

WP4: Quality Control and Monitoring

Audit Report

(External Quality Control and Monitoring)

Project Acronym:	MSIE 4.0
Project full title:	Curriculum Development of Master's Degree Program in Industrial Engineering for Thailand Sustainable Smart Industry
Project No.:	586137-EPP-I-2017-I-TH-EPPKA2-CBHE-JP
Funding Scheme:	Erasmus + KA2 - Capacity Building in the field of Higher Education
Coordinator:	AIT
Work Package:	WP4
WP Leader:	Livia Lazar
Task Title:	Task 4.3: Inviting external evaluation of the project results
Task Leader:	Supapan Chairapat
Last version date:	26.11.2020.
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REVISION SHEET

Version	Date	Author (Partner/Person)	The revision reason
1	18.11.2020.	Ružica Nikolić	
2	26.11.2020.	Ružica Nikolić	Accepted remarks from the PC, PEC and QCMB
3	30.11.2020.	Ružica Nikolić	Accepted remarks from the PC

DISTRIBUTION LIST

Project Partner	Acronym	Responsible (for dissemination)*
PEC		
P1: Chiang Mai University	CMU	Wichai Chattinnawat
P2: Khon Kaen University	KKU	Kanchana Sethanan
P3: King Mongkut's University of Technology North Bangkok	KMUTNB	Athakorn Kengpol
P4: Czestochowa University of Technology, Poland	CUT	Tomasz Nitkiewicz
P5: Prince of Songkla University	PSU	Thanate Ratanawilai
P6: Thammasat University	TU	Apiwat Muttamara
P7: University of Minho, Portugal	UMinho	Rui M. Lima
P8: University Politehnica of Bucharest, Romania	UPB	Tom Savu
P9: Asian Institute of Technology	AIT	Pisut Koomsap
QCMB		
University Politehnica of Bucharest	UPB	Livia Lazar
Prince of Songkla University	PSU	Supapan Chaiprapat
Asian Institute of Technology	AIT	Huynh Trung Luong
Chiang Mai University	CMU	Wasawat Nakkiew
King Mongkut's University of Technology North Bangkok	KMUTNB	Warapoj Meethom
Thammasat University	TU	Anintaya Khamkanya
Khon Kaen University	KKU	Sirorat Pattanapiroj
University of Minho	UMinho	Diana Mesquita
Częstochowa University of Technology	CUT	Robert Ulewicz



Work Package Leader		
University of Minho	UMinho	Rui M. Lima, WPL1
Chiang Mai University	CMU	Wichai Chattinnawat, Co-WPL1
Częstochowa University of Technology	CUT	Tomasz Nitkiewicz, WPL2
Asian Institute of Technology	AIT	Pisut Koomsap, Co-WPL2
Asian Institute of Technology	AIT	Huynh T. Luong, WPL3
University of Minho	UMinho	Rui M. Lima, Co-WPL3
University Politehnica of Bucharest	UPB	Livia Lazar, WPL4
Prince of Songkla University	PSU	Supapan Chairapat, Co-WPL4
Khon Kaen University	KKU	Kanchana Sethanan, WP5
University Politehnica of Bucharest	UPB	Andrei Dumitrescu, Co-WPL5

***The dissemination responsible refers to the team member of each partner involved in the task's deliverable/outcome that must disseminate the data within the partner internal team.**



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1 Executive Summary

This Audit report contains data on the performed Audit process of the Project "Curriculum Development of Master's Degree Program in Industrial Engineering for Thailand Sustainable Smart Industry Project (MSIE4.0)", which is funded by the European Commission within the Erasmus+ program, KA2 – Cooperation for innovation and the exchange of good practices – Capacity Building in the field of Higher Education, Project number 586137-EPP-1-2017-1-TH-EPPKA2-CBHE-JP.

This audit process has covered the period of the project realization from 01.11.2019 to 14.10.2020, i.e. since the Mid-term implementation audit until the project completion.

The audit process was realized in two phases: the first phase assumed that auditor reviewed the available documentation on the project implementation, while the second phase consisted of the four-day online interviews with the project team members. It was realized according to mutually agreed Audit plan during the period from 02.11.2020 to 05.11.2020.

The auditor has interviewed, via the tele-conferencing, all the categories of the project team members, including the Project Coordinator – professor Pisut Koomsap from Asian Institute of technology, members of the Project Executive Committee (PEC), members of the Quality Control and Monitoring Board (QCMB), other members of the Project Management Team (PMT) – Work Package Leaders and Task Leaders, as well as the project administrative and technical staff and students that were attending the *Pilot courses* offered during the project realization.

The main objective of this audit was to review and evaluate the actual status of the project implementation at its closing. That assumed establishing the level of compliance of achieved results with criteria determined for the project success and verifying the content of the project documents and all the kinds of reports.

The audit process included evaluation of quality of the project management process, evaluation of Implementation of the planned activities and workload distribution across the work packages and activities actually undertaken, as well as estimate of compliance of the achieved project outputs and outcomes with the planned ones. Efficiency and quality of the project documentation were also evaluated, as well as efficiency of the applied project management tools and the project results validity and sustainability.

Based on the reviewed documentation, the online interviews with team members and their answers to questionnaires, as well as the virtual tour of the project laboratory at Asian Institute of Technology in Bangkok, the auditor was able to draw conclusions on all the aspects of the project implementation, management, quality control, realized activities, executed outputs, outcomes and deliverables.

The problems that were noticed in the project realization by the project team members were presented to auditor sincerely and without hesitation.

The general conclusion by the auditor is that the project was executed properly and successfully, that the project team was doing their best to implement all the aspects of the project in time and with adequate level of quality. Eventual setbacks and problems were remedied and eliminated in time and the project was fully implemented as planned.

It should be emphasized that the project team members managed to bring the project to a successful closure despite the Covid-19 pandemic, which caused changes in activities on project realization, especially in the area of communication and planned meetings realization, which almost all had to switch either to fully online or to the hybrid form.



2 Introduction

Project:

"Curriculum Development of Master's Degree Program in Industrial Engineering for Thailand Sustainable Smart Industry Project (MSIE4.0)"

Funded by the European Commission:

Project number 586137-EPP-1-2017-1-TH-EPPKA2-CBHE-JP

Erasmus+ programme, KA2 – Cooperation for innovation and the exchange of good practices – Capacity Building in the field of Higher Education

Audit period:

01.11.2019 – 30.09.2019 (Final implementation audit)

Project is implemented by the following universities:

P1: Chiang Mai University (CMU)

P2: Khon Kaen University (KKU)

P3: King Mongkut's University of Technology North Bangkok (KMUTNB)

P4: Czestochowa University of Technology (CUT), Poland

P5: Prince of Songkla University (PSU)

P6: Thammasat University (TU)

P7: University of Minho (UMinho), Portugal

P8: University Politehnica of Bucharest (UPB), Romania

P9: Asian Institute of Technology (AIT)

Project coordinator: Dr. Pisut Koomsap, Associate professor (AIT)

Auditor:

Professor **Ružica Nikolić**, PhD, SM, MSc, Dipl. Eng.

University of Žilina

Research Center

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Slovakia

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Basic information on the project

[01 MSIE 4.0 Project Proposal.pdf](#)

Project objective(s):

Wider Objective:

The objective of this capacity building project is to enhance the capacity and ability of universities in Thailand for the delivery of a high quality competence-based curriculum for Master's degree in industrial engineering that supports sustainable smart industry, conforms to European Qualifications Framework (EQF), is applicable to European partner universities, and strengthens a partnership between participating European and Thai universities.

Specific project Objectives:

- **SO1** Modernization of the education of industrial engineering discipline in Thailand by the development of a curriculum for Master's degree in industrial engineering to support sustainable smart industry,
- **SO2** Development of courses, learning and teaching tools, delivery processes and platform for student-centered learning of the curriculum,
- **SO3** Implementation of modern ICT tools and methodologies for effective student-centered learning of the curriculum,
- **SO4** Introductions of quality assurance and of the EQF approach for the delivery of the curriculum meeting international accepted education,
- **SO5** Establishment and continuation of partnerships among partner universities.

Project outputs and outcomes:

[01 MSIE 4.0 Project Proposal.pdf](#)

WP1 – Gap Analysis

- Gap Analysis working plan
 - Comprehensive analysis of MSIE curricula in Thailand and in EU partner countries
 - Assessment of learning and teaching tools & methods in Thailand and in EU partner countries
 - Analysis of needs of industry and students
 - Gaps between the needs and graduates' competences
 - Competitive factors for the curriculum
 - Recommendations for specifications and areas of specialization for the curriculum
- Workload 16 %, Budget 6.7 %

WP2 – Curriculum Development I: Curriculum Structure and Courses

- A modernized curriculum for Master's degree in IE
 - Syllabuses for all courses in the curriculum
 - Pilot teaching in modernized MSc at partner universities
 - Assessment of pilot test of the key courses & improved courses
 - Accreditation of the curriculum
- Workload 16 %, Budget 6.5 %

WP3 – Curriculum Development II: Modernization of Teaching Methods and Tools for Innovative MSc Programmes

- *Teaching materials for instructors*
 - *Learning materials for students*
 - *A platform for online learning*
 - *Trained instructors & staffs on new teaching tools & methods*
 - *Online learning materials*
 - *Installed hardware & software*
 - *Laboratory equipped with online remote access from partner locations*
- *Workload 28 %, Budget 51.2 %*

WP4 – Quality Control and Monitoring

- *Quality control & monitoring system*
 - *Internal quality control & monitoring*
 - *External quality control & monitoring*
 - *External financial audit*
- *Workload 13 %, Budget 14.3 %*

WP5 – Dissemination and Exploitation of Project Results

- *A Dissemination, Exploitation and Sustainable plan (DESP),*
 - *A project website,*
 - *Dissemination materials,*
 - *Publications in professional journals, newspapers, magazines, brochures and social media,*
 - *Short-term courses in the field of Industrial Engineering for professionals,*
 - *Dissemination events,*
 - *A dissemination-sustainability conference*
 - *Sustainable network between project partners & IE enterprises*
- *Workload 13 %, Budget 5.2 %*

WP6 – Project Management

- *Project management & communication plan (PMCP)*
 - *Kick-off & regular consortium meetings*
 - *Documents on daily project administration and coordination*
 - *Project reports*
- *Workload 15 %, Budget 16.1 %*

Project budget:

[01 MSIE 4.0 Project Proposal.pdf](#)

Staff costs: 392,328 eur

Travel costs: 135,590 eur

Costs of stay: 131,040 eur

Equipment costs: 292,670 eur

Subcontracting costs: 30,000 eur

Total budget: 981,628 eur.

*B: Budget awarded by the European Commission:*

Staff costs: 392,328 eur

Travel costs: 135,590 eur

Costs of stay: 131,040 eur

Equipment costs: 292,670 eur

Subcontracting costs: 30,000 eur

Total budget: 981,628 eur.

Implementation dates:

15.10.2017. – 14.10.2020.

Audit objectives:

The main objective of this audit was to review and evaluate the actual status of the project implementation at its closure. That includes establishing the level of compliance of achieved results with the criteria determined for the project success, to verify the content of the project documents and QCM reports.

To achieve the set objective, the following partial objectives were set: evaluation of the quality of the project management process, evaluation of implementation of the planned activities and the workload distribution across the work packages and activities actually undertaken. Further, to estimate compliance of the achieved project outputs and outcomes with the planned outputs and outcomes, to review efficiency and quality of the project documentation, evaluate efficiency of the applied project management tools and assess the validity and sustainability of the project results: outcomes of the corresponding tasks.

Representatives of the audited project

The project is represented by the Project Coordinator, Professor Pisut Koomsap of AIT, The Project Management Team (PMT), consisting of The Project Executive Committee (PEC), which consists of representatives of all the partner universities (Table 1) and the Administrative members (AM) (Table 2) that consists of the Work-Packages Leaders and Co-leaders. The quality control of the project realization is conducted by the Quality Control and Monitoring Board (QCMB), which also has representatives of all the partner universities (Table 3).



