

Building Skills 4.0 through University and Enterprise Collaboration

SHYFTE 4.0

WP3: WP Quality Plan

D3.2: Quality audit report vs:2.0

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This document describes the quality audits design and aims to analyze the quality audits of the learning processes and training.

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1. Executive Summary

This document describes train the trainers in the Partners Countries to the basic of Quality Management Systems (QMS) according to ISO 9001, it aims to propose an operative formation plan of the Quality Managers (QM) for quality audits of the Learning Processes:

- Giving to the trainers the competencies needed to manage a QMS;
- Giving to the QM the skills for the Processed revision and re-engineering;
- Deepening of the structure of a QMS and its dynamics, the techniques used to measure Customer Satisfaction and set up an internal control system to monitor each process.

Capacity to develop internal auditing to evaluate the conformity of a QMS to ISO 9001:2015 regulations and its correct application for the Shyfte Learning Centers in the universities.

2. What is Quality auditing?

Quality auditing is the systematic examination of an organization's quality management system (QMS). A quality audit is typically carried out by an internal or external quality auditor or audit team. It is a key component of the ISO 9001 quality system standard.

Audits are usually conducted at agreed time intervals, ensuring that an organization has a clearly defined system for quality monitoring. They can also help determine whether an organization is compliant with the requirements of a specific quality system.

As well as being an integral part of compliance and regulatory requirements, audits are essential for assessing the success of processes, products, and systems—whether existing or newly-implemented. They are also a vital tool for verifying objective evidence of processes and providing evidence for the reduction and elimination of any problem areas.

To ensure maximum benefit for an organization, quality auditing should highlight examples of good practice, rather than simply identifying non-conformance, process issues, and corrective actions. This will allow other departments to share information and adjust their working practices, delivering continuous improvement as a result.

2.1 What is the role of the auditor?

The auditor can either be an employee who understands but isn't directly involved in the process, product, or system being audited, or somebody from outside the organization who understands the business and industry standards. In essence, they are the individual (or individuals) who perform the audit on behalf of an organization, customer, or supplier.

There are various types of quality audit, but they can be broadly categorized as follows:

- **Process audit**

A process audit determines whether an organization's processes are working within established limits. It measures conformance to any predetermined or industry standards, as well as the effectiveness of any instructions.

This type of audit will check various aspects of a process, including:

- Conformance to defined requirements such as temperature, accuracy, time, responsiveness, pressure, and composition.

- The resources (materials, equipment, people) used to transform inputs into outputs, the methods that are followed, the environment in which the process takes place, and the measurements taken to determine process performance.
- Effectiveness and adequacy of the process controls, as established by work instructions, procedures, training, and process specifications.

- **Product audit**

This type of audit examines whether a particular product or services conforms to the necessary requirement, whether that's specifications, customer requirements, or performance standards.

- **System audit**

A system audit verifies that all elements of a management system are effective and appropriate, and have been developed, documented, and implemented in accordance with the specified requirements.

A quality management system audit evaluates an organization's existing quality management system (QMS) to ascertain its conformance with company policies, contract commitments, and regulatory requirements.

2.2 Sections of the audit

- **First-party audit**

A first-party audit is an internal audit designed to measure an organization's strengths and weaknesses against its own methods or procedures and/or against external standards voluntarily adopted by—or imposed upon—the organization. The audit is conducted by auditors who are employed by the organization being audited but who don't have a vested interest in the audit results.

- **Second-party audit**

This is an external audit performed on a supplier by a customer or contracted organization on the customer's behalf. Second-party audits are typically more formal than a first-party audit because the audit results could influence the purchasing decisions of the customer.

- **Third-party audit**

A third-party audit is performed by an independent organization with no conflict of interest. This independence is a key part of a third-party audit, as it may result in certification, recognition, license approval, a fine, or a penalty being issued by the third-party

2.3 The Quality audit process

1. Determining the scope of the audit

Before appointing an auditor, it's important to establish the criteria and scope of an internal audit; this is usually best placed with a quality manager, or somebody in an equivalent role. The criteria should focus on risk areas in the business or process lifecycle and remain consistent over time wherever possible. This makes it easier to analyse performance and gives employees clear goals to work towards between audits.

2. Planning and preparation

A fair amount of preparation is required ahead of an audit. The priority for the organization being audited is to appoint an auditor, whether from inside or outside the company. Together with the auditor, the organization will then establish the format of the audit, ensuring it aligns with its objectives and that all employees have time to prepare.

3. Audit execution

The audit consists of various activities including interviews with employees, on-site audit management, assessing process and system controls, and regular communication with other relevant parties within the organization. This phase of an audit is often called the 'fieldwork' and tends to conclude with an exit meeting between the auditor and auditee.

4. Reporting

The audit report outlines the results of an auditor's investigation, providing accurate data to management along with recommendations on any corrective actions that need to be taken. It should also enable an organization to effectively track quality and performance over time, identify areas for improvement, and highlight any successes or achievements.

5. Corrective action

If the audit has uncovered any areas of non-compliance with industry or company standards, an organization will need to ensure they act on the findings promptly. It can be beneficial to focus on one or two areas at a time and monitor their impact regularly, thus following the kaizen methodology of continuous improvement. Involving all employees in this process is a key part of complying with quality standards over the long term.

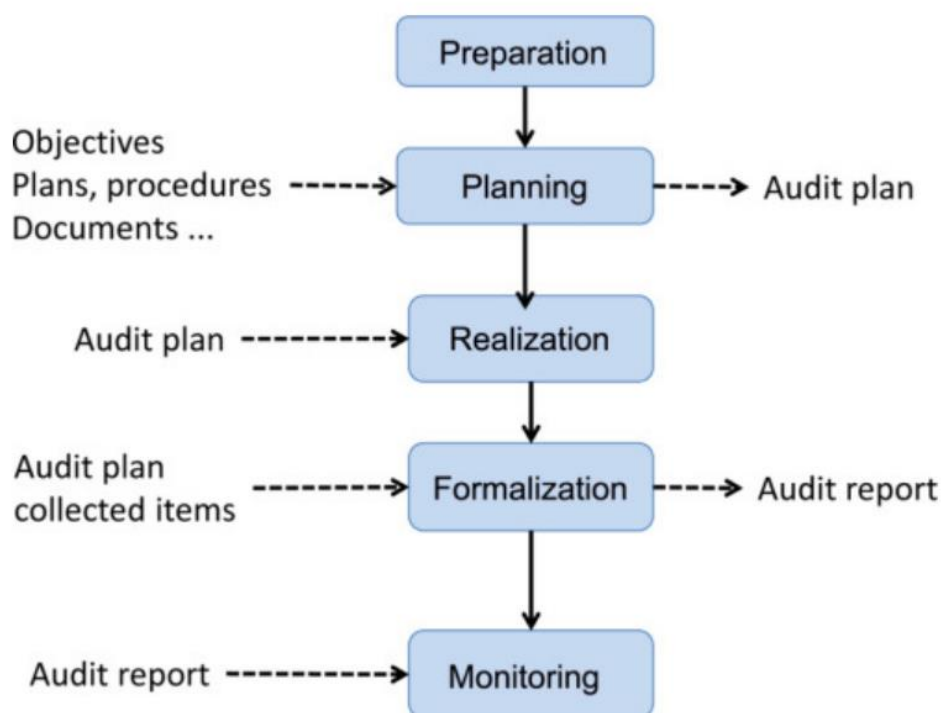


Figure 1. The quality audit process (1)

2.4 Audit Targets

1. Objectives, overall structure, and internal coherence of the quality assurance system
2. Documentation, including the formulation of quality policy of the Shyfte Learning Centres and the definition of procedures, actors, and responsibilities
3. Comprehensiveness of quality assurance:
 - a) Degree education
 - b) Research/R&D
 - c) Interaction with and impact on companies and contribution to regional development
 - d) Support and other services (such as library and information services, career and recruitment services, and international services)
 - e) Staff development
4. Participation of staff, students, and external stakeholders in quality assurance
5. Interface between the quality assurance system and management/steering
6. Relevance of, and access to, quality assurance information within the Shyfte 4.0
7. Relevance of, and access to, quality assurance information for external stakeholders
8. Efficiency of quality assurance procedures and structures and their effect on the development of activities
9. Use of information produced by the quality assurance system as a tool for quality management and enhancement in education and other activities
10. Monitoring, evaluation and continuous development of the quality assurance system.

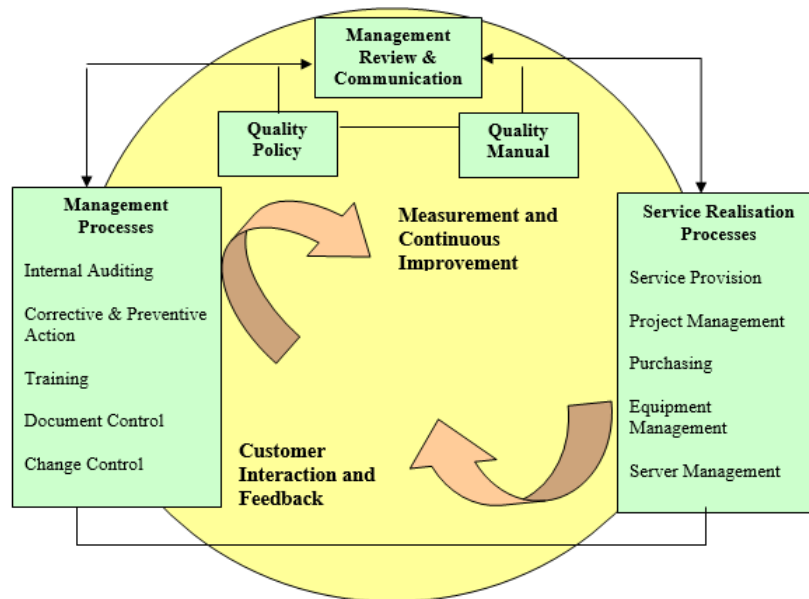


Figure 2. The quality audit process (2)

3. Shyfte 4.0 Quality Processes

The Shyfte Learning Centers propose several training services which are available for two types of users: HEI trainees and SME trainees. In terms of interface visualization, the former are offered the training domains of Shyfte. The latter are presented with the upskill service and allowed to select competencies in one of the Shyfte domains.

After selecting the aim of the training, users fill out a questionnaire to acquire a skills and competencies profile. Next, users receive a proposal for customized training. Once training is accomplished, users are invited to fill out a quality questionnaire, which is the base for the Learning Center Quality Evaluation.

The Quality Management System developed for the Learning Centers is based on several services and processes.

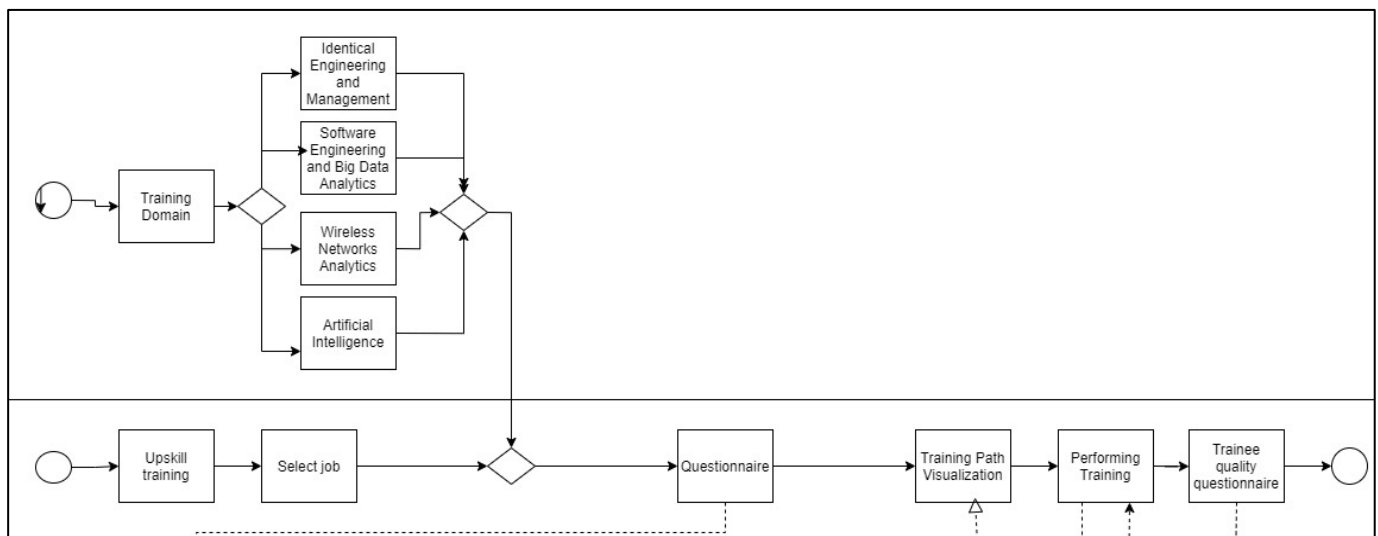


Figure 1. Quality Training processes for HEI trainees and SME trainees.

The Quality Assessment Dashboard is a service presented to the quality Manager, for the visualization of the quality of the Learning Centre. The dashboard has information for all the main domains of the CEO, for trainees, training, and trainers.

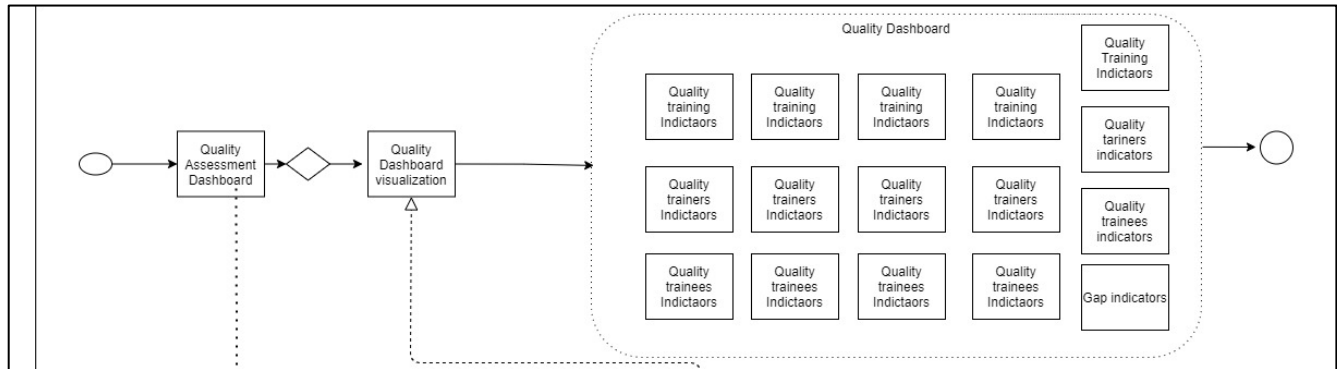


Figure 2. Quality Assessment Dashboard.

The trainee quality questionnaires and the quality training indicators are described in the following sections.

4. Shyfte 4.0 Audit of the trainers

According to the Learning Centers services and following the training sessions carried out during the project, we audited the trainers. In this section we report on the questionnaires sent to the trainers and analyze the responses obtained.

Q1. Did the trainer(s) assigned a correct workload?	Score
	1. Strongly disagree;
	2. Somewhat disagree;
	3. Somewhat agree;
	4. Strongly agree.

Q2. Did the trainer(s) provide suitable learning material to teach the specific topic?	Score
--	-------

Q3. Did the learning method of trainer(s) stimulate interest in the specific topic?	Score
---	-------

Q4. The degree of explanation of the trainer(s) is adequate for this topic?	Score
---	-------

Q5. Do you think that the trainer(s) owns complete experience to teach this topic?	Score
--	-------

Q6. Do you think to understand the most part of explanation?	Score
--	-------

Q7. Did the trainer(s) expose focus on practical cases?

Score

Q8. Did your trainer(s) respond to your queries in a timely manner?

Score

Q9. After attending this training, are you comfortable to be a trainer yourself?

Score

4.1 Results of the Training of the Trainers session evaluation

We received a total of 132 responses from university and business for the Training of the Trainers (ToT) sessions. The following table shows the trainers' answers for each question requested by the questionnaire.

	Did the trainer(s) assigned a correct workload?	Did the trainer(s) provide suitable learning material to teach the specific topic?	Did the learning method of trainer(s) stimulate interest in the specific topic?	The degree of explanation of the trainer(s) is adequate for this topic?	Do you think that the trainer(s) owns complete experience to teach this topic?
Strongly disagree	1	2	2	1	2
Somewhat disagree	2	0	0	1	1
Somewhat Agree	25	21	26	14	13
Strongly agree	104	109	104	116	116
TOTAL		132	132	132	132

	Did you understand the content of the module?	Did the trainer(s) expose focus on practical cases?	Did your trainer(s) respond to your queries in a timely manner?	After attending this training, are you comfortable to be a trainer yourself?
Strongly disagree	0	0	1	0
Somewhat disagree	1	1	1	11
Somewhat Agree	39	25	15	51
Strongly agree	92	106	115	70
TOTAL	132	132	132	132

Table 1. ToT evaluation

Below are the names of the university or company affiliations to which the questionnaire was submitted:

University / Company affiliation:

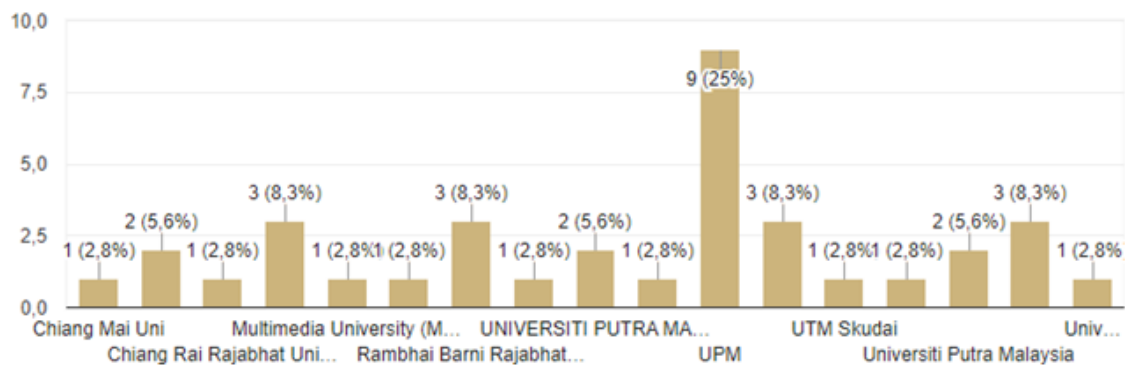


Figure 1. ToT University/Company affiliation

- Rambhai Barni Rajabhat University, Thailand
- Universiti Putra Malaysia
- UTM, telecommunication, Malaysia
- Chiang Mai University, Thailand
- Universiti Teknologi Malaysia
- Chiang Rai Rajabhat University, Thailand
- UTM Skudai, Malaysia
- Kasetsart University, Thailand
- Multimedia University (MMU), Thailand
- Chiang Mai University, Thailand
- Valaya Alongkorn Rajabhat University under the Royal Patronage, Thailand
- Universiti Teknologi Malaysia (UTM), Johor Bahru, Malaysia
- Phetchabun Rajabhat University, Malaysia
- BBTW New Media, Malaysia
- King Mongkut's Institute of Technology Ladkrabang, Thailand
- BUUIC, SUIC, Thailand

- Centre For Artificial Intelligent And Robotics (CAIRO), Malaysia
- KMITL Business School, Thailand
- Sripatum University, Thailand
- Sukhothai Thammathirat Open University, Thailand
- Assumption University, Thailand
- SCG co., Thailand
- The Queen Sirikit Department of Sericulture, Thailand
- DD Medicine, Thailand

From the list below, we can see that the people who participated in the training have different functions. The Figure 2. shows some roles.

Position:

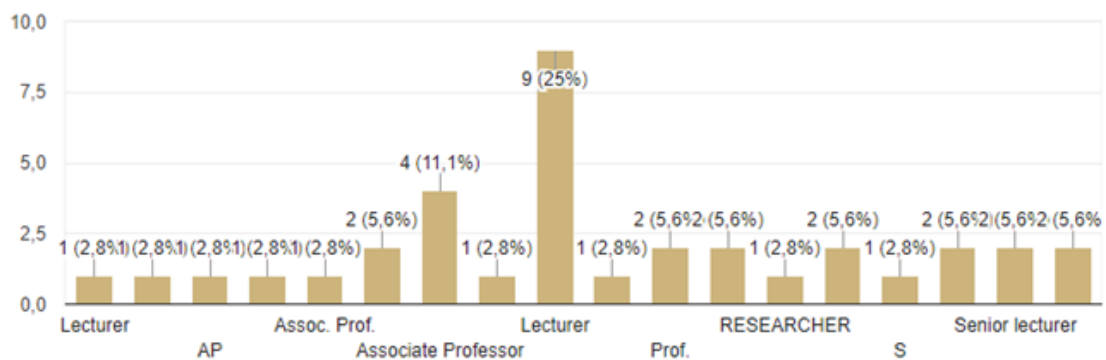


Figure 2. ToT participants position

Example of positions:

- Senior Lecturer
- Research Associate
- Associate Professor
- Lecturer
- Intern at A2Lab in Centre For Artificial Intelligent And Robotics (CAIRO)
- Professor
- Associate Professor
- Content Management
- Part-Time Instructor in Finance and Start up business

- Honorary Professor
- General Administration Officer
- Marketing
- Company employee
- Food Regulatory Consultant
- ...

Training for university and companies was provided in a mixed mode (physically and remotely) and most of the participants followed online. It has been divided into 18 different modules as follows:

Module title:	Answers
Advance Machine Learning for Big Data	7
AI for Industry	1
Artificial Intelligence for Computer Vision	7
Business Intelligence	5
Convolution Neural Network	8
Data Acquisition and Analysis	11
Data Governance and Management	10
Digital Communication	5
Green Energy Wireless Network	5
Human Resource Management for Industry 4.0	8
Introduction to AI Application	11
Introduction to Cybersecurity	7
Introduction to Energy Management	3
Introduction to Industry 4.0	1
New Product Development	6
Renewable Energy for Wireless Networks	22
Role of Data for Future Organization	8
Supervised and Unsupervised Learning	7

Table 2. ToT participants per module

Based on the answers obtained, we analysed the percentage of satisfied and dissatisfied with each question. Below are the graphs.

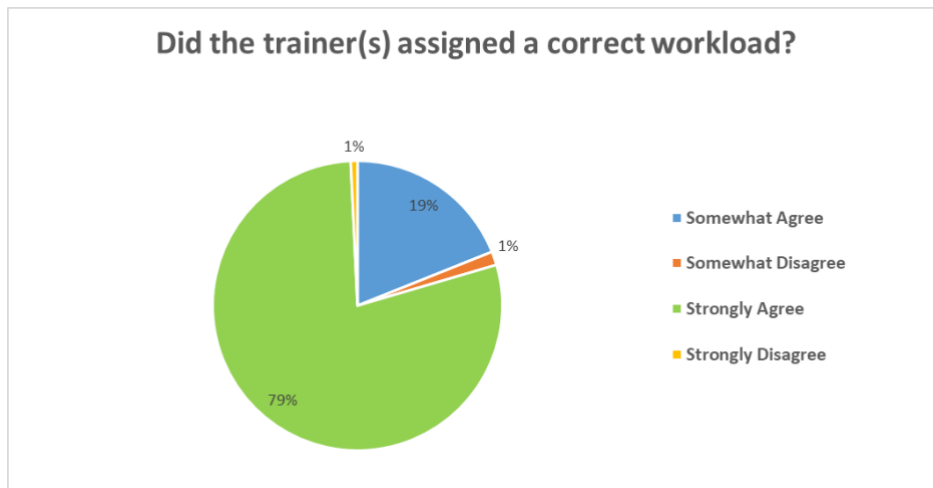


Figure 3. ToT Workload satisfaction

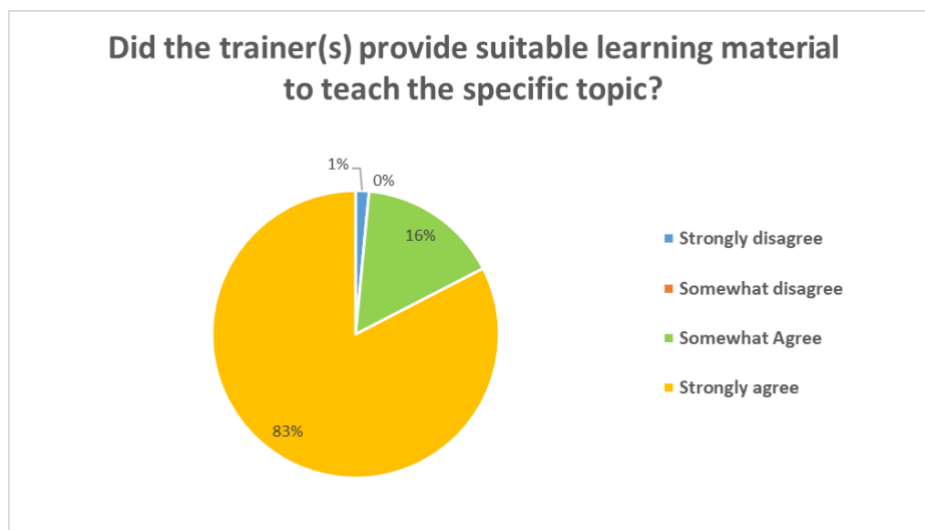


Figure 4. ToT Learning Material satisfaction

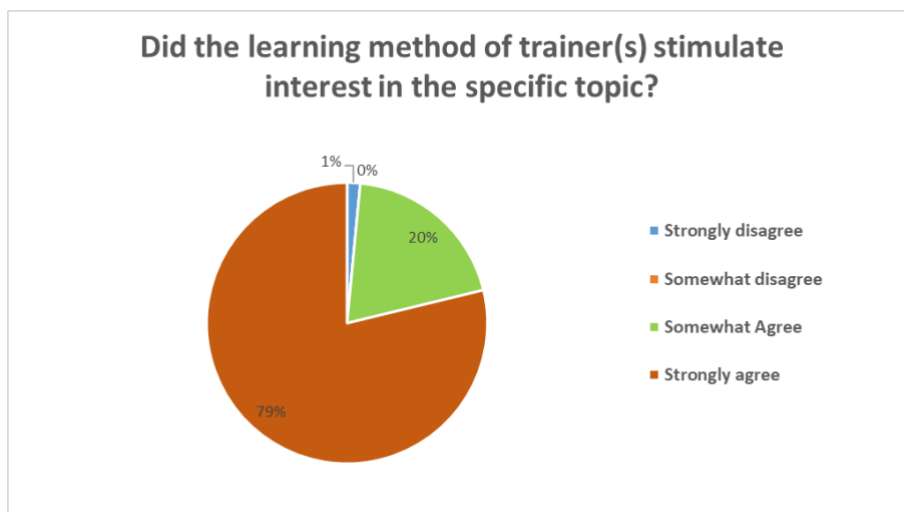


Figure 5. ToT Learning method satisfaction

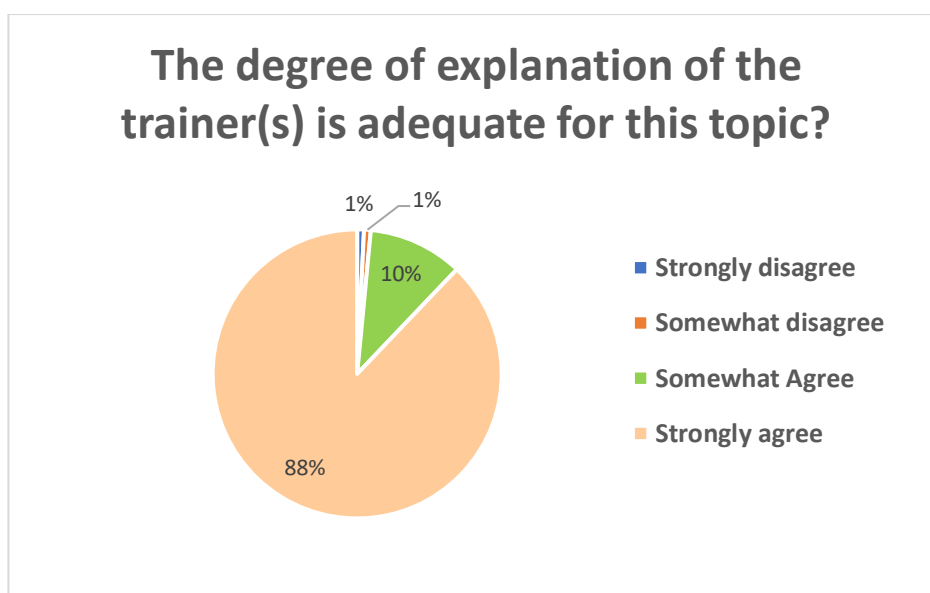


Figure 6. ToT Degree of explanation satisfaction

Do you think that the trainer(s) owns complete experience to teach this topic?

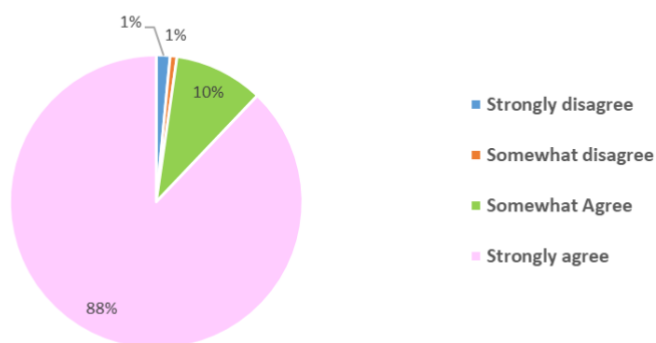


Figure 7. ToT Experience satisfaction

Did you understand the content of the module?

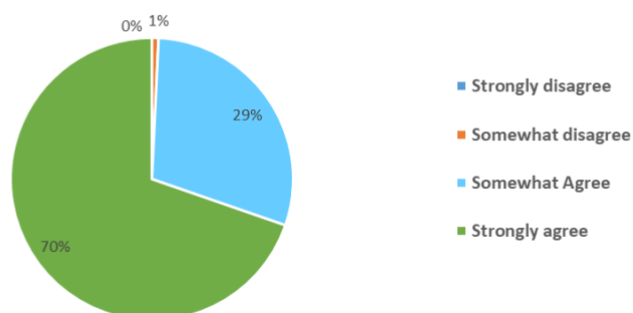


Figure 8. ToT Understanding satisfaction

Did the trainer(s) expose focus on practical cases?

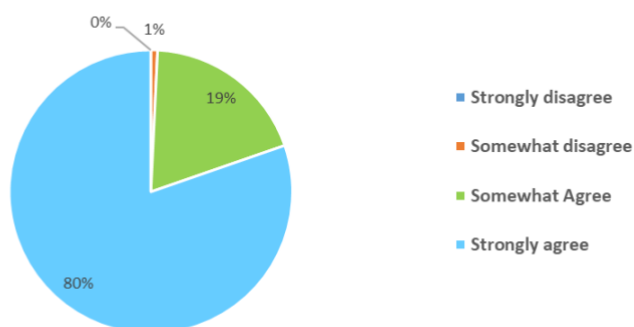


Figure 9. ToT Practical cases satisfaction

Did your trainer(s) respond to your queries in a timely manner?

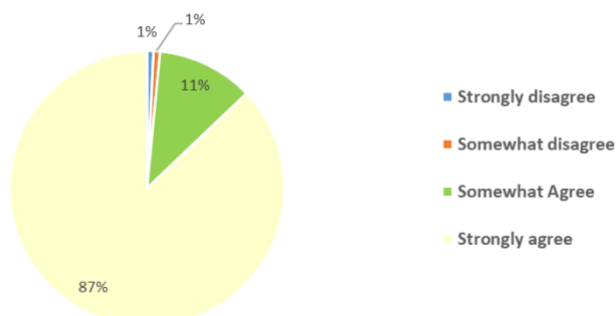


Figure 10. ToT Answers to question satisfaction



Figure 11. ToT Comfortable to be a trainer

The comments and recommendations of each trainer were analysed and reported:

- Thanks for the useful training. Hope to have the opportunity to attend interesting training sessions in the future.
- Good
- Good examples and scenarios shared during the training.
- thanks so much
- The training video must be made available for the trainers to go through again.
- Provide the brief understanding on neural network with the parameters and basic processes before the hands-on exercise.
- as a whole, the talk is very well-presented
- No comment. Thank you for the inspiration.
- great presentation
- More Hands-on applications for trainees
- Good introduction on cybersecurity, CS goals and types of malwares
- The questionnaire answers could be arranged from strongly disagree to strongly agree.
- Timing schedule
- Appreciate if this session can be extended since seems not enough for 2 hours period to cover the topic.
- 2 hours is inadequate for trainers to be able to train students. Just for exposure is fine
- Maybe the case study can be presented earlier since time is not permitting.

- understand
- This session is very interesting. Thank you for the contributions.
- It's a story that doesn't quite match the actual implementation but very interesting and can be applied in teaching. In addition, I would like the organizers to share or send documents or power point by via email so that the information I can be used for further use. Thank you so much.
- The content and use cases are very relevant.
- Very good session from a true expert.
- The content and previews are interesting. A good example can be seen from a case study in Malaysia.
- Good webinar
- Hands on session will elaborate on this topic
- Good
- Helpful presentation.
- no comment
- No comment
- Good real-world example
- It is information that can be used to build on to manage information well. and can learn to apply further
- good topic
- The learning material is very interesting.
- I learn a lot from this session. The trainer has much experience in this field. Thank you.

4.2 Audit Results (KPI for University and Company)

Based on the previously developed KPIs (see the Shyfte deliverable D3.1), the results received from university and business affiliations are analysed and the various indices calculated.

1) Effectiveness Indicator (EI) - Planned teaching and Teaching provided

This indicator will help us evaluate the training commitment undertaken by the organization towards students, with respect to the teaching actually provided.

$$EI = \frac{\text{Level of programmed teaching}}{\text{Level of teaching provided}} = 0,98$$

2) Customer Service Indicator (CSI)– Students Complaints

This indicator can also be assessed considering the workload of the teaching and the teaching material provided to the student:

$$CSI = \frac{\text{teaching workload}}{\text{teaching material}} = 0,96$$

3) Productivity Index (PI)

Refers to the teacher's responsibility for student learning.

$$PI_m = \frac{\text{Teacher Motivation}}{\text{Student learning}} = 0,87$$

$$PI_e = \frac{\text{Ability to explain}}{\text{Student learning}} = 0,90$$

4) Efficiency Indicator (E_fI)

It refers to the teacher's ability to arouse interest in students for the different domains examined. This indicator was calculated by considering each module and the responses received from both university and business affiliation.

$$E_f I_{SM} = \frac{\text{Teacher Motivation}}{\text{Interest in a specific Module}}$$

Module title	$E_f I_{SM}$
Advance Machine Learning for Big Data	0,92
AI for Industry	0,99
Artificial Intelligence for Computer Vision	0,99
Business Intelligence	0,99
Convolution Neural Network	0,93
Data Acquisition and Analysis	0,89
Data Governance and Management	0,94
Digital Communication	0,99
Green Energy Wireless Network	0,99
Human Resource Management for Industry 4.0	0,85
Introduction to AI Application	0,92
Introduction to Cybersecurity	0,88
Introduction to Energy Management	0,90
Introduction to Industry 4.0	0,99
New Product Development	0,99
Renewable Energy for Wireless Networks	0,96
Role of Data for Future Organization	0,97
Supervised and Unsupervised Learning	0,96

5) Impact Indicator (II)

This indicator allows us to make a correlation between the module in order to evaluate what is most interesting, attractive to trainers.

$$II_{SMP} = \frac{\text{Interest in a specific Module}}{\text{interest in the topics covered}}$$

Module title	Π_{SMP}
Advance Machine Learning for Big Data	0,91
AI for Industry	0,92
Artificial Intelligence for Computer Vision	0,88
Business Intelligence	0,82
Convolution Neural Network	0,96
Data Acquisition and Analysis	0,99
Data Governance and Management	0,82
Digital Communication	0,94
Green Energy Wireless Network	0,95
Human Resource Management for Industry 4.0	0,94
Introduction to AI Application	0,81
Introduction to Cybersecurity	0,71
Introduction to Energy Management	0,99
Introduction to Industry 4.0	0,99
New Product Development	0,98
Renewable Energy for Wireless Networks	0,95
Role of Data for Future Organization	0,92
Supervised and Unsupervised Learning	0,99

6) Load indicator (I_{lo})

These indicators evaluate the training commitment undertaken by the trainers and their skills.

$$I_{lo} = \frac{\text{workload value}}{\text{Max Score}} = 0,91$$

7) Compliance indicator (I_c)

Through this indicator, the proportionality of the teaching material with respect to the study topic is assessed.

$$I_c = \frac{\text{suitable teaching material}}{\text{Max Score}} = 0,92$$

8) Level indicators (LI_{pk} , LI_{st})

to evaluate the explanation of trainer and supplementary activities

$$LI_{pk} = \frac{\text{Relevance of explanation}}{\text{Max Score}} = 0,86$$

$$LI_{st} = \frac{\text{Importance of supplementary teaching activities}}{\text{Max Score}} = 0,94$$

9) Level indicators (LI_e , LI_a)

to evaluate the learning of the topics.

$$LI_e = \frac{\text{teacher skills}}{\text{Max Score}} = 0,93$$

$$LI_a = \frac{\text{teacher available}}{\text{Max Score}} = 0,95$$

4.3 Audit Results (KPI for University)

In this section we calculate the parameters based on the results received by the university affiliation.

1) Effectiveness Indicator (EI) - Planned teaching and Teaching provided

This indicator will help us evaluate the training commitment undertaken by the organization towards students, with respect to the teaching actually provided.

$$EI = \frac{\text{Level of programmed teaching}}{\text{Level of teaching provided}} = 0,97$$

2) Customer Service Indicator (CSI)– Students Complaints

This indicator can also be assessed considering the workload of the teaching and the teaching material provided to the student:

$$CSI = \frac{\text{teaching workload}}{\text{teaching material}} = 0,94$$

3) Productivity Index (PI)

Refers to the teacher's responsibility for student learning.

$$PI_m = \frac{\text{Teacher Motivation}}{\text{Student learning}} = 0,83$$

$$PI_e = \frac{\text{Ability to explain}}{\text{Student learning}} = 0,90$$

4) Efficiency Indicator (E_fI)

It refers to the teacher's ability to arouse interest in students for the different domains examined.

This indicator was calculated by considering each module and the responses received from both university and business affiliation.

$$E_f I_{SM} = \frac{\text{Teacher Motivation}}{\text{Interest in a specific Module}}$$

Module title	$E_f I_{SM}$
Advance Machine Learning for Big Data	0,92
AI for Industry	0,99
Artificial Intelligence for Computer Vision	0,99
Business Intelligence	0,99
Convolution Neural Network	0,93
Data Acquisition and Analysis	0,89
Data Governance and Management	0,94
Digital Communication	0,99
Green Energy Wireless Network	0,99
Human Resource Management for Industry 4.0	0,85
Introduction to AI Application	0,98
Introduction to Cybersecurity	0,88
Introduction to Energy Management	0,90
Introduction to Industry 4.0	0,99
New Product Development	0,99
Renewable Energy for Wireless Networks	0,96
Role of Data for Future Organization	0,99
Supervised and Unsupervised Learning	0,96

5) Impact Indicator (II)

This indicator allows us to make a correlation between the module in order to evaluate what is most interesting, attractive to trainers.

$$II_{SMP} = \frac{\text{Interest in a specific Module}}{\text{interest in the topics covered}}$$

Module title	II_{SMP}
Advance Machine Learning for Big Data	0,91
AI for Industry	0,92
Artificial Intelligence for Computer Vision	0,88
Business Intelligence	0,82
Convolution Neural Network	0,96
Data Acquisition and Analysis	0,99
Data Governance and Management	0,82
Digital Communication	0,94

Green Energy Wireless Network	0,95
Human Resource Management for Industry 4.0	0,94
Introduction to AI Application	0,84
Introduction to Cybersecurity	0,71
Introduction to Energy Management	0,99
Introduction to Industry 4.0	0,99
New Product Development	0,98
Renewable Energy for Wireless Networks	0,95
Role of Data for Future Organization	0,96
Supervised and Unsupervised Learning	0,99

6) Load indicator (I_{lo})

These indicators evaluate the training commitment undertaken by the trainers and their skills.

$$I_{lo} = \frac{\text{workload value}}{\text{Max Score}} = 0,89$$

7) Compliance indicator (I_c)

Through this indicator, the proportionality of the teaching material with respect to the study topic is assessed.

$$I_c = \frac{\text{suitable teaching material}}{\text{Max Score}} = 0,92$$

8) Level indicators (LI_{pk} , LI_{st})

to evaluate the explanation of trainer and supplementary activities

$$LI_{pk} = \frac{\text{Relevance of explanation}}{\text{Max Score}} = 0,84$$

$$LI_{st} = \frac{\text{Importance of supplementary teaching activities}}{\text{Max Score}} = 0,92$$

9) Level indicators (LI_e , LI_a)

to evaluate the learning of the topics.

$$LI_e = \frac{\text{teacher skills}}{\text{Max Score}} = 0,91$$

$$LI_a = \frac{\text{teacher available}}{\text{Max Score}} = 0,97$$

4.4 Audit Results (KPI for Company)

In this section we calculate the parameters based on the results received by the company affiliation.

1) Effectiveness Indicator (EI) - Planned teaching and Teaching provided

This indicator will help us evaluate the training commitment undertaken by the organization towards students, with respect to the teaching actually provided.

$$EI = \frac{\text{Level of programmed teaching}}{\text{Level of teaching provided}} = 0,99$$

2) Customer Service Indicator (CSI)– Students Complaints

This indicator can also be assessed considering the workload of the teaching and the teaching material provided to the students:

$$CSI = \frac{\text{teaching workload}}{\text{teaching material}} = 0,98$$

3) Productivity Index (PI)

Refers to the teacher's responsibility for student learning.

$$PI_m = \frac{\text{Teacher Motivation}}{\text{Student learning}} = 0,79$$

$$PI_e = \frac{\text{Ability to explain}}{\text{Student learning}} = 0,92$$

4) Efficiency Indicator (E_fI)

It refers to the teacher's ability to arouse interest in students for the different domains examined.

This indicator was calculated by considering each module and the responses received from both university and business affiliation.

$$E_f I_{SM} = \frac{\text{Teacher Motivation}}{\text{Interest in a specific Module}}$$

Module title	$E_f I_{SM}$
Advance Machine Learning for Big Data	0,91
Business Intelligence	0,99
Convolution Neural Network	0,94
Data Acquisition and Analysis	0,91
Data Governance and Management	0,95
Digital Communication	0,99
Green Energy Wireless Network	0,99
Human Resource Management for Industry 4.0	0,88
Introduction to AI Application	0,86
New Product Development	0,99
Renewable Energy for Wireless Networks	0,97
Role of Data for Future Organization	0,95

5) Impact Indicator (II)

This indicator allows us to make a correlation between the module in order to evaluate what is most interesting, attractive to trainers.

$$II_{SMP} = \frac{\text{Interest in a specific Module}}{\text{interest in the topics covered}}$$

Module title	II _{SMP}
Advance Machine Learning for Big Data	0,92
Business Intelligence	0,82
Convolution Neural Network	0,96
Data Acquisition and Analysis	0,99
Data Governance and Management	0,85
Digital Communication	0,94
Green Energy Wireless Network	0,96
Human Resource Management for Industry 4.0	0,94
Introduction to AI Application	0,78
New Product Development	0,98
Renewable Energy for Wireless Networks	0,95
Role of Data for Future Organization	0,88

6) Load indicator (I_{lo})

These indicators evaluate the training commitment undertaken by the trainers and their skills.

$$I_{lo} = \frac{\text{workload value}}{\text{Max Score}} = 0,93$$

7) Compliance indicator (I_c)

Through this indicator, the proportionality of the teaching material with respect to the study topic is assessed.

$$I_c = \frac{\text{suitable teaching material}}{\text{Max Score}} = 0,91$$

8) Level indicators (LI_{pk} , LI_{st})

to evaluate the explanation of trainer and supplementary activities

$$LI_{pk} = \frac{\text{Relevance of explanation}}{\text{Max Score}} = 0,88$$

$$LI_{st} = \frac{\text{Importance of supplementary teaching activities}}{\text{Max Score}} = 0,96$$

9) Level indicators (LI_e , LI_a)

to evaluate the learning of the topics.

$$LI_e = \frac{\text{teacher skills}}{\text{Max Score}} = 0,94$$

$$LI_a = \frac{\text{teacher available}}{\text{Max Score}} = 0,93$$

5. Shyfte 4.0 Audit to the students

Following the training sessions carried out during this last year of the project, we audited the students. In this section we report on the questionnaire sent to the students and analyze the responses obtained.

The response scale includes the following 4 values:

1. Strongly disagree
2. Somewhat disagree
3. Somewhat agree
4. Strongly agree.

Q1. Was the preliminary knowledge owned sufficient to understand the topics?	Score
Q.2. Is the teaching workload proportional to the work assigned?	Score
Q.3. Is the teaching material (indicated and available) suitable for the study of the topic?	Score
Q.4. Have the evaluation methods been clearly defined?	Score
Q.5. Are the lessons, exercises and other teaching activities carried out in accordance with the timetable?	Score
Q.6. Does the teacher stimulate / motivate interest in the topic?	Score
Q.7. Does the teacher explain the topics clearly?	Score
Q.8. Are the other teaching activities (exercises, games, simulation, etc.) useful for learning the topic?	Score
Q.9. Is the teacher available for clarifications and explanations?	Score
Q.10. Are you interested in the topics covered?	Score
Q.11. Have you recently developed new skills or abilities?	Score
Q.12. What is the degree of achievement of the objectives?	Score

Q.13. Did you keep your class schedule?	Score
Q.14. Have you always been cooperative?	Score
Q.15. Have you shown proper communication?	Score
Q.16. Did you use specific and appropriate language?	Score
Q.17. Did you perform the assigned tasks, respecting times and methods?	Score
Q.18. Within the topics taught, do you think that has been of your interest “Approaches and methods for value chain management”?	Score

5.1 Results of the Training of the Students sessions questionnaires

We received a total of **95 responses** from students for the Training of the Students (ToS) sessions. The following table shows the Student's answers for each question requested by the questionnaire:

	Q1. Was the preliminary knowledge owned sufficient to understand the topics?	Q.2. Is the teaching workload proportional to the work assigned?	Q.3. Is the teaching material (indicated and available) suitable for the study of the topic?	Q.4. Have the evaluation methods been clearly defined?	Q.5. Are the lessons, exercises and other teaching activities carried out in accordance with the timetable?	Q.6. Does the teacher stimulate / motivate interest in the topic?	Q.7. Does the teacher explain the topics clearly?	Q.8. Are the other teaching activities (exercises, games, simulation, etc.) useful for learning the topic?	Q.9. Is the teacher available for clarifications and explanations?
Strongly Disagree	0	0	0	0	0	0	0	0	0
Somewhat Disagree	10	0	0	0	0	0	0	7	1
Somewhat Agree	44	33	26	44	33	24	18	20	12
Strongly Agree	41	62	69	51	62	71	77	68	82
	95	95	95	95	95	95	95	95	95

	Q.10. Are you interested in the topics covered?	Q.11. Have you recently developed new skills or abilities?	Q.12. What is the degree of achievement of the objectives?	Q.13. Did you keep your class schedule?	Q.14. Have you always been cooperative?	Q.15. Have you shown proper communication?	Q.16. Did you use specific and appropriate language?	Q.17. Did you perform the assigned tasks, respecting times and methods?	Q.18. Within the topics taught, do you think that has been of your interest in this particular module?
Strongly Disagree	0	0	0	1	0	0	0	5	0
Somewhat Disagree	6	1	0	11	16	13	7	2	3
Somewhat Agree	31	33	31	30	39	44	39	38	20
Strongly Agree	58	61	64	53	40	38	49	50	72
	95	95	95	95	95	95	95	95	95

Training for students was provided in a mixed mode (physically and remotely) and most of the participants followed online. It has been divided into 14 different modules as follows:

Module title	Answers
All for Industry	5
Business Intelligence	7
Data Governance and Management	10
Digital Communication”	7

Fundamental of Artificial Intelligence	7
Green Energy Wireless Network	1
Human Resource Management for Industry 4.0"	7
Introduction to Cybersecurity	18
Introduction to Energy Management	13
New Product Development"	7
Role of Data for Future Organization"	7
Supervised and Unsupervised Learning	6

Based on the answers obtained, we analysed the percentage of satisfied and dissatisfied with each question. Below are the graphs.

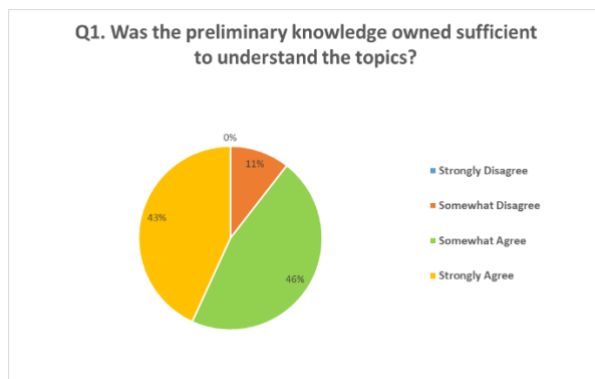


Figure 12. ToS Preliminary knowledge

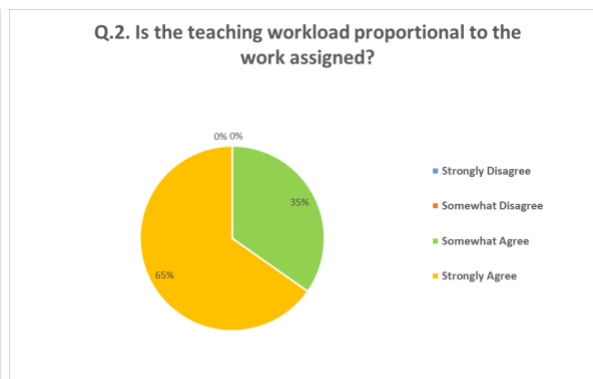


Figure 13. ToS Workload satisfaction

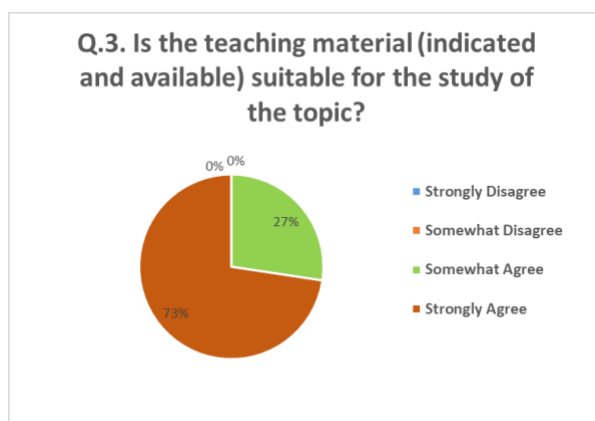


Figure 14. ToS Learning Materials

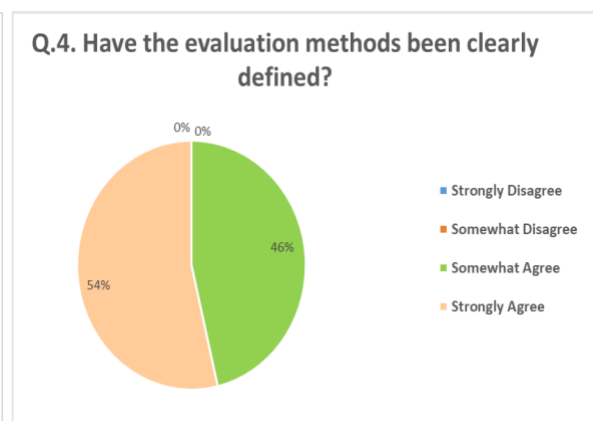


Figure 15. ToS Evaluation methods

Q.5. Are the lessons, exercises and other teaching activities carried out in accordance with the timetable?

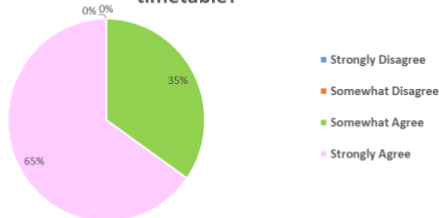


Figure 16. ToS Timetable respect

Q.6. Does the teacher stimulate / motivate interest in the topic?

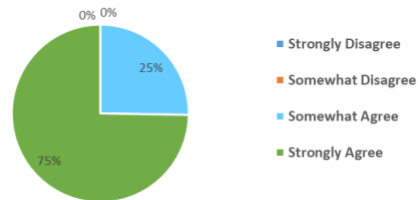


Figure 17. ToS Interest in the topic

Q.7. Does the teacher explain the topics clearly?

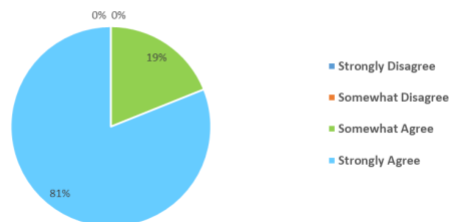


Figure 18. ToS Trainer explanation

Q.8. Are the other teaching activities (exercises, games, simulation, etc.) useful for learning the topic?

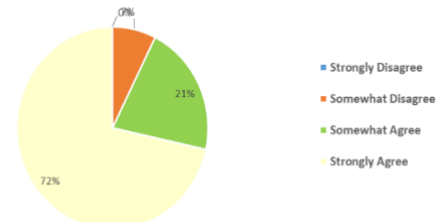


Figure 19. ToS Teaching activities

Q.9. Is the teacher available for clarifications and explanations?

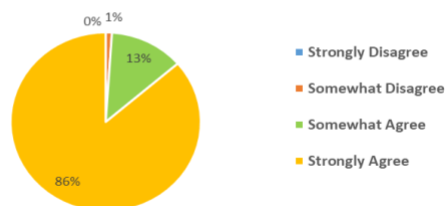


Figure 20. ToS Trainer availability

Q.10. Are you interested in the topics covered?

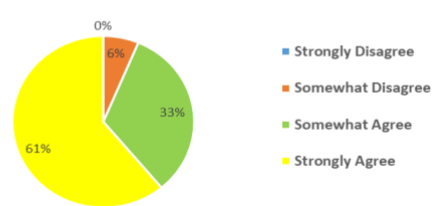


Figure 21. ToS Interest for the topic

Q.11. Have you recently developed new skills or abilities?

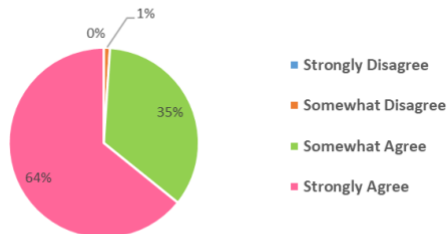


Figure 22. ToS New skills developed

Q.12. What is the degree of achievement of the objectives?

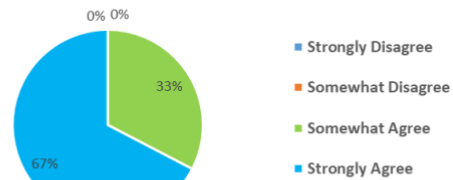


Figure 23. ToS Achievement of the objectives

Q.13. Did you keep your class schedule?

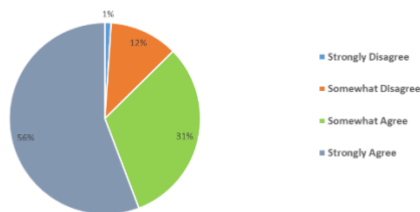


Figure 24. ToS Class schedule

Q.14. Have you always been cooperative?

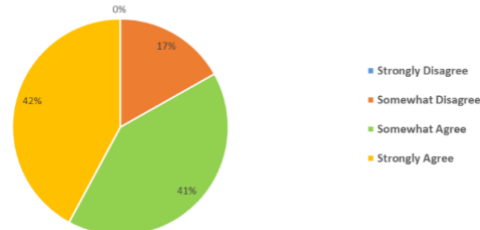


Figure 25. ToS Behavior/Cooperative

Q.15. Have you shown proper communication?

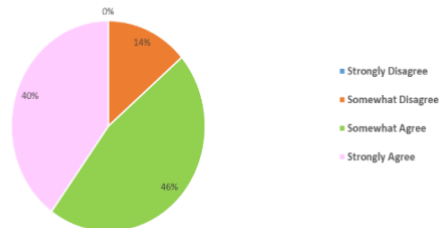


Figure 26. ToS Proper communication

Q.16. Did you use specific and appropriate language?

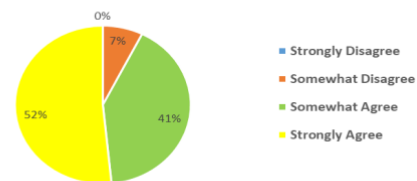


Figure 27. ToS Appropriate language

Q.17. Did you perform the assigned tasks, respecting times and methods?

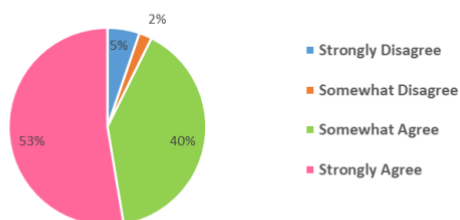


Figure 28. ToS Assigned tasks performed

Q18. Within the topics taught, do you think that has been of your interest in this particular module?

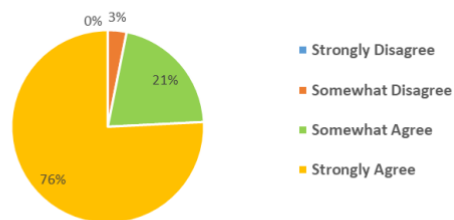


Figure 29. ToS Interest in particular module

5.2 Audit Results (KPI for Students)

Based on the previously developed KPIs (see the Shyfte deliverable D3.1), the results received from students are analysed and the various indices calculated.

1) Effectiveness Indicator (EI) - Planned teaching and Teaching provided

This indicator will help us evaluate the training commitment undertaken by the organization towards students, with respect to the teaching actually provided.

$$EI = \frac{\text{Level of programmed teaching}}{\text{Level of teaching provided}} = 0,95$$

2) Customer Service Indicator (CSI)– Students Complaints

This indicator can also be assessed considering the workload of the teaching and the teaching material provided to the student:

$$CSI = \frac{\text{teaching workload}}{\text{teaching material}} = 0,96$$

3) Productivity Index (PI)

Refers to the teacher's responsibility for student learning.

$$PI_m = \frac{\text{Teacher Motivation}}{\text{Student learning}} = 0,97$$

$$PI_e = \frac{\text{Ability to explain}}{\text{Student learning}} = 0,96$$

4) Efficiency Indicator (EI)

It refers to the trainer's ability to arouse interest in students for the different domains examined.

This indicator was calculated by considering each module and the responses received from both university and business affiliation.

$$E_f I_{SM} = \frac{\text{Teacher Motivation}}{\text{Interest in a specific Module}}$$

Module title	$E_f I_{SM}$
All for Industry	0,97
Business Intelligence	0,91
Data Governance and Management	0,95
Digital Communication"	0,93
Fundamental of Artificial Intelligence	0,94
Green Energy Wireless Network	0,99
Human Resource Management for Industry 4.0"	0,83
Introduction to Cybersecurity	0,94
Introduction to Energy Management	0,95
New Product Development"	0,93
Role of Data for Future Organization"	0,92
Supervised and Unsupervised Learning	0,93

5) Impact Indicator (II)

This indicator allows us to make a correlation between the module in order to evaluate what is most interesting, attractive to trainers.

$$II_{SMP} = \frac{\text{Interest in a specific Module}}{\text{interest in the topics covered}}$$

Module title	II_{SMP}
All for Industry	0,94
Business Intelligence	0,92
Data Governance and Management	0,92
Digital Communication"	0,91
Fundamental of Artificial Intelligence	0,92
Green Energy Wireless Network	0,50
Human Resource Management for Industry 4.0"	0,89
Introduction to Cybersecurity	0,89
Introduction to Energy Management	0,92
New Product Development"	0,91
Role of Data for Future Organization"	0,89
Supervised and Unsupervised Learning	0,91

6) Load indicator (I_{lo})

These indicators evaluate the training commitment undertaken by the trainers and their skills.

$$I_{lo} = \frac{\text{workload value}}{\text{Max Score}} = 0,91$$

7) Compliance indicator (I_c)

Through this indicator, the proportionality of the teaching material with respect to the study topic is assessed.

$$I_c = \frac{\text{suitable teaching material}}{\text{Max Score}} = 0,92$$

8) Level indicators (LI_{pk} , LI_{st})

To evaluate the explanation of trainer and supplementary activities

$$LI_{pk} = \frac{\text{Relevance of explanation}}{\text{Max Score}} = 0,83$$

$$LI_{st} = \frac{\text{Importance of supplementary teaching activities}}{\text{Max Score}} = 0,91$$

9) Level indicators (LI_e , LI_a)

To evaluate the learning of the topics.

$$LI_e = \frac{\text{teacher skills}}{\text{Max Score}} = 0,94$$

$$LI_a = \frac{\text{teacher available}}{\text{Max Score}} = 0,96$$

6. Conclusion

The Shyfte Learning Centers propose several training services for students and SME trainees.

The quality management system developed for the Learning Centers is based on several services and processes. It proposes a quality dashboard to evaluate and analyze the main KPI's defined to evaluate the quality of the training processes.

This deliverable described the training program audits. These audits allowed partner countries to analyze and evaluate the transfer of Skills 4.0 to trainers and students. The evaluation of the Impact Indicators allowed the dissemination of the results with dedicated events in the Partner Countries.

An audit campaign was also conducted in a group of SMEs from the Partner Countries with impact indicators (see deliverable D3.3).

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