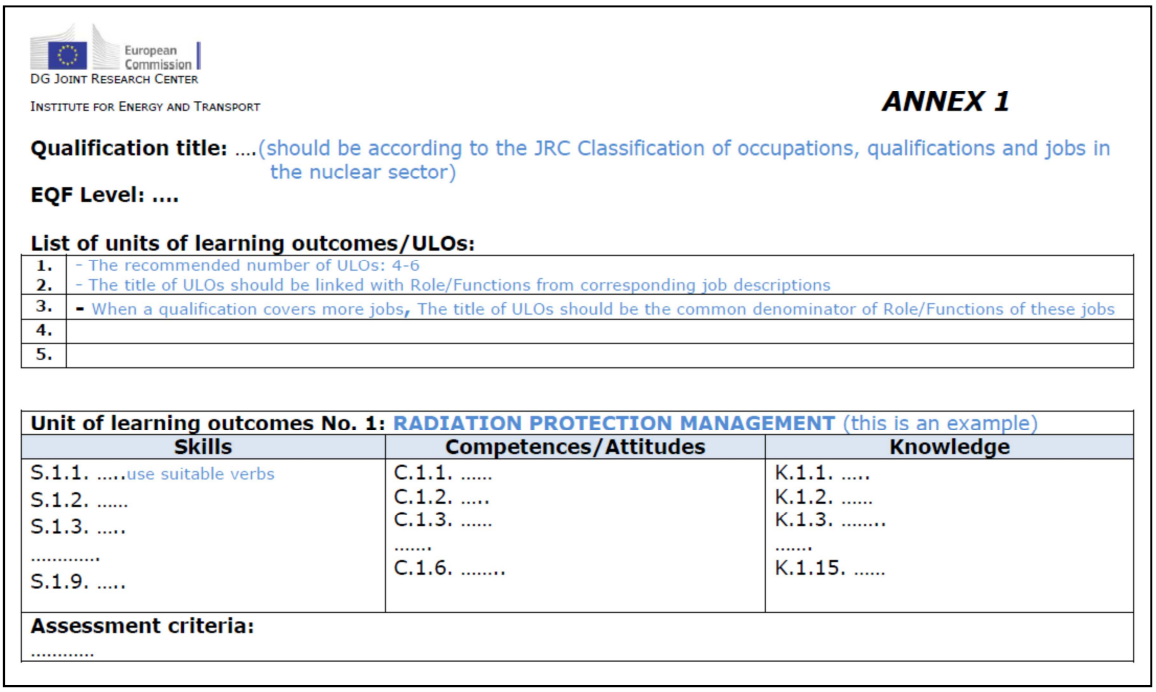
- Yes, fully
- Yes, partially
- No, but it is the ambition to implement ECVET
- No, and the implementation is not planned

If yes (fully or partially), go to next question (and skip question 4.11).
If no, skip questions 4.8 and 4.9.

### 6.8 Which technical components are implemented?

6.8.1 Designing qualifications

- Qualifications linked to a specific job description from the Nuclear Job Taxonomy as developed by JRC-IET
- Qualification designed using the dedicated template (see Figure 20)
- Units of learning outcomes (content and structure of qualifications)
- Credit points (size of qualifications an relative weight units)



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**ANNEX 1**

**Qualification title:** ....(should be according to the JRC Classification of occupations, qualifications and jobs in the nuclear sector)

**EQF Level: ....**

**List of units of learning outcomes/ULOs:**

| | |
|---|---|
| 1. | - The recommended number of ULOs: 4-6 |
| 2. | - The title of ULOs should be linked with Role/Functions from corresponding job descriptions |
| 3. | - When a qualification covers more jobs, The title of ULOs should be the common denominator of Role/Functions of these jobs |
| 4. | |
| 5. | |

**Unit of learning outcomes No. 1: RADIATION PROTECTION MANAGEMENT** (this is an example)

| Skills | Competences/Attitudes | Knowledge |
|---|---|---|
| S.1.1. ....use suitable verbs<br>S.1.2. .....<br>S.1.3. .....<br>.....<br>S.1.9. ..... | C.1.1. .....<br>C.1.2. .....<br>C.1.3. .....<br>.....<br>C.1.6. ..... | K.1.1. .....<br>K.1.2. .....<br>K.1.3. .....<br>.....<br>K.1.15. ..... |
| **Assessment criteria:**<br>..... | | |

Figure 20: Qualification template

6.8.2 Designing learning outcomes

- Definition of learning outcomes according to Knowledge, Skills and Competences
- Assessment of learning outcomes
- Validation of learning outcomes
- Recognition of learning outcomes

6.8.3 Agreements

- Memorandum of understanding (partnership)
- Learning agreement
- Learners' transcript of record (individual achievement)

### 6.9 Are you aware of the Nuclear Job Taxonomy as developed by JRC-IET?

- Yes and we are using it in the development of our training programmes
- Yes but we are not using it in the development of our training programmes
- No

### 6.10Which technical components do you think are the most difficult to implement?

(4-point scale: very difficult, difficult, less difficult, not difficult)

- Qualifications linked to a specific job description from the Nuclear Job Taxonomy as developed by JRC-IET
- Units of learning outcomes (content and structure of qualifications)
- Credit points (size of qualifications an relative weight units)
- Definition of learning outcomes according to Knowledge, Skills and Competences
- Assessment of learning outcomes
- Validation of learning outcomes
- Recognition of learning outcomes
- Memorandum of understanding (partnership)
- Learning agreement
- Learners' transcript of record (individual achievement)

**6.11 Which of the following aspects are essential to you to implement ECVET in your vocational learning initiatives?**

- ECVET added value
- Commitment from all parties (interest and support)
- Legislative and regulatory framework (recognition)
- Qualification frameworks
- Learning outcomes approach (assessment, validation, recognition, units)
- Other

**6.12 Where do you see the most added value in implementing ECVET? Please rate the following items.**

(4-point scale: very useful, useful, less useful, not useful)

- Transparency of qualifications
- Transnational mobility
- Qualitative development of courses in terms of knowledge, skills and attitude
- Strengthen the link between research, education and training, and the labur market

**6.13 Do you see benefit in linking ECTS to ECVET?**

- Yes
- No

If yes, what would be your approach in linking these credit systems?
If no, please explain.

**6.14 How can we involve major nuclear stakeholders (in particular nuclear regulatory bodies) in the implementation of ECVET?**

- By organizing customized seminars/workshops for interested stakeholders
- By face-to-face meetings
- Other ways. Please specify

**6.15 Do other credit systems apply to these vocational learning initiatives?**

Yes-no
If yes: please provide more information.

**6.16 Is there a certification from a governmental institute for these vocational learning initiatives?**

Yes-no
If yes: please provide more information.

**6.17 As an end user, please rate the following criteria when searching for vocational learning initiatives.**

(4-point scale: very important, important, less important, not important)

- Content and E&T approach
  - Practical applicability to the working environment
  - Multidisciplinary
  - Exchange opportunities (On-the-job training)
  - Continuous professional development, rather than basic training courses
  - Specific courses focusing on safety culture
- Certification and accreditation
  - ECVET system implemented

- Certification by a competent authority
- Certification by a leading stakeholder in the domain
- Certification by an independent party (e.g. ISO, Qfor,…)

- Accessibility
  - Cost of VET activities
  - Physical accessibility to the VET opportunities (e.g. distance-learning)
  - Availability of VET infrastructure (e.g. laboratory, reactor,…)

Comment (please specify)

## 7. E-learning

### 7.1 Do you already offer online learning activities?

- Yes
- No, but it is the ambition to develop online learning in the future
- No, and the development of online learning is not planned

If no: go to question 5.3

### 7.2 If yes, which types of online learning activities are offered?

- MOOC (Massive Open Online Course)
- Video lecture
- Animations
- E-books
- PODcast
- Serious game
- Virtual reality
- Other (please specify)

### 7.3 If no, please rate the following aspects that could inhibit you to develop online learning?

(4-point scale: very inhibiting, inhibiting, less inhibiting, not inhibiting)

- Lack of technical competence
- Unavailability of software
- Funding
- Suitability of training content for online learning
- Keeping the content up to date
- Evaluation of participants
- Other aspects that could inhibit you to develop online learning: (please specify)

## 8. Quality assurance in academic and vocational E&T in nuclear

### 8.1 Which of the following features are implemented in the quality assurance of your courses?

(Separate answers for academic E&T and VET)

8.1.1 Documentation and archiving

- Documented procedures on how to organise a course (administration)
- Documented procedure on how to develop a course (format & content)
- Learning management system (hover-on with extra information rmation: a software application for the administration, documentation, tracking, reporting and delivery of courses or training programs)
- Standardised (templates) on course certificates, lay-out of course material,…
- Policy/rules/procedures for education, training and exams

8.1.2 Course evaluation

- Level 1: Reaction (Qualitative feedback forms – how did the participant experience the training course)
- Level 2: Learning (Assessment of the learner - did the participant learn anything)
- Level 3: Behavior (Did the participant use the acquired knowledge, skills and attitude)
- Level 4: Results (Did the training course lead to a better result in the working environment?)
- Level 5: Return on Investment-ROI (Was the better result worth the effort?)

8.1.3 Independent evaluation of the course provider

- Internal review/audit/assessment
- External review/audit/assessment (e.g. by the government or competent authority)
- Quality label (please specify)

8.1.4 Lecturer/trainer evaluation

- Didactic degree requirement
- Learning facilitator – train-the-trainer requirement
- Validation by professional experience in the topic
- External assessment/certification (e.g. by the government or competent authority)

Other features implemented in the quality assurance of your courses: (please specify)

**8.2 Please rate the following aspects which could enhance the quality of academic learning initiatives and vocational learning initiatives.**

(4-point scale: Very relevant, relevant, less relevant, not relevant)
(Separate answers for academic E&T and VET)

- Documentation and archiving
- Course evaluation
- Independent evaluation of the course provider
- Lecturer/trainer evaluation
- Other aspects which could enhance the quality of academic learning initiatives and vocational learning initiatives: (please specify)

**8.3 As an end user, please indicate in which of the following domains your organization is following courses. Use the last column to identify topics for which suitable courses are difficult to find.**

| | Course organised by a university | Course organised by professional training provider | Difficult to find |
|---|---|---|---|
| Nuclear technology | | | |
| Nuclear materials | | | |
| Radiation protection | | | |
| Medical applications of nuclear technologies | | | |
| Decommissioning and waste management | | | |
| Geological disposal | | | |

| | | | |
|---|---|---|---|
| Nuclear safety, security and/or safeguards | | | |
| Fusion | | | |

### 8.4 Is your organization in need of a specific course that is currently not available according to you?

- Yes
- No

If yes; please provide the following details:

- Title / description
- EQF Level
  - Level 2-4 and lower (Secondary school)
  - Level 5 (Higher professional level)
  - Level 6 (Bachelor equivalent)
  - Level 7 (Master or postgraduate equivalent)
  - Level 8 (PhD or senior level)
- Preferentially organised by
  - A university
  - A professional training provider
- Target audience
- Comment

## 9. Optimisation and networking in academic and vocational learning activities

### 9.1 How frequent do you experience one of the following issues in academic learning activities?

(4-point scale: Never, seldom, often, always. Divided for 2 categories: academic E&T - VET)

- Lack of coordination of activities between providers
- Lack of information exchange on E&T matters (communication channels – dissemination of information)
- Lack of multidisciplinary
- Lack of exchange opportunities for students and teaching staff
- Lack of internship opportunities in professional organisations
- Lack of structured funding
- Lack of modern learning tools
- Lack of dedicated E&T infrastructure for practical training
- Other issues in academic learning activities:

### 9.2 How frequent do you experience one of the following issues in vocational learning activities?

(4-point scale: Never, seldom, often, always. Divided for 2 categories: academic E&T - VET)

- Lack of coordination of activities between providers
- Lack of information exchange on E&T matters (communication channels – dissemination of information)
- Lack of multidisciplinarity
- Lack of exchange opportunities for professionals and teaching staff
- Lack of on-the-job training in professional organisations
- Lack of structured funding
- Lack of modern learning tools
- Lack of dedicated E&T infrastructure for practical training
- Other issues in vocational learning activities:

**9.3 Which of the following possibilities would you think have a positive impact on the issues mentioned before? (Divided for 2 categories: academic E&T – VET)**

9.3.1 Accessibility

- The use of modern learning tools, such as e-learning (MOOCS)
- The use of social media
- Free access to all course material

9.3.2 Outreach activities

- Extend E&T initiatives towards secondary school pupils
- Extend E&T initiatives towards secondary school teachers
- Extend E&T initiatives towards the general public

9.3.3 Recognition

- Certification by governmental institutes
- European certification by leading organisations

9.3.4 Cooperation

- A coordinating network
- A database with all available E&T and VET opportunities
- Train-the-trainers in specified domains
- Discussion forums on E&T in specific domains

Other possibilities:

**9.4 Do you believe that an advanced coordinating network, bringing most E&T and VET initiatives in nuclear together, can contribute to one or more of the issues identified above?**

Yes-no
If no, please motivate and go to the next section
If yes, please please describe the issues for which the networking can be mostly benificial.

**9.5 According to you, what should be the task(s) of such an advanced networking approach? Please rate the following options.**
**(4-point scale: very relevant, relevant, less relevant, not relevant)**

- Sharing experience
- Organise multidisciplinary events
- Coordinate and provide funding
- Facilitate student and teacher exchange
- Bridging the different E&T initiatives across the different nuclear domains (monitoring superposition and gaps)
- PR (public relations)
- Provide statement documents for policy makers
- Cross-continent collaboration
- Develop/share modern learning tools for wider dissemination
- QA (external audit/review of the offered training courses)
- Other task(s) of an advanced networking approach:

**9.6 Can you list a number of groups or activities in E&T and/or VET which could be conveniently coordinated in an advanced networking approach? Please add a reference contact or a website link**

(name, description, contact person, website)