Table 1. Project Executive Committee members

[02 PMC Plan.pdf](#)

No.	Partner	Name	E-mail
1	AIT	Pisut Koomsap	pisut@ait.asia
2	CMU	Wichai Chattinnawat	chattinw@gmail.com
3	KMUTNB	Athakorn Kengpol	athakorn.kengpol@gmail.com
4	TU	Apiwat Muttamara	mapiwat@engr.tu.ac.th
5	KKU	Kanchana Sethanan	ksethanan@gmail.com
6	PSU	Thanate Ratanawilai	thanate.r@psu.ac.th
7	UPB	Tom Savu	tomsavu@gmail.com
8	UMinho	Rui M. Lima	rml@dps.uminho.pt
9	CUT	Tomasz Nitkiewicz	tomasz.nitkiewicz@wz.pcz.pl

Table 2. Administrative members

[02 PMC Plan.pdf](#)

WP	Role	Name	Partner	E-mail
6	PC ¹	Pisut Koomsap	AIT	pisut@ait.asia
1	WP-L ²	Rui M. Lima	UMinho	rml@dps.uminho.pt
	Co-WP-L ³	Wichai Chattinnawat	CMU	chattinw@gmail.com
2	WP-L	Tomasz Nitkiewicz	CUT	tomasz.nitkiewicz@wz.pcz.pl
	Co-WP-L	Pisut Koomsap	AIT	pisut@ait.asia
3	WP-L	Huynh T. Luong	AIT	luong@ait.asia
	Co-WP-L	Rui M. Lima	UMinho	rml@dps.uminho.pt
4	WP-L	Livia Lazar	UPB	livia_veronica_lazar@yahoo.com
	Co-WP-L	Supapan Chairapat	PSU	supapan.s@psu.ac.th
5	WP-L	Kanchana Sethanan	KKU	ksethanan@gmail.com
	Co-WP-L	Andrei Dumitrescu	UPB	dumitrescu.andrei@yahoo.co.uk

¹ PC – Project Coordinator; ² WP-L – Work Package Leader; ³ Co-WP-L – Co-Work Package Leader



Table 3. Quality Control and Monitoring Board members

[03_QCM Plan.pdf](#)

No.	Partner	Name	Role	E-mail
1	UPB	Livia Veronica Lazar	Chair	livia_veronica_lazar@yahoo.com
2	PSU	Supapan Chaiprapat	Co-Chair	supapan.s@psu.ac.th
3	AIT	Huynh Trung Luong	Member	luong@ait.asia
4	CMU	Wasawat Nakkiew	Member	wasawat@eng.cmu.ac.th
5	KMUTNB	Warapoj Meethom	Member	Warapoj.m@kmutnb.ac.th
6	TU	Anintaya Khamkanya	Member	kanintay@engr.tu.ac.th
7	KKU	Sirorat Pattanapiroj	Member	siropa@kku.ac.th
8	UMinho	Diana Mesquita	Member	diana@dps.uminho.pt
9	CUT	Robert Ulewicz	Member	robert.ulewicz@wz.pcz.pl

List of the checked documentation:

[06 Project Documents List.pdf](#)

1. Project proposal [01_MSIE 4.0 Project Proposal.pdf](#)
2. Midterm Technical Report 14.04.2019. [04 Midterm Technical Report.pdf](#)
3. Annex V – Technical Implementation report of 14.04.2019.

[05 Annex V - Technical Implementation Report.pdf](#)

4. Quality Control and management plan
5. Project Management and Communication Plan
6. Reports on individual Work Packages, Tasks and Outputs
7. Meetings' minutes (PEC, QCM Board and Training sessions)
8. Document templates
9. Courses' syllabi
10. Courses' teaching materials
11. Video clips
12. List of promotional meetings/seminars
13. List of published papers related to the project realization
14. Templates for various reports
15. Questionnaire answers of the Project coordinator
16. Questionnaires answers of the PEC members
17. Questionnaires answers of the QCMB members
18. Questionnaires answers of the team members

19. Questionnaires answers of students

20. Mid-term audit report

https://msie4.ait.ac.th/wp-content/uploads/sites/5/2020/11/Audit-report_Final-version.pdf

Audit process overview

[07 Audit Plan \(Final Audit\) with Meeting ID.pdf](#)

Audit process was performed in two phases.

The first phase assumed that auditor reviewed the available documentation on the project implementation.

That included daily contacts with Mrs. Supapan Chaiprapat, person in charge of supplying all the necessary information that auditor requested and/or could not find in available documentation.

Auditor is again expressing gratitude for all the help and the time she has devoted to help in making this report.

The second phase consisted of four days of online interviews with the project team members and virtual tour to the project laboratory at Asian Institute of Technology in Bangkok, Thailand. Total of 47 team members and students took part in the auditing process, including Project Coordinator, 8 members of the Project Executive Committee, 8 members of the project Quality Control and Monitoring Board, 22 team members and 8 students.

That phase was realized according to mutually agreed audit plan during the period from 02.11.2020 to 05.11.2020.

The following project representatives and team members were participating in the audit (Tables 4 to 10).

Table 4. Project Executive Committee members present during the online interviews

No.	Name	Partner	Role(s)	Date and time (CET)
1	Pisut Koomsap	AIT	Project Coordinator	02.11.2020. 09:00 – 11:00
2	Athakorn Kengpol	KMUTNB	PEC member	02.11.2020. 13:00 – 15:00
3	Apiwat Mutamara	TU	PEC member	
4	Wichai Chattinnawat	CMU	PEC member	
5	Rui M. Lima	UMinho	PEC member	
6	Tomasz Nitkiewics	CUT	PEC member	
7	Tom Savu	UPB	PEC member	
8	Livia Lazar	UPB	PEC member	
9	Kanchana Sethanan	KKU	PEC member	
10	Thanate Ratanawilai	PSU	PEC member	


Table 5. Project Quality Control and Monitoring Board members present during the online interview

No.	Name	Partner	Role(s)	Date and time (CET)
1	Livia Veronica Lazar	UPB	QCM Board Chair	04.11.2020. 09:00 – 11:00
2	Supapan Chaiprapat	PSU	QCM Board member	
3	Anintaya Khamkanya	TU	QCM Board member	
4	Sirorat Pattanapiroj	KKU	QCM Board member	
5	Wasawat Nakkiew	CMU	QCM Board member	
6	Warapoj Meethom	KMUTNB	QCM Board member	
7	Diana Mesquita	UMinho	QCM Board member	
8	Robert Ulewicz	CUT	QCM Board member	

Table 6. Work Package Leaders and Task Leaders present during the online interview

No.	Name	Partner	Role(s)	Date and time (CET)
1	Tomasz Nitkiewics	CUT	WP2 Leader, Task Leader 2.1, 2.2., 2.4.	03.11.2020. 09:00 – 10:00
2	Huynh Trung Luong	AIT	WP3 Leader, Task Leader 2.3., 3.3., 3.5.	
3	Kanchana Sethanan	KKU	Task Leader 2.5.,2.6	
4	Diana Mesquita	UMinho	Task Leader 3.1., 3.4.	
5	Montalee Sasananan	TU	Task Leader 3.2.	
6	Kanchana Sethanan	KKU	WP5 Leader, Task Leader 5.7.	03.11.2020. 10:00 – 11:00
7	Andrei Dumitrescu	UPB	Task Leader 5.1.	
8	Huynh Trung Luong	AIT	Task Leader 5.2.	
9	Thitipong Jamrus	KKU	Task Leader 5.3., 5.4, 5.6.	
10	Athakorn Kengpol	KMUTNB	Task Leader 5.5.	
11	Pisut Koomsap	AIT	WP6 Leader, Task Leader 6.1. - 6.4.	

Table 7. Project Course Developers and Pilot Test Instructors present during the online interview

No.	Name	Partner	Course	Date and time (CET)
1	Uttapol Smutkupt	CMU	<i>Smart Operations Management*</i>	03.11.2020. 13:00 – 15:00
2	Anna Wiśniewska-Sałek	CUT	<i>Sustainable Supply Chain Management*</i>	
3	Suriya Jirasatitsin	PSU	<i>Intelligent Decision Support Systems*</i>	
4	Kunlapat Thongkaew	PSU	Collaborative Manufacturing Systems	
5	Mihaela Ulmeanu	UPB	Additive Manufacturing for Industry 4.0	
6	Agnieszka Ociepa-Kubicka	CUT	Innovative Product Design and Development	
7	Naris Charoenporn	TU	<i>Human-centric Design for Operator 4.0*</i>	

*Pilot-tested courses

Table 8. Conference Organizers and Project Administratives present during the online interview

No.	Name	Partner	Role	Date and time (CET)
1	Pisut Koomsap	AIT	Conference organizing, participants, content and feedback	04.11.2020. 13:00 – 14:00
2	Kanchana Sethanan	KKU		
3	Duangthida Hassadintorn Na Ayutthaya	AIT		
4	Technical team members			

Table 9. Training instructors present during the online interview

No.	Name	Partner	Course	Date and time (CET)
1	Kanchana Sethanan	KKU		04.11.2020. 14:00 – 15:00
2	Athakorn Kengpol	KMUTN B		
3	Wichai Chattinnawat	CMU		
4	Naris Charoenporn	TU		
5	Suriya Jirasatitsin	PSU		

Table 10. Students present during the online interview

No.	Name	Partner	Course	Date and time (CET)
1	Ms. Phanumas Sojithamporn	AIT	Applied Data Analytics	05.11.2020. 13:00 – 14:00
2	Mr. Kaswan Sriadan	PSU	Intelligent Decision Support Systems	
3	Mr. Chaichana Suedamrong	CMU	Smart Operations Management	
4	Ms. Kannika Charoenwong	CMU	Smart Operations Management	
5	Mr. Akkasajja Duangsupasin	KMUTNB	Digital Factory	



3 Audit findings

3.1. Findings based on the reviewed project documentation

Project was executed according to the Adjusted Work Plan, which is the substitute for the Original Work Plan from the project proposal.

[08 Adjusted Work Plan 30.09.2019.pdf](#)

[09 Proposed Workplan.pdf](#)

3.1.1 Project implementation management

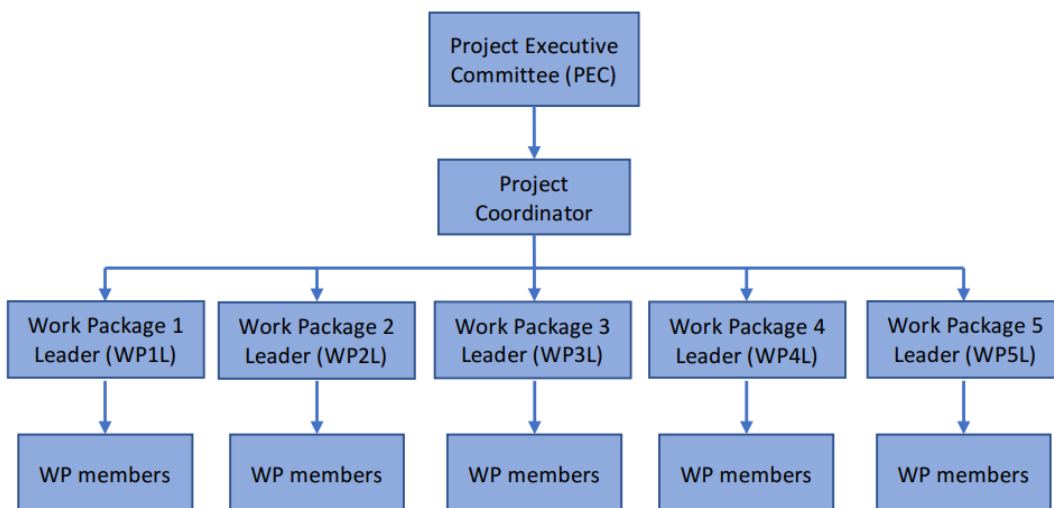
Based on review of the available documentation, presented by the project team, as well as on answers to respective questionnaires (by the Project Coordinator, members of the Project Executive Committee (PEC), members of the Quality Control and Monitoring Board (QCMB), the Team members and students) it was established that there were adequate procedures for all the aspects of the project realization.

[03 QCM Plan.pdf](#)

Those include the project management, quality control and monitoring, budget management, risk management, tasks and results (outputs and deliverables) management, introducing changes and producing and keeping the project documentation. The project management structure is presented in Table 11.

[02 PMC Plan.pdf](#)

Table 11. The project management structure



The Project Coordinator, as well as members of the PEC and QCM Board were appointed by their respective institutions (universities). Each member of these bodies was aware of his/hers tasks, competencies, as well as their extents.

Roles and responsibilities of all the project-managing bodies, Work Package leaders and team members were strictly defined in the Project Management and Communication Plan.

Project Operations Management Flow was defined in such a way that the project is managed at three levels: operation (WP1, WP2, WP3, and WP5), monitoring and control (WP4) and management (WP6).

[02 PMC Plan.pdf](#)



The Work Package Leaders (WPLs) were managing and were accountable for their WPs. All the operational tasks were initiated by the WPLs who allocated the tasks to the task members nominated by the Partner Leaders (PLs). The WPLs were responsible for updating the Project Coordinator on the status of ongoing tasks on a monthly basis. For each completed task, the responsible WPL submitted the deliverable to his/her representative in the QCMB for initial evaluation. The deliverable was then sent to the QCMB for approval. Then, the deliverable was submitted to the PEC via the PC for final approval. In the case that the deliverable was rejected at any stage, the WPL was informed immediately. According to the monthly reports from the WPLs, the PC was submitting the progress report to the PEC and was informing the QCMB. For the WP4 tasks, the chair of the QCMB initiated all the tasks. With endorsement of the QCMB, the Chair submitted deliverables to the PEC via the PC for the final approval. For the WP6 tasks, the PC submitted the progress reports to the PEC directly for approval and informed the QCMB.

Communication within the project managing bodies, between them and with other team members was going on without major problems, as before the mid-term audit. The problems caused by the Covid-19 pandemic did cause some delays in communications, which is understandable, particularly since the QCMB Chair was ill and hospitalized. Despite that, Ms. Livia Lazar managed to follow the QCMB tasks and submitted the final QCMB report in time for this auditing.

Channels for communications were face-to-face meetings, teleconferences, E-mail, written messages and the project website. Since March of 2020, the face-to-face meetings actually were limited to Thailand partners. The communication with the EU partners was strictly online.

At the time of the mid-term auditing the Project Coordinator, as well as the PEC and QCMB members pointed that at the very beginning of the project realization there were some problems in communications, in general. In their opinion, those problems primarily appeared from the two reasons: the differences that appear in the timeline of the school year's beginning and duration between the European and Thailand universities (as well as between the Thailand universities themselves), which can be as long as two months (illustration is presented in Table 12) and some cultural differences. In addition, the time difference of 5 or 6 hours is not helping to unimpeded flow of communications.

Table 12. Partners' Academic Schedule

School year	2017		2018		2019		2020	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Partner								
AIT	05.08.2017	07.01.2018	05.08.2018	07.01.2019	05.08.2019	07.01.2020	05.08.2020	07.01.2021
UMinho	11.09.2017	05.02.2018	10.09.2018	04.02.2019	09.09.2019	03.02.2020	TBA	TBA
CUT	01.10.2017	19.02.2018	01.10.2018	18.02.2019	01.10.2019	24.02.2020	01.10.2020	22.02.2021
UPB	25.09.2017	19.02.2018	24.09.2018	18.02.2019	23.09.2019	17.02.2020	21.09.2020	15.02.2021
CMU	15.08.2017	03.01.2018	06.08.2018	02.01.2019	05.08.2019	16.12.2019	22.06.2020	09.11.2020
KKU	31.07.2017	08.01.2018	06.08.2018	07.01.2019	22.07.2019	02.12.2019	TBA	TBA
TU	15.08.2017	08.01.2018	14.08.2018	14.01.2019	13.08.2019	13.01.2020	TBA	TBA
PSU	15.08.2017	08.01.2018	14.08.2018	07.01.2019	05.08.2019	23.12.2019	13.07.2020	30.11.2020
KMUTNB	08.08.2017	09.01.2018	07.08.2018	08.01.2019	06.08.2019	11.12.2019	17.06.2020	11.11.2020

However, the general conclusion of all the participants in the auditing process was that the initial differences have been overcome and that communication at all the levels was normal and without any problems.



That is reiterated during the final audit, since all the participants in their respective questionnaires emphasized that there were no communication problems, apart from those due to the Covid-19 epidemic.

In the other types of communication, which are concerned with assigning tasks to the team members and their executing them, there were no major problems, which was already established during the mid-term audit. The only problems could (and did) arise from the fact that this was the first time that this type of project was realized at Thailand high education institutions. Some team members, as well as some of the project management bodies' members, did not quite grasp the EU programs (Erasmus+) procedures and regulations, since those are very different from the ways of the projects, in which they participated earlier, were realized. Problems of this type were gradually overcome, as well. It is the opinion of the auditor that those problems were eliminated as well, since the project participants answered in questionnaires that they were happy and grateful to being given a chance to work on this new type of projects and that they learned a lot about the project procedures and management. (See some answers in section 3.4 of this report).

The project management was executed by the Project Executive Committee (PEC), which consists of representatives of all the participating universities. The PEC is led (chaired) by the Project Coordinator, Professor Pisut Koomsap from Asian Institute of Technology (AIT) in Bangkok.

[01_MSIE 4.0 Project Proposal.pdf](#)

[05_Annex V - Technical Implementation Report.pdf](#)

The Project Executive Committee was meeting regularly, according to the Work plan presented in the project proposal. However, besides those scheduled meetings, the members of the PEC were communicating with each other if there were a need for that, mainly by teleconferencing and/or e-mail.

[02_PMC Plan.pdf](#)

The project management was executed according to adopted procedures in accordance with the adopted Project Management and Communication Plan.

3.1.2 Project implementation quality control and monitoring

Project progress was monitored by the Quality Control and Monitoring Board according to the QCM plan.

[03_QCM Plan.pdf](#)

The QCM Board consists of representatives of all the partner universities and is chaired by Professor Livia Veronica Lazar of University Politehnica of Bucharest (UPB) and is co-chaired by Supapan Chairapat of Prince of Songkla University (PSU).

The QCM Board has held regular meetings according to the project proposal and the QCM plan and was preparing the Minutes and Reports on those meetings accordingly.

All the QCM documents were at auditor's disposal. Based on those documents, as well as answers from the QCM Board members, it could be concluded that the project implementation, its management and quality of those actions, were monitored constantly according to established plan and procedures, Table 5, page 11 of the QCM Plan.

[03_QCM Plan.pdf](#)

The project outputs quality was also constantly monitored, according to the established procedures and outputs were released only after passing the rigorous checking and only after complying with the adopted quality criteria. In the case that those criteria were not met, the output in question (report, meeting minutes, etc.) was returned to the responsible team member (or body) for corrections.



3.1.3 Project results and outputs and project risk management

The project tasks and outputs creating and executing were monitored throughout the complete process. The linked Table gives an overview of the realized tasks and their outputs.

[10 QCM report no6 final.pdf](#)

The project risks were defined in the Project Proposal, for each Work Package, activity and outcome. The risk management procedure was defined as well. The risks of all the aspects of the project realization were monitored by The Risk Management Committee (RMC), which is composed of all the WP Leaders or Co-WP Leaders and chaired by the Project Coordinator (PC).

All events, conditions and conflict that had a potential to delay the delivery of deliverables or to lower the quality of those deliverables were considered as the project risks.

All the RMC members were asked to consult with their Work Package team members to perform the risk assessment on an annual basis. The risk eliminating procedure consisted of the risk identification, risk assessment (according to the risk assessment form) and response planning. Table 13 presents the Risk Assessment Form, Table 13, page 48 of the PMC plan.

[02 PMC Plan.pdf](#)

Levels of the individual risk impacts on the project realization were defined in three categories as high, medium and low and the priority of mitigating them was set accordingly. The risks were classified according to the Risk Assessment Matrix, Table 14. Priority in resolving the critical situations was given to the critical and significant risks, Table 14, page 49 of the PMC Plan.

[02 PMC Plan.pdf](#)

Thus, the risk managing procedure was defined in details, what made possible to deal with all the potential risks and eliminate those in time. In such a way, those eventual risks were prevented from causing any negative impact on the project realization (delaying and/or reducing the project outcomes (benefits), reducing the quality of project outputs, extending the project activities' timeframes or increasing any type of costs in project realization).

The Covid-19 epidemic outbreak was a situation that no risk procedure could predict. The Project Management Team and the Risk Management Committee had to act in completely unknown circumstances. Numerous meetings and activities had to be changed from the "in person" or "face-to-face" events (like PEC or QCMB meetings) to the FULLY online form. That caused inevitable delays in realization of some activities. Furthermore, due to changed format additional work was required from all the project members involved in those activities. For instance, the Workshop planned for May 2020 at University Politehnica Bucharest was not held, while the accompanying QCMB meeting was held online.

Table 13. The risk assessment form

Risk No.	Descriptions	WP	Risk Assessment			Mitigation Measures	Risk Owner
			Likelihood	Impact	Level		



Table 14. The risk assessment matrix

Likelihood	Impact		
	Low	Medium	High
Unlikely	Mild	Mild	Moderate
Likely	Mild	Moderate	Significant
Most Likely	Moderate	Significant	Critical

The risks due to the Covid-19 pandemic belongs into the "critical" category, i.e. as the "Most likely" to have high impact on activities of the project realization. Project team members found themselves in an utterly unknown situation, where not only that the project realization was at risk, but the lives of the participants were/are at risk. Despite that, the project team members succeeded to bring the project to a successful closure.

3.1.4 Project Dissemination and Exploitation of results

Dissemination and Exploitation of the project results was done according to the Dissemination, Exploitation and Sustainability Plan (DES).

[11 DES Plan.pdf](#)

The usual dissemination activities for this type of project were conducted. The project web site was created, with the Facebook page and YouTube channel. Numerous video clips were posted on both project introduction and realization of project activities, like clips on WPs and others. Brochures and the project posters were also prepared.

The dissemination activities included presentations to introduce the project to wider audience, in both educational and industrial community. That included promotional seminars at Thailand universities (both the project partner and non-partner ones), presentations of the project topic, program, results and outcomes at various international conferences, seminars and symposia in South Korea, Romania, Poland, Spain and Croatia.

[12 Dissemination events.pdf](#)

Further activity was publishing papers related to the project topic at various scientific and educational meetings, in both Thailand and other countries (Poland, South Korea, Spain, Romania, Tunis, Japan).

[13 List of Publications.pdf](#)

Numbers of dissemination events and publications are quite impressive. It should be mentioned that at the final assessment the list of publications is updated to 38.

3.1.5 Project changes and project documentation management

During the project realization, some changes were inevitable, due to various reasons, as dully noticed and recorded in the Mid-term Audit report. Changes were possible to be proposed by the Project Coordinator, PEC and QCMB members or the regular team members. Changes proposed by the project (managing) bodies were first discussed at their meetings and then adopted either by consensus or by majority; the former practically being a rule. Changes proposed by the team members were submitted either to the Team leader (of the particular Partner) or to the Work Package Leader and then either accepted/rejected or forwarded to the proper managing body (PC, PEC, QCMB), depending on the nature of the proposed change, for the further decision. Examples of some changes are already given in the Mid-term Audit report.



The project documentation contains all the details on the complete project implementation. It includes various documents regarding all the aspect of the project realization.

The project management developed coding of all the documents. There are three types of documents: plan, form and document.

[02_PMC Plan.pdf](#)

Note: The following text (until the end of this section) – *marked in blue* – is copied *verbatim* from the Mid-term Audit report for the sake of completeness of this report:

The coding is done according to six work packages:

G – Documents from WP1: Gap Analysis

C – Documents from WP2 & 3: Curriculum Development

Q – Documents from WP4: Quality Control and Monitoring

D – Documents from WP5: Dissemination and Exploitation of Project Results

M – Documents from WP6: Project Management

For the project plan, the code is XXXP-VY. “XXX” is three initial capital letters of the plan followed by “P” (e.g., QCMP is for Quality Control and Monitoring Plan, and PMCP is for Project Management and Communication Plan). VY is a version number of the document. *For example*, QCMP-V1 is a Quality Control and Monitoring Plan version 1.

For the project form: the code is AF-XXX-VY. “A” is a WP code, “F” means form and “XXX” is three initial capital letters of a form (e.g., QF-QFT is for Quality Form Template, and MF- WMR is for Work Package Monthly Report). VY is a version of the document. *For example*, QF-QFT-V1 is a quality form template version 1.

For the project document: the code is AD-XXX-VY. “A” is a WP code, “D” means a document and “XXX” is three initial capital letters of a document. VY is a version of the document. *For example*, MD-PMR-V1 is the first PEC meeting minutes report.

The project documentation is very voluminous. Auditor, with help of the Project Coordinator, tried to actually count all the documents and realized that this is really a very difficult task. However, ALL the pieces of project documentation are well kept in several ways and places. The Project Coordinator keeps all the project documents and soft copies of all the partner documents both in his personal server and computer and on the project website. Hardcopies are kept in his office. Members of the PEC and QCMB also keep all the records of their activities, reports, meeting minutes, etc. Some individual team members also keep their own records and documentation.

All the project official documents are available for inspection to any team member, without any restrictions, as well as to authorities of the partner universities.

3.1.6 Project Financial Management

The project budget handling was not within the scope of this auditing process. All the details on the project financial management procedures, including the general provisions, financial reporting, exchange rates, staff costs, travel costs and costs of stay, equipment costs, reimbursement procedures and budget transfer procedures, are described in details in the Project Management and Communication Plan, Section 5.

[02_PMC Plan.pdf](#)



3.2. Analysis of individual Work Packages' results

It should be mentioned here that titles of some project outcomes are somewhat different with respect to their original titles in the project proposal. This is because these new titles had better described the outcomes' content and activities performed towards their realization.

3.2.1. WP1 Gap Analysis

This Work package was completed before the mid-term auditing.

3.2.2 WP2 Curriculum Development I: Curriculum Structure and Courses

Outcome 2.1 - A modernized curriculum for Master's degree in Industrial Engineering

<https://msie4.ait.ac.th/outcome-2-1-a-modernized-curriculum-for-masters-degree-in-industrial-engineering/>

This is the key outcome of the project. The curriculum is defined with 12 Program Learning Outcomes and 16 courses. The studying program accounts for 2 + 2 semesters (studying and working on thesis). Studying program includes three core courses, related to Industrial Engineering, one compulsory course, covering transversal skills and 12 elective courses. The integral part of the curriculum is the set of 16 course syllabi that are presented in Outcome 2.2.

The building blocks of the curriculum development are: program learning outcomes (PLOs), list of courses, matrix of PLOs and courses relationship and structure of the curriculum – Outcome 2.1; course objectives and course learning outcomes (CLOs), teaching and learning methods with the assessment approach and evaluation schemes, courses content and description of modules, references and learning resources, time distribution and study load, prerequisites – Outcome 2.2.

The decision over compulsory and core courses were taken in a participatory way by all the partners involved in the WP2. The selection was based on WP1 findings and recommendations, industrial engineering specificity and arguments of Partner Universities during the decision process.

The list of the MSIE4.0 courses is given in Table 2, page 9 of the Outcome 2.1 report.

After completing the list of courses the course teams have been established based on certain specific rules: 1) one person can lead only one course; 2) one Thai University should lead at least one course while one EU University should lead at least two; 3) Thai Universities should participate in at least four course teams while EU in at least five. The process of establishing teams needed some time and was several times a subject of WP2 team meetings.

The credits allocated to individual courses were calculated taking into account different credit systems in Thailand universities.

The report on this outcome also included calculation of the students' workload, given in Table 7, page 14 of the report.

Outcome 2.2 - Syllabuses for all courses in the curriculum

<https://msie4.ait.ac.th/outcome-2-2-syllabuses-for-all-courses-in-the-curriculum/>

This report contains the courses' syllabi evaluation process. Before the final version, the course syllabus development progress was evaluated by two internal experts that did not participate in developing the specific course. The evaluation criteria, based on the adopted curriculum and course development approach and the objectives and assumptions of the project, are given in Table 1, pages 9-10 of this outcome report. After the several steps of the review process, the final list of courses was accepted, presented in table 2, pages 10-11 of the report.



Outcome 2.3 - Pilot Teaching at Partner Universities

<https://msie4.ait.ac.th/msie-4-0-pilot-testing-courses/>

Ten courses from the MSIE 4.0 curriculum have been pilot tested since July 2019 by nine partner universities. There were a total of twelve pilot tests. The course "Sustainable Supply Chain Management" was offered twice by the CUT. The course "Communication and People Skills Development for Engineering leaders" was also offered twice but by two different partner universities. Two courses were taught by a team of instructors. Several courses were offered with teaching methods that required high student involvement. All courses included project preparing or problem solving, or both.

The list of all the courses with details on their delivering are given on the project website in a table. The right-hand column provides links to individual courses and learning materials.

Outcome 2.4 - Assessment of pilot test of the key courses and improved courses

<https://msie4.ait.ac.th/outcome-2-4-assessment-of-pilot-test-of-the-key-courses-and-finalize-the-curriculum-and-the-courses/>

This report gives in Table 1 dates when the courses were tested, at which partner university, who were the instructors and number of students attending the course, Table 1, page 7. Table 2, page 8, provides the number of students surveyed about the courses that they had attended. The detailed analysis of all the courses execution, students' satisfaction, teachers' evaluation and other relevant data is presented in 49 figures with recommendations for the MSIE4.0 curriculum following from that analysis. Figure 49 gives an average assessment of the general course characteristics from students' perspective.

Outcome 2.5 - Preparation for Accreditation of the curriculum

https://msie4.ait.ac.th/wp-content/uploads/sites/5/2020/11/CDD-T2.5_O2.5V3withUpdate.pdf

The progress of the curriculum accreditation is presented in this report, with the activity not being finished, yet. The main reason is that the accreditation procedure differs between Thailand universities. The short summary of the status of the accreditation process at different partner universities is presented.

Only the KMUTNB has done a major revision of the existing curricula since June 2020 and the admission has started using the revised curriculum (MSIE4.0) since August 2021. Only the "Digital Factory" course was added to the revised curriculum since the MSIE4.0 curriculum has not been completed, yet.

However, the KMUTNB will put all of the courses from the MSIE4.0 curriculum to their revised curriculum once the MSIE4.0 curriculum is completed.

Additionally, the three Thailand universities – Prince of Songkla University (PSU), Khon Kaen University (KKU) and Chiang Mai University (CMU) are in the progress of revising their existing curriculum to open for admission next semester (June 2021).

At the end of the project, the curriculum will be completely reviewed by the faculty at the PSU. At the KKU it will be completely reviewed by the Graduating Committee, while the CMU is in the process of preparing the document to propose to the Prescreening committee. However, for the other Thai universities, including the Asian Institute of Technology (AIT) and Thammasat University (TMU), they have the plan to implement the MSIE4.0 curriculum, as well. AIT will have the new submission for approval for August 2021, while TU plans admission with the revised curriculum (MSIE4.0) in May 2022.

The CUT is preparing new Master curriculum on Quality and Production Management that would be based on MSIE4.0 curriculum.

The planned date to finish up with faculty, university and Ministry of Education accreditation is September 2021.



3.2.3 WP3 Curriculum development II: Modernisation of teaching methods and tools for MSc programmes

Outcome 3.1. Developing teaching materials (in English and Thai languages)

<https://msie4.ait.ac.th/msie-4-0-courses-materials/>

This report contains course materials both in English and Thai language for all the sixteen MSIE4.0 curriculum courses. The data include course's syllabus, with course objective, learning outcomes, prerequisite and course outline, which gives schedule of topics being considered per week. The data also include learning resources, with major textbook and additional references; the students' workload and evaluation scheme are presented, as well.

Outcome 3.2. Translating teaching materials

<https://msie4.ait.ac.th/msie-4-0-courses-materials-in-thai/>

All the teaching materials given within Outcome 3.1 in English language are here given in Thai language.

Outcome 3.3. V class Online Learning Platform

https://msie4.ait.ac.th/wp-content/uploads/sites/5/2020/11/CDD-T3.3_O3.3V4.pdf

The Virtual Class Online Learning Platform is completed. The content of the learning platform is well presented in this report. It also contains five annexes that include Teachers Manual for the Virtual classroom, Students Manual for the Virtual classroom, Questionnaire survey, Student's Evaluation form and Lecturer's Evaluation form.

A virtual classroom conducted on an online learning platform may involve three overlapping scopes of interaction technologies; i.e., virtual courses, online meetings and online presentations (Class activities, Group and individual learning activities, Discussion and chats with students, Quizzes and surveys, Homework activities and assessment documents, Full online courses with modules of work and Forum and synchronous chat session).

This platform was developed at AIT and has been initially tested with 3 regular courses of ISE program at AIT, i.e., AT72.03 Statistical Models & Design of Experiments (August Semester, 2018 & August Semester, 2019), AT72.08 Stochastic Decision Models (January Semester, 2019) and AT72.05 Quality Control and management (August Semester, 2019). After that, a training session on the use of the V class for faculty members from all the Thai university partners was conducted at AIT to collect constructive comments to help revise the structure of the platform and to improve functional quality of some modules of the platform. The platform was then tested with pilot test courses in MSIE 4.0 project to collect feedback from lecturers and students who enrolled in those pilot test courses.

The report contains summarized results of a survey on the V class training (via 21 figures), as well as five annexes.

Outcome 3.4. Training of Staff on new tool and best practice exchange on modern teaching methods

<https://msie4.ait.ac.th/msie-4-0-training/>

The report presents an overview of the training activities carried out throughout the project. This includes two types of activities: 1) The two workshops that were held as planned Ta EU partners; 2) Six seminars delivered during the project meetings in Thailand.

The report contains evaluation of Workshops held at University of Minho, Portugal and Technical University of Czesochowa, Poland. Due the COVID 19 the last workshop, planned to be held at University Politehnica in Bucharest, Romania was not possible to be organized. A total of six seminars were realized, which include



a total of 34 speeches. The training workshops were evaluated by the participants and the results show their relevance for the project activities and for professional development as teachers in Engineering Education context. The materials of seminars and workshops are available at the project website.

3.2.4. WP4 Quality Plan for implementation of the project

Outcome 4.1. Quality control and monitoring system

This outcome has been finished for the Mid-term auditing.

Outcome 4.2. Internal quality control and monitoring conducted

This outcome has been conducted throughout the project duration.

Outcome 4.3. External quality control and monitoring

This outcome includes the Mid-term auditing, which was finished and the Final auditing of the project realization for which this report is being produced.

Outcome 4.4. External financial audit

This process is being conducted parallel with this final auditing and the report by the financial auditor is expected to be delivered in predicted due time.

The WP4 leader prepared six QCM reports. The first four were submitted for the mid-term auditing and were not considered by the auditor at this moment.

The QCM Report #5 (of 06.04.2020) covers the period from October 2019 to March 2020 and it gives the list of the project product submitted for the quality evaluation and approval.

This report also gives all the details of preparations of the PAEE/ALE 2020 conference, with emphasis on the project's impact:

"The impact of the project is also seen in the acceptance of renowned personalities in industry and education fields, to be part in the project's conference with the theme "Striving Engineering Education Towards Student Competence Development", PAEE/AE'2020, International Conference on Active Learning in Engineering Education, 12th International Symposium on Project Approaches in Engineering Education (PAEE) AND 17TH Active Learning in Engineering Education Workshop (ALE), organized by AIT , in collaboration with PAEE-Project Approaches in Engineering Education Association and Active Learning in Engineering Education Network (ALE). The confirmed Keynote Speaker are Hon. Abhisit Vejjajiva, Thailand's 27th Prime Minister; Prof. David W Rosen, The George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology and Digital Manufacturing and Design Centre, Singapore University of Technology and Design; Michael Christie, Emeritus Professor at Stockholm University, Sweden, and Associate Professor at the School of Education, University of the Sunshine Coast, Queensland, Australia; Sampan Silapanad, Vice President and General Manager of Western Digital; Dr. Cynthia Finelli, Professor of Electrical Engineering and Computer Science, Professor of Education, and Director of Engineering Education Research at University of Michigan".

The QCM Report #6 (of 26.10.2020) covers the period from April to October 2020 and it gives the list of the project product submitted for the quality evaluation and approval.

Major effort of the project members focused on the organization of the final dissemination-sustainability conference – The International Conference on Active Learning in Engineering Education (PAEE/ ALE'2020), for the first time in Asia. The conference theme was "Striving Engineering Education Towards Student Competence Development".



As it is well known and emphasized, the Conference format had to be changed and it was held "in-person" for participants from Thailand and online for participants from other countries.

The report gives the detailed account of the conference unfolding, with the main point being (by the auditor's opinion):

"There were 87 participants from 13 countries; Brazil (25.6%), Portugal (25.6%), Poland (9.3%), Thailand (9.3%), Tunisia, Denmark, Romania, Russia, South Africa, Spain, Taiwan, Netherlands, and Vietnam. - Sixty-one academic articles were submitted".

The report also covers other project activities within the reported period:

"Between July and August 2020, within the MSIE 4.0 project, there was set a training program for industry. The training program consisted in 5 short courses: Digital Factory by KMUTNB on the Saturday, July 18, 2020, Human-Centric Design for Operator 4.0 by TU on Saturday, July 25, 2020, Smart Operations Management by CMU on Saturday, August 1, 2020, Sustainable Supply Chain Management by KKU on Saturday, August 8, 2020, and Intelligent Decision Support Systems by PSU on Saturday, August 15, 2020. Three communication channels were used: onsite at the university, online by ZOOM application, online by MSIE4.0 Facebook Live. The opportunity for promoting the concepts of MSIE4.0 curriculum came also through the seminar "The smart operations management 4.0 and lean 4.0" conducted by CMU, in August 2020. By the October 2020, the project team members managed to produce another 22 VDO clips for projects outcomes presentation, available an official MSIE4.0 YouTube Channel".

3.2.5 WP5 Dissemination and Exploitation of Project Results

What concerns the WP 5, as already stated in the Mid-term audit report, this WP is practically being executed throughout the whole project duration. The Dissemination and Exploitation strategy was well defined in the project proposal (page 79).

Outcome 5.1. Dissemination Exploitation and Sustainability Plan – DESP

<https://msie4.ait.ac.th/wp-content/uploads/sites/5/2019/04/DESP-V0.8.pdf>

This outcome has been finished before the Mid-term auditing.

Outcome 5.2. Creating a project website

<https://msie4.ait.ac.th/>

This outcome has been finished before the Mid-term auditing. However, this task is being ongoing throughout the project duration with website updating, improving and modernizing.

The new link was created on the project web page so teachers can upload the course materials directly.

The report also contains analysis of impact of the Website and the FB profile of the project on its realization.

Outcome 5.3. Production and dissemination of project materials

<https://msie4.ait.ac.th/reports-on-dissemination-of-project-materials/>

This task concerns production and dissemination of the project materials, which include the project webpage, newsletters, flyers, brochures and presentations on events. The two kinds of brochures were developed; the first one for introducing the MSIE4.0 Project by all the partners; the second one was a flashback of the first half of the project for introducing its progress. At the end of the project, the brochures were created to promote the international conference on engineering education (PAEE/ALE2020) and distributed to the



target groups via various distribution channels (posting on the project website and Facebook, e-mails, LINE and WhatsApp).

Additionally, a presentation Board was prepared for the exhibition of Science and Modern Technology to celebrate the 60th year of KMUTNB to promote the MSIE4.0 project outcomes. It was held on 22.03.2019 at which Her Royal Highness Princess Maha Chakri Sirindhorn presided over the opening ceremony. That event increased the project visibility effectively since it was the news on the national level of Thailand.

The project and its results were also promoted through meetings, seminars and workshops. Those methods were used when it was required to communicate with the audiences. Meetings were usually conducted for introducing the project, while seminars and workshops were used for disseminating the outputs of the project.

An analysis is also presented of dissemination materials and their distribution on the project. Table 2 of the Report on Outcome 5.3 presented the distribution channels for different dissemination materials and activities, while in Table 3 is shown analysis of the impact of materials to the dissemination of the project. It contains pros and cons for each activity and way of its promotion.

Outcome 5.4. Publications in professional journals, newspapers, magazines and brochures, social media

<https://msie4.ait.ac.th/publications-reports/>

There were 38 publications produced during the project duration; specification of publications is given in Table 1 (pages 6 to 14) of the report on this outcome. Two papers were published in professional and scientific journals; thirty-four were presented at academic scientific conferences and one was published in newspapers. The report clearly presents distribution of publications among the project partners, from which one can conclude that all the partners contributed to project results dissemination.

Outcome 5.5. Developing joint short-term courses in the field of Industrial Engineering in cooperation with industry for professionals

<https://msie4.ait.ac.th/msie-4-0-trainings-for-industry/>

Total of five short courses were organized, each at a different university. The short courses included lecturing and workshops, which had to be completed within one day. The courses were primarily conducted online with some participants attending the courses on site. These events were open to the wide audience; participants could be students, industrialists or academics.

At King Mongkut's University of Technology North Bangkok (KMUTNB), the speaker was Athakorn Kengpol, the topic was Digital Factory. This short course was held on 18.07.2020.

At Thammasat University (TU) the speaker on the short course was Naris Charoenporn, the topic was Human-Centric Design for Operator 4.0 and it was held on 25.07. 2020.

For short course at Chiang Mai University (CMU) the topic was Smart Operations Management and the speaker was Wichai Chattinnawat on 01.08.2020.

At Prince of Songkla University (PSU) the speaker was Suriya Jirasatitsin. The short course was held on 15.08.2020 and the topic was Intelligent Decision Support Systems.

At Khon Kaen University (KKU) the topic of the short course was Sustainable Supply Chain Management; it was held on 08.08.2020 and the speaker was Kanchana Sethanan.

Besides these short courses, the two training courses were conducted at two companies at the company's request. They were internal events organized only for the company staff. The topic for both courses was "Engineering Leader" from the pilot course "Communications and People Skills Development for Engineering Leaders". These two trainings were led by Kanchana Sethanan and Pisut Koomsap. The first training was at Kanchanaburi Bio-Energy Company Limited (Electric power generation and transmission) on 18.09. 2020

between 1-4 pm, attended by 41 persons. The second training was at Rajburi Sugar Company Limited on 19.09. 2020 at 9-12 am, attended by 21 persons.

The auditor's conclusion from report on this outcome is that it was quite substantiated. The report presents detailed analysis on each of the short courses with prepared training materials, surveys of participants' opinions and their results with accompanying analysis.

Outcome 5.6. Organizing dissemination events with relevant stakeholders

<https://msie4.ait.ac.th/activities-events-reports/>

The list of workshops and seminars conducted to promote the project is given in Table 3, pages 9 to 11, with summary given in table 4, page 11. There were total of 23 dissemination events.

Outcome 5.7. Organizing the final dissemination-sustainability conference

<http://paeale.ait.ac.th/>

The organizing of the final conference on project realization had to be changed, both formwise and venuewise.

Due to the Covid-19 pandemic the PAEE/ALE 2020 Conference could not be held, as originally planned in Pattaya, but it was moved to Bangkok and held at Asian Institute of Technology, on 26-28.08.2020. What concerns the form, it had to be held in the so-called "hybrid form", as a combination of the on-site and online events. The participants from Thailand were able to attend the conference in person, while participants from other countries had to be included online.

To organize the conference efficiently, brochures were made to promote of the conference with all the information, such as a hybrid format of the conference, venue, sessions and topics of interest, keynote presentations, oral presentation sessions, local workshop and three hybrid workshops. These brochures were distributed to the target groups, such as professors, academic staff, students, and industry representatives via different channels, such as giving in-person, by Application Line, e-mail, MSIE 4.0 Facebook and website, partners' institutions.

For the onsite participants, the first two days (26-27.08.2020) sessions were held at the AIT Conference Center and the last day (28.08.2020) they were moved to the Pinehurst Golf Club and Hotel. The online participants attended the conference via the Zoom Meetings. There were four keynote presentations, thirteen oral presentation sessions, of which the two were for student papers. Besides that, there was a local workshop and three hybrid workshops. There were 87 participants from 13 countries; Brazil (25.6%), Portugal (25.6%), Poland (9.3%), Thailand (9.3%), Tunisia, Denmark, Romania, Russia, South Africa, Spain, Taiwan, Netherlands, and Vietnam, participated in this conference. Sixty-one academic articles were submitted for this conference.

The Student Best Paper Award is always a special moment in the PAEE/ALE conference. Students had a chance to share their ideas, to show their work developed at the university, to get to know people from all over the world and to learn from each other.

There were 8 students' presentations, organized in 2 sessions. A committee of experts in Engineering Education has selected the three best papers:

The First: "A Student Perspective on the Blended Learning Experience in a Project Based Context", by Johannes Kruse Hellmers and Robert Nedergaard Nielsen, Aalborg University, Denmark.



The Second: "Development of Automated Guided Vehicles for a Smart Factory: A Project-Based Learning Experience",

by Yasiru Shikshitha Malshan Benaragama and Pisut Koomsap, Asian Institute of Technology, Thailand.

The Third: "Active Learning Workshops Production: Impacts and Benefits for Engineering Students",
by Arthur R. Costa, Emily M. B. Cornelio, Fernanda R. Silva, Filipe A. Batista, Larissa P. C. Santos, Marcus J. A. Oliveira, Carla M. C. C. Koike and Dianne M. Viana, University of Brasília, Brazil.

Outcome 5.8. Sustainable network between project partners and IE enterprises

This outcome has been finished for the Mid-term auditing.

3.2.6 WP6 Project Management

Outcome 6.1. Project Management and Communication Plan (PMCP)

<https://msie4.ait.ac.th/wp-content/uploads/sites/5/2019/04/Revised-MSIE4.0-Project-Management-and-Communication-Plan-PMCP-V2.0.pdf>

This outcome has been finished for the Mid-term auditing.

Outcome 6.2. PEC kick-off and regular meetings

<https://msie4.ait.ac.th/category/resources/wp6/wp6-reports/>

This outcome has been ongoing throughout the project duration.

All the meetings were held regularly except the final one, which was planned to be held at the project's final conference, but it could not be held due to the Covid-19 pandemic.

Outcome 6.3. Documents on daily project administration and coordination

Access to these documents is limited only to project team members, authors of documents and agency. It is being executed throughout the project realization. The project documentation is kept and archived regularly by the Project Coordinator, the Project Executive Committee and the Quality Control and Monitoring Board.

Outcome 6.4. Project reports

<https://msie4.ait.ac.th/outcome-6-4-project-reports/>

This outcome contains the Mid-term project report submitted and approved by the Erasmus+ programme officials.

The second report would be the final report, which would be submitted in the beginning of December 2020, as requested by the project work plan.

3.3. Findings based on answers to questionnaires sent to all categories of the project team members

In order to prepare the audit online interview, the questionnaires were prepared for all the categories of project participants: the PC and the PEC members, the QCMB members and the team members, as well as for students who attended the Pilot courses.

[15 Questionnaires for the Final Audit Interviews.pdf](#)

[16 Summary of answers to Questionnaire for the Project Coordinator and PEC members.pdf](#)



[17 Summary of answers to Questionnaire for the QCMB members.pdf](#)

[18 Summary of answers to Questionnaire for the team members.pdf](#)

[19 Summary of answers to Questionnaire for students.pdf](#)

Answers were obtained from the PC and all of the PEC and QCMB members and from 22 team members and from 4 students from the Thailand partner universities. Questionnaires were anonymous, except for the PC!

The questionnaire for the PC, the PEC members and the QCMB members contained questions regarding the project implementation stage with emphasis on a period from the project mid-term evaluation until the project completion (01.11.2019 to 14.10.2020). The questionnaire for the team members was given in two versions (A and B) for team members that did and did not fill-in the similar questionnaire at the mid-term evaluation stage. The questionnaire for students contained questions related to their opinions on the Pilot courses that they attended.

Here are some remarks from questionnaires that attracted the auditor's attention and should be the part of this Audit Report.

Auditor's remarks and conclusions are marked by italic letters in red.

3.3.1. Answers from the PC and PEC members

[16 Summary of answers to Questionnaire for the Project Coordinator and PEC members.pdf](#)

Project completion/final audit stage	
1	Were there any changes/ problems in the project team communicating since the mid-term audit?
<p>PC: <i>Since the COVID-19 pandemic, the channel of communication has been limited to only online meetings, emails, and social media between the EU and Thai members. An in-person meeting has been limited to only among Thai members. Our EU members have observed from a distance. The pandemic, to a certain extent, has created a gap between the EU and Thai members. Online communication is not as effective as face-to-face communication, which allows much better networking.</i></p> <p>Other PEC members: <i>Lack of in-person meetings in the last period of project realization due to COVID-19 outbreak has impacted the information flow – I think virtual meetings have not engaged whole research staff strongly enough to smoothly run the project.</i></p> <p><i>The last project meeting, supposed to take place in Bucharest, was organized online.</i></p> <p>A: Mainly all the PEC members answered in the similar manner, citing problems due to COVID-19 epidemic outbreak.</p>	
2	Did the Project Executive Committee meetings take place in accordance with the adopted rules and plan since the mid-term audit?
<p>PC: <i>We have been able to organize two out of three PEC meetings after the midterm audit. The fifth meeting was in Jan 2020 at KKU. The sixth meeting was in May 2020 online. We were supposed to be together in Thailand for the seventh meeting during the final conference in Aug 2020, but we could not make it. We could not manage to have a meeting also because we had to handle several activities for the hybrid conference covering time zone difference. However, there have been regular communications among the partner leaders who are the PEC members on documents required, especially on a financial matter, for closing the project.</i></p> <p>A: All the PEC members agreed with the PC's opinion on this.</p>	



3	Did the project team meetings take place in accordance with the adopted rules and plan since the mid-term audit?
<p>PC: Most of the meetings have been small unofficial for working groups to move the project forward.</p> <p>Other PEC member: Yes, with the change to virtual meetings. In my opinion, conference took over too much attention and final project dedicated meeting should be also organized.</p> <p>A: Interesting opinion on "final meeting". In what format? Who would participate? The PEC?</p>	
6	Did any predicted risks/new risks appear since the mid-term audit? If yes, how did you handle the identified risks?
<p>PC: We have experienced risks from the unexpected COVID-19 pandemic. It has affected several tasks, including but not limited to the regular meetings, laboratory development and the dissemination events (e.g. training for industry and conference). To keep activities as planned, especially for the ones having people gathering, we monitored closely to see the situation developed. We tried to delay our decisions unless decisive ones were required.</p> <p>We could not avoid replacing the meeting at UPB in May in Romania with an online meeting. We were able to organize a conference as planned after the situation in Thailand had been alleviated. However, we had to move the venue from Pattaya back to AIT to facilitate the participation of non-Thai participants in a hybrid format.</p> <p>The pandemic has significantly stymied the development of the laboratory. We tried to work from home as much as we could when the COVID-19 situation got more serious and scheduled our presence in the lab on alternative days when the situation got better for social distancing. Once the situation significantly improved, we have put much more effort into building the laboratory to catch up with the time lost. We have been able to build the physical infrastructure, but there is still a work on a virtual layer to be developed and connected to the physical units.</p> <p>In terms of industry training, we have also adopted a hybrid format to avoid the inconvenience of a long distance travel and keep social gathering to a local level.</p> <p>I believe that our members have tried to keep things moving during this challenging period and tried to adjust ourselves to working in a new normal to maintain our performance</p> <p>Other PEC members: The pandemic situation made us move to full online meetings and a hybrid final conference.</p> <p>The information flow was a bit limited among research staff (not PEC) and it resulted in a bigger workload for WP and Partner leaders to keep the information flow going.</p> <p>Some problems has resulted from PALE/ALE20 conference that was organized by project staff, with key roles of project coordinator and WP leader. A lot of additional work (organization, collection of papers, reviews, conference schedule and payments) has slowed down the flow of the project.</p> <p>A: The obvious new risk was the Covid-19 epidemic, which influenced the project realization in all the aspects. The information were forced to be mainly online, with some exceptions in Thailand due to alleviated situation in that country.</p>	
8	Were there any problems recorded related to compliance with contractual obligations since the mid-term audit? If yes, what are they? How were those problems eliminated? If not, why? Please, elaborate.
<p>PC: No. We have tried our best to deliver what have been promised in the proposal. We have been able to deliver most of the outcomes completely. A few of them have been partially completed.</p> <p>Other PEC members: There was a problem with the financial statement of UPB. This was not fully accepted by the project coordinator and I am not sure how the situation is at this moment.</p>	



<p><i>I believe that there was a difficulty of communication and negotiation to achieve a fast and acceptable solution. *1</i></p> <p>A: This needs to be cleared with PC</p> <p><i>There were some problems on the communication among WP leaders and team members. However, the problem has been alleviated and recognized and solved by the PEC. *2</i></p> <p>A: How was this resolved?</p>	
9	<p>Did the project management (Coordinator/PEC) follow recommendations from the mid-term audit for improving the organization of work?</p> <p>PC:</p> <p><i>Regarding the project management, I have tried to perform professionally to ensure the success of the project with all respects to EACEA and the auditor's comments and suggestions. I guess my colleagues have tried to do the same.</i></p> <p><i>Regarding some recommendations and initiatives, we were able to do some of them. We organized workshops for Thai members on the online learning platform and the Tecnomatix simulation software. We have not pursued accreditation with the European Network for Quality Assurance (ENQA) due to the limited time and resource as well as the pandemic.</i></p> <p><i>Regarding sustainability, I submitted another winning proposal to the 2020 Erasmus Plus Call for Proposal. Based on the nature of the new project focusing on reinforcing capacity building, it will be a composition of several current partners and a few new partners.</i></p> <p>A: Only the PC's answer is presented, though the PEC members agree with its content.</p>
10	<p>Which measures were implemented? Please, elaborate.</p> <p>PC:</p> <p><i>The workshops were organized for Thai members for WP3. A proposal was submitted and won for the sustainability of the project.</i></p> <p>Other PEC members:</p> <p><i>Adjustment of teaching and learning platform to make it more accessible.</i></p> <p><i>Cooperation between partners for further projects (ERASMUS+ KA107 between CUT, TU, KMUTNB, CMU).</i></p> <p><i>There was a small delay in acquiring equipment but all was solved and a great lab implementation was achieved.</i></p> <p>A: The PEC members agree on implemented measures and their results.</p>
13	<p>Were all the outputs, planned to be realized, implemented, in what amount and quality? If not, why? Please, elaborate.</p> <p>PC:</p> <p><i>Yes.</i></p> <p><i>Outcome 3.1: Teaching materials for instructors are being developed. Most of them are completed.</i></p> <p><i>Outcome 3.4: Two workshops were offered by the EU partners. The third one could not be made due to the pandemic. Six public seminars were offered by EU members during their visits to Thailand for the project meetings.</i></p> <p><i>Outcome 5.4: 37 articles have been published through the project period.</i></p> <p>Other PEC member:</p> <p><i>In general, the outputs have been developed and implemented. Some of the outputs are being developed right now and should be submitted soon. This mostly concerns the accreditation of MSIE4.0 curricula in different schemes on Partner universities (tasks 2.5 and 2.6). It is also related to some dissemination activities that are dependent to publication procedures.</i></p> <p>A: All the PEC members agreed that the planned project outputs and outcomes were realized.</p> <p>https://msie4.ait.ac.th/activities/</p>
14	<p>Were all the products, planned to be realized, implemented? If not, why?</p>



	<p>PC: <i>Outcome 2.1: A modernized curriculum for a Master's degree in Industrial Engineering was officially completed in February 2020. A few partners have already submit their requests to their university for adopting the curriculum for their programs. Some courses will be utilized in the new project.</i> <i>Outcome 3.6: A Future Learning Factory has been developed. Machines have been built. Robots and software have been purchased and installed.</i></p> <p>Other PEC member: <i>I do not have enough information. *3</i></p> <p>A: The PEC member is not well informed??? This needs to be cleared with PC and the PEC member. All other PEC members answered in the same manner that all the products were realized.</p>
19	<p>How were the project outputs promoted to stakeholders/general public? Please, elaborate.</p>
	<p>PC: <i>We have promoted the outputs in various capacities.</i> <i>We share our outputs to students, industry, colleagues in other universities and public.</i> <i>The level of information is adjusted according to the stakeholders.</i></p> <p>A: List of outputs promotions is available on the project web site.</p>
22	<p>Do you consider the project <i>in general</i> is a success, i.e. are the project objectives met within the planned deadline(s) using the planned funds? Are all the predicted indicators and outputs met?</p>
	<p>PC: <i>Yes. Most of the tasks have been completed.</i> <i>We have achieved the outcomes.</i> <i>Some of them exceeded what we had promised in the proposal.</i> <i>For example, we had promised to develop 15 courses. We developed 16 courses.</i> <i>For pilot testing, we had promised to pilot test 9 courses. We tested 10 courses.</i> <i>We had promised to organize a conference. We expanded it to an international conference with four prominent keynote speakers, including the former Thai prime minister.</i></p> <p>Other PEC member: <i>I consider project as a success, confirming it by:</i> <i>- innovative MSIE4.0 curriculum</i> <i>- multiple efforts to implement it in both Thai and EU partners,</i> <i>- significant interest to the project from external stakeholders (mainly in Thailand)</i> <i>- significant follow-up activities (e.g. KA107 project),</i> <i>- significant dissemination event (participation in worldwide renowned conference).</i></p> <p>A: Both the PC's and PEC member answers illustrate the level of the project completion (some results were even better/larger than planned).</p>
24	<p>Is there anything you would like to add?</p>
	<p>PC: <i>As the project coordinator, I delegated tasks and authorities to workpackage leaders from the beginning. I have managed this project by observing and assisting when needed. When the members were not able to deliver or did not perform properly, I would normally communicate first with the workpackage leaders. I intervened only when the problems could not be solved by the WP leaders and/or the results were unacceptable to keep the project on track with quality.</i> <i>We are grateful to receive funding from the Erasmus Plus Program of the European Union. This funding has allowed us to be a small mechanism to contribute to support Thailand towards a sustainable smart industry. Since day one, several activities have been conducted under the MSIE 4.0 project that includes, but are not limited to, curriculum development, laboratory development, pilot testing of developing courses, industrial training, public seminars, and an international conference on education.</i></p>



Despite the difficulty and challenge, we are able to deliver the outcomes as promised in the proposal. The quality of the work is acceptable, considering the uncontrollable circumstances.

Other PEC members:

This was a very ambitious project that was hard to develop but achieved great results. At some points, cultural or specific personal characteristics put some stress in communication. I believe we learned a lot with each other.

We were able to gain a valuable experience from the project. We want to thank EU/ERASMUS for funding.

This project is my first one in engineering education. It is very interesting. I have learnt many things, including the content of the project, the way to work with other partners, and how to manage the project.

A: This is a very indicative answer. Even teachers could learn new things, especially within the project's area.

This project resulted in all the outputs according to the proposal. The ultimate objective outcomes are to devise new courses with hand on experiences for the learners. The project achievement lacks only the validation how all the lab gadgets aligned with all the course learning objectives of all the designed courses.

*There was no use of the lab gadgets for the demo/trial teaching. *4*

A: This needs to be cleared with PC

*1 The matter was discussed during the online interview.

*2 The matter was discussed during the online interview.

*3 The PEC member who gave this answer explained during the online interview that this was a misunderstanding, that he is well informed about the project, in particular the project management, which was his main activity.

*4 This was explained by the PC that some of the Thailand partners were not aware that they could use the project laboratory online. That was resolved during the online interview.

3.3.2 Answers from the QCMB members

17 Summary of answers to Questionnaire for the QCMB members.pdf

Project Project completion/final audit stage	
1	Was the communication within the QCMB without any major problems since the mid-term audit?
<i>Yes, the communication within the QCMB was clear during this period and no problems were identified.</i>	
A: All the QCMB members agreed in a similar manner that the communication was good without any major problems	
2	Was the communication of the QCMB with the Project Coordinator without any major problems since the mid-term audit?
<i>Communication was good. There were several communication channels available in this project such as email, what's app, line, phone call.</i>	
A: All the QCMB members agreed in a similar manner that the communication was good without any major problems.	
4	Was the communication of the QCMB with the project team members without any major problems since the mid-term audit?
<i>Yes. Mainly, WPLs communicate to team members for the task that must be done at every period of the plan.</i>	
<i>N/A. I rarely contact the project team members directly. I mainly contact with task leaders and course leaders, and I have no problem with them.</i>	
A: All the QCMB members agreed in a similar manner that the communication was good without any major problems, except for this member who obviously did not have contact with other team members.	



5	Did the QCMB meetings take place in accordance with the adopted rules and plan since the mid-term audit?
<p><i>After the midterm audit, there were two QCMB meetings as planned.</i></p> <p><i>Yes. Although we canceled the plan to Romania due to COVID19, we set up an online QCMB meeting as a way to communicate.</i></p> <p>A: All the QCMB members agreed on this, with emphasis on the Covid-10 causing problems forcing the meetings to be held online.</p>	
6	Did the project team meetings take place in accordance with the adopted rules and plan since the mid-term audit?
<p><i>There were two project meetings as planned.</i></p> <p><i>Yes, I think that the project team meetings were taken place according to the rules and plans, and these meetings are effective in term of problem solving.</i></p> <p>A: Again, all the QCMB members were unanimous on this question.</p>	
7	<p>Did any predicted risks/new risks appear since the mid-term audit?</p> <p>If yes, how did you handle the identified risks?</p> <p>Did those risks affect the quality of the project realization?</p> <p>If yes, how were they eliminated?</p>
<p><i>Yes. The breakout of the coronavirus brings the team to a higher risks of not accomplishing tasks on time and/or efficiently.</i></p> <p><i>Each partner had to adjust the mean of handling and delivery all the deliverables. However, the quality of the project realization has not been affected.</i></p> <p><i>Yes. Covid-19 pandemic held a risk for the meeting held in Romania, as the activities scheduled were needed to be moved online. However, the project's tasks and results were fulfilled as the same quality level, by using Zoom for online meetings, google drive for sharing and working with different versions of the documents within teams, and the project's website for disseminate the results.</i></p> <p>A: All the QCMB members were unanimous on this question, while these two answers describe the best what was the actual problem, which has been overcome.</p>	
8	Was the quality and quantity of the achieved outputs monitored as before the mid-term audit?
<p><i>Yes, the expected outcomes were monitored during the process. In some tasks, a delayed was identified, but at the end of the project, I believe that all tasks were finished and the outcomes delivered.</i></p> <p>A: All the QCMB members were unanimous on this question, as well.</p>	
9	Which measures have been taken by the QCMB to assure the quality of the project outcomes /products since the mid-term audit?
<p><i>The documentation and the degree of achievement of the assumed objectives were reviewed and the compliance analysis regarding the prepared reports was performed. Areas for improvement have been identified.</i></p> <p><i>The evaluations of the project outcomes /products followed the same procedure established before the mid-term audit.</i></p> <p><i>There were no problems related to quality. But, there exists a problem related to quantity, i.e., some tasks was delayed. However, I believe that the project can be finished in due time</i></p> <p>A: Unanimous opinion that the measures related to quality were well implemented before and after the mid-term audit.</p>	
12	<p>Were all the tasks, planned to be realized implemented at a standard level of quality as before the mid-term audit?</p> <p>If not, why?</p> <p>Please, elaborate.</p>
<p><i>As far as I know, yes. The tasks were carried out considering the standard level of quality. For instance, WP2 and WP3 involved tasks that are the core of the project (curriculum development). Sometimes, it was not</i></p>	



easy to develop the tasks and engage the partners on them, but with effort and communication (the meetings were really important for that) the different tasks were conducted with quality.

In my opinion, all planned tasks have been conducted at standard level of quality.

A: The first answer presents an excellent analysis of manners in which the project tasks were realized at the standard level of quality, while the second answer practically summarizes opinions of all the QCMB members.

14	Do you consider, from the quality aspect, that the project is a success <i>in general</i> , i.e. are the project objectives met at a standard level of quality? Please, elaborate.
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Yes, I believe that the standard level of quality has been maintained throughout the project.

Yes. The project is a success that demonstrates that different people from different cultures, continents, and despite a global situation, can work together in order to develop a master curriculum in industrial engineering 4.0 field, and to do that at the standard level of quality.

A: This second answer the best represents opinion of all the QCMB members on the project realization as a whole.

17	Is there anything you would like to add?
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A: Here the auditor's analysis is presented before quoting some of the answers. They were all very positive towards the project realization as being a success and some answers are really worth citing.

I would like to underline the very good work in the team. Very good communication, high professionalism of the team members. Working in a team was a real pleasure. Great project and great team.

There were delays in tasks due to the pandemic situations. However, project members from all partners worked so hard to catch up with the schedule. I really appreciate their efforts.

Only to thank all the project's members for their hard work in overcoming all the difficulties and achieving such results.

3.3.3 Answers from the Team members

[18 Summary of answers to Questionnaire for the team members.pdf](#)

Project completion/final audit stage	
A3/B1	How often did the project team meetings take place? Did you attend the meetings? How many meetings were held and at how many you were present? Please elaborate.
	<p><i>Held in two-week gaps (not regular)</i></p> <p><i>Yes. For the meetings I was invited to.</i></p> <p><i>About 10 meetings. I attended for 5 meetings, which were mainly during the planning stage.</i></p> <p><i>At least once a month.</i></p> <p><i>I always attended the meetings related to my responsibility.</i></p> <p><i>I cannot remember in number but it should be more than 50 meetings.</i></p> <p><i>To elaborate, following is the estimated numbers of meetings I attended in categories.</i></p> <p><i>WP1: More than 12; WP3: For course development, it was more than 15. For the development of the Learning Future Factory Laboratory, it was more than 10; WP5: For organizing the PAEE/ALE' 2020 conference, it was around 10. For other activities and event, it was about 5; WP6: For PEC meeting, it was around 8 (6 PEC meetings and additional meetings regarding special issues that needed PEC decisions).</i></p>



<p><i>The frequency of organizing the meetings of project team varied and depended on the current needs. I have been to 4 general project team meetings. Additionally, I attended meetings about my course in smaller groups once a month on average.</i></p> <p><i>My participation in the project covered only a specific task. It was only for this purpose that I contacted the project team. Apart from the general schedule of meetings, there were also meetings on request - and I participated in them most often. At least 2-3 times a month.</i></p> <p><i>I was involved in the project for 7 months since May 2019. I tried to attend all the meetings where I was invited but I succeed to participate to about 65% of them.</i></p> <p>A: Here answers were very different, since certain members attended numerous meetings, others less. The general conclusion is that they were all very much involved in realization of their tasks and did not have any reserves to fulfill them.</p>	
A5	<p>If it was necessary to make the project changes, do you know about the related processes?</p> <p><i>There were times of miscommunications in between related processes. But overall, everyone had an understanding on major changes which are about to happen.</i></p> <p><i>The project development was quite closed with the initial proposal. Some changes were conducted but were shared during the project meetings and documented in the minutes.</i></p> <p>A: The team members were mainly aware of the project changes process. This second answer raises an interesting question. "Project being closed by the proposal". Meaning that the more "freedom" in project's realization should be left to partners and project teams.</p>
A6/B3	<p>Did you have an overview of requested changes? Did you know which changes were approved and which were turned down? How were the changes approved?</p> <p><i>Yes. I had access to the change overview. I knew which ones were rejected which were approved. The changes were approved for example at the meetings (on-line and face-to-face).</i></p> <p><i>I have a general view of the changes approved in the project.</i></p> <p>A: Mainly all the members gave the similar answer to this question. There were two team members that answered either "N/A" or did not answered at all to several questions, including to this one. The impression is that either they did not understand their role in the project or their knowledge of English language was not at a sufficient level to express their opinion, which is quite understandable.</p>
A8	<p>How did you monitor the results achieved and their qualitative characteristics?</p> <p><i>During the team meetings and e-mail information's we analyzed the materials with the members of the course team.</i></p> <p><i>Before completing tasks/project deliverables, there were meetings to provide information and expectations to the involved project members. The following meetings and discussions were conducted to plan and execute the tasks. From that, we were always in line with each other and were in the right track to achieve the tasks. When performing tasks, the task leader/WP leader/ PC were in contact with us to follow up the progress.</i></p> <p><i>I was following the process in the meetings and also inside our team, because the coordinator of our university were quite engaged in this project since the very beginning. The effort, the number of outputs developed, the competencies acquired during the project, were quite remarkable.</i></p> <p>A: The team members were interested in monitoring the results achieved, especially how their own partial results did fit into the wider picture, i.e. how they were contributing to project's outcomes and results in general.</p>
A9/B5	<p>Are you satisfied with your role in the project realization? Please elaborate.</p> <p><i>Yes, I am satisfied with the role in the project.</i></p> <p><i>Yes. I received full freedom and required help in order to carry out my duties in the project.</i></p>



	<p><i>Yes, I am satisfied. The task assigned to me was adjusted to my competences (this was the case with all team members). Due to this, the work was a pleasure.</i></p> <p><i>Yes. It was a great challenge for me I was able to learn a lot, improve my vocational experience and gain knowledge for future projects.</i></p> <p><i>Yes, I am. My role is about the dissemination of the project, conducting pilot course, and short course for industry.</i></p> <p><i>Yes, I am. It was an amazing opportunity to work with different people, with different backgrounds. I was involved in different WP and that was quite challenging.</i></p> <p>A: Almost all the members were satisfied with their assigned tasks, i.e. with the role they had in the project.</p>
A10/B6	<p>Were the tasks assigned to you adequate with respect to your qualifications?</p> <p><i>Not really, but I have done my best.</i></p> <p><i>The task entrusted to me was fully in line with my scientific interests and competences. I was able to use my experience and knowledge to improve project areas.</i></p> <p><i>Yes, they were. The tasks coincided with the area of my research interests and didactic classes.</i></p> <p><i>Yes, the subject of the course that I prepared was in line with the subject of my scientific didactic interest.</i></p> <p><i>Yes. At the beginning of the project, a few of my tasks seem too hard. However, the strong collaboration between others and support from PC could make a lot of thing possible.</i></p> <p><i>I saw a lot of differences in myself before and after joining the project for 3 years. The challenging tasks built my academic competences as well as the people management.</i></p> <p><i>It was more than worth joining this project. With the opportunity and experience to do so many challenging works with the great support from the agency and the consortium.</i></p> <p>A: These answers describe in the best way how different members understood and fulfilled their tasks in the project.</p>
A11/B7	<p>Do you think that you could execute some other tasks better? If yes, which one(s)? Please elaborate.</p> <p><i>Yes. Maybe I could done the GAP analysis better.</i></p> <p><i>Yes, I believe that some of my tasks could have been carried out better - unfortunately the world situation made it impossible. This applies in particular to tasks that were performed during lockdown.</i></p> <p><i>I do not think so. I tried to do tasks as well as possible.</i></p> <p><i>Yes. Online training and Pilot Testing could be better if there are equipment and tools supporting the learning, such as laboratory, modern learning tools.</i></p> <p><i>No, I do not think so. I know that I give all my best to this project and I also learned a lot.</i></p> <p>A: From these answers, one can conclude that the team members were really trying to do their best, regardless of the fact that some assignments were not in the area of their narrow specialization or expertise.</p>
A12/B8	<p>What is your general opinion on the project realization so far? Please elaborate.</p> <p><i>I think it was a really challenging project, very ambitious (e.g. number of outputs), but the result was quite impressive.</i></p> <p><i>The project has been known by some partners in Thailand. The project discrimination are very important.</i></p> <p><i>I think that the project has surpassed its initials goals. Taking into consideration the restrains experience after Feb/Mach 2020.</i></p> <p><i>Interesting project and partnership. A very useful exchange of cultures and educational approaches.</i></p> <p><i>This project is not better nor worse than the average European project.</i></p>



I could only speak about the laboratory part. Building too many machines for laboratory and not much budget/time are big problem.

In my opinion, the realization of the project was a valuable experience for each of the participants. Personally, I believe that the project allowed to develop teaching and interpersonal skills, as well as became an inspiration to undertake research activities.

A: Mainly all the answers of the team members are positive with respect to the project realization.

A14/B10 | *Is there anything you would like to add?*

This project is my first one in engineering education. It is very interesting. I have learnt many things, including the content of the project, the way to work with other partners, and how to manage the project.

I have the great experience for my life.

To try to exploit this experience thought other project proposals.

The development of this project made it possible to share knowledge and experiences among researchers from different countries, enriching their skills and competences.

A: These answers speak for themselves, no comment is necessary.

3.3.4 Answers from students

[19 Summary of answers to Questionnaire for students.pdf](#)

Project completion/final audit stage	
1	How much, in general, do you know about this project? Please elaborate.
<p><i>My knowledge and experience are better than in the past.</i></p> <p><i>This program is to develop a Master's Program in Industrial Engineering to support Smart Industry 4.0. In the future, it will be used to teach both in Thailand And European countries.</i></p> <p><i>1. Communications Course: It will help the learner to build and develop in leadership communication skills and people skill. 2. Applied Data Analytics Course: I heard about Data Analytics in computer engineering faculty. It is the tool, which helps to develop competences on statistical techniques needed for data analysis. Moreover, it is a process of discovering patterns in large data sets involving methods at the intersection of machine learning, statistics, and database systems.</i></p> <p><i>Not much. I just know that there are many universities such as Chiang Mai university, Asian institute of technology, etc. are collaborated in order to develop the curriculum.</i></p> <p>A: From students' answers one can conclude that some did and some did not know all the facts/data about this project.*1</p>	
2	How many pilot courses, offered within the project realization, did you attend? Please, list which courses.
<p><i>On my understanding had only one. That was I attended.</i></p> <p><i>There are 2 pilot courses: Digital Factory Course and Communications and People Skills Development for Engineering Leaders Course.</i></p> <p><i>2 courses.</i></p> <p><i>I took 2 courses in the last semester. First is Applied Data Analytics and another one is Communications and People Skills Development for Engineering Leaders.</i></p> <p>A: Student were attending the courses that were at their disposal, at certain universities two pilot courses were offered and at some others only one.</p>	
3	Why did not you attend more/all the courses?
<p><i>Because my teaching location and address are far apart, for example teaching in the south of the country and I am in the central part of the country.</i></p>	



<p><i>I heard only two courses in my department.</i></p> <p>A: The first answer is indicative. Student insists on having courses "closer" and probably online.</p>	
5	<p>How do you evaluate the course/ courses you did attend?</p> <p>Please give grade: From 1 (poor) to 5 (excellent). Please evaluate <u>all</u> the courses that you attended.</p>
<p><i>I appreciate on this class because my knowledge is better than in the past. For example in coding and decision marking design.</i></p> <p><i>I evaluated the courses I participated in under the topic teacher's knowledge transfer, participation, modern teaching materials, teamwork, case study to visit in the factory and open opportunities to show talent, etc. Grade of Digital factory course is 5 and grade of Communications and People Skills Development for Engineering Leaders Course is 5.</i></p> <p><i>Communications Course: Grade 4 Applied data analytics: Grade 5.</i></p> <p><i>For Applied Data Analytics, I give 4. For Communications and People Skills Development for Engineering Leaders, I give 3.</i></p> <p>A: Some students were evaluating courses according to the procedure(s) at their universities, while some gave concrete grades here.</p>	
6	<p>Were the conditions for the course adequate?</p> <ol style="list-style-type: none"> 1) Number of students in the class? 2) Teaching equipment? 3) Course materials? 4) Were the course materials provided? (In advance, in time, later). 5) Teacher's attitude? 6) Number of credits? <p>Please, elaborate on each issue.</p>
<p><i>No.</i></p> <p><i>1) Suitable on this class; 2) Maybe to have more than this; 3) Maybe to have more than this; 4) Provided but not more; 5) Good attitude because he taught like active thinking; 6) The credit is 3 units.</i></p> <p><i>The conditions for the course were adequate. 1) The number of students in a class is no more than 15, it is appropriate. 2) The teaching equipment was studied and practiced from the laboratory and real factory. 3) The learning materials are theoretically sufficient and include video clips and multimedia. 4) Have documents for teaching and learning in advance from google classroom. 5) The attitude of the teachers changed from the teacher to the teaching director. 6) Number of credits: 3 credits of each subject are sufficient.</i></p> <p><i>Yes.</i></p> <p><i>1) Yes for Communications and People Skills Development for Engineering Leaders but for Applied Data Analytics no, because there are many students interesting in this course. 2) Yes for both. 3) Yes for both. 4) The course materials provide in advance for both courses. 5) For both courses, teachers care for their students a lot. 6) Number of credits for both courses is 3, which are enough.</i></p> <p>A: All the answers to the first question were positive, except for the first one. Student even explained what he considered as insufficient.</p>	
7	<p>What would you change/improve?</p>
<p><i>The code, decision marking design and implementation based on design decision.</i></p> <p><i>N/A.</i></p> <p><i>For communications course, The study time should separate to 2 sections, which is different days because the student can review the lesson of lecture time.</i></p>	



For Applied Data Analytics, this courses should add a condition about the former course that the student should be taken before taking this course because this course need knowledge about basic statistics. If we do this, I think we will get more benefit from this course. For Communications and People Skills Development for Engineering Leaders, no need to change anything.

A: The third answer contains the proper suggestion for organizing the lecturing. There should be a time gap between the theoretical and practical (lab) parts of the course, so that students can have time to "digest" the theory and prepare for the second part of classes.

9	Did you find the course(s) that you attended useful for your further studies? Which one(s) and how was it useful? Please, elaborate.
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Of course, it must be continued for those who are interested.

The Application of the coding of the Decision Process.

Of course, the digital factory course useful for my further studies. The teaching and learning have built real working skills such as presenting the concept of converting a traditional factory into a digital factory. Students can bring Virtual Reality: VR, Augmented Reality: AR, Robotics, Automated Guided Vehicle (AGV) are used to improve factories to suit the industrial 4.0 includes solving complex problems, presenting and communicating for real-time connection between users and machines by applying applications based on the learning outcomes of the subjects. A digital factory where students can use digital technology for modeling and communication for design. Evaluate and implement production processes to suit the industrial age 4.0.

*Communications course: It develops my communications whatever speaking, writing, listening and reading.
Applied data analytics course: It helps me to manage the big data about statistics.*

- For Applied Data Analytics, of cause I can use the knowledge I learned from this course to deal with the data in my further studies because data is everywhere.

- For Communications and People Skills Development for Engineering Leaders, I can apply the skill I learned from this course during meeting or working with foreigners.

A: All the answers to this question were quite detailed, providing the useful information how the courses brought benefits to them and how they would profit for them.

10	Did you find the course(s) that you attended useful for your future employment? Which one(s) and how was it useful? Please, elaborate.
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This is mega trend for the future.

Yes, Communications and People Skills Development for Engineering Leaders Course, which brings knowledge in practical teaching science on communication skills Leadership Motivate students to learn Develop communication with society and allow students to learn Practice effective presentation methods. Students will be keen learners to practice skills, not only in decision-making, problem solving, critical thinking. Also including writing and communication Verbal communication, gestures, presentations, discussions, and teamwork.

Both courses are useful for my further my future life.

- Nowadays, data is very important for everyone and in every company also. So, after taking this course I can know how to analyze the data that we have or how to categorize the data that have the relationship.

- For Communications and People Skills Development for Engineering Leaders, this course provide courage for me while talking with foreigners or presenting in public.

A: Here applies the same remark as for question # 9.



The general conclusion by the auditor is that the PC and the PEC, QCMB and team members are quite sure that the project was successfully conducted, realized and finished to the benefit not only for the participating Thailand universities, but to the European partners, as well.

Furthermore, there were number of proposals for extending the scope of the project application to other Thailand universities, maybe even to universities in the region.

The proposal for extending this project's topic (Smart Industry 4.0) to the non-university sector in Thailand was submitted and accepted by the Erasmus+ program. Its three-year realization started on 15.11.2020.

This testifies that the sustainability of the project results is pretty ensured.

3.4. Findings based on the audit interviews and virtual laboratory tour

[07_Audit Plan \(Final Audit\) with Meeting ID.pdf](#)

3.4.1 The Project Coordinator (PC)

Interview with the PC was done on November 02. 2020.

The first part of the interview consisted of going through some of PC answers to points raised in questionnaires by the PEC, QCMB and team members and students.

Project completion/final audit stage		
PEC members questionnaire		
Original answer	What has changed and/or Auditor's remarks	
3	<p><i>Did the project team meetings take place in accordance with the adopted rules and plan since the mid-term audit?</i></p> <p>Most of the meetings have been small unofficial for working groups to move the project forward.</p>	<p>Auditor asked (referring to an answer of one PEC member) why there was no final meeting of the PEC?</p> <p>PC: It was planned to be held during the Final Conference. Due to Covid-19 epidemic the Conference was held in hybrid form, where the non-Thai participants were only "present" on-line". The final meeting could not have been held, among other reasons, due the time difference between Thailand and different countries in Europe (5 to 7 hours).</p>
6	<p><i>Did any predicted risks/new risks appear since the mid-term audit? If yes, how did you handle the identified risks?</i></p>	



<p>We have experienced risks from the unexpected COVID-19 pandemic. It has affected several tasks, including but not limited to the regular meetings, laboratory development and the dissemination events (e.g. training for industry and conference). ... We tried to delay our decisions unless decisive ones were required. ...</p> <p>I believe that our members have tried to keep things moving during this challenging period and tried to adjust ourselves to working in a new normal to maintain our performance.</p>	<p>Auditor asked (referring to an answer of one PEC member) about problems in information flow and increased workload related to organization of the PALE/ALE20 conference that was organized by the project staff.</p> <p>PC: It was "normal" that all the activities were slowed down due to epidemics and that communications (information flow) had to be reorganized to practically only online forms. What concerns the Conference, there were no problems, except for holding it in a necessary "hybrid" form.</p>
<p>8</p>	<p><i>Were there any problems recorded related to compliance with contractual obligations since the mid-term audit? If yes, what are they? How were those problems eliminated? If not, why?</i></p>
<p>No. We have tried our best to deliver what have been promised in the proposal. We have been able to deliver most of the outcomes completely. A few of them have been partially completed.</p>	<p>Auditor asked (referring to an answer of one PEC member) that there was a problem with the financial statement of UPB. This was not fully accepted by the project coordinator and I am not sure how the situation is at this moment.</p> <p>PC: The problem was that some of the activities were not properly reported by UPB (in their financial statements). That was resolved after the UPB partner provided explanations and corrected the financial reports</p>
<p>10</p>	<p><i>Which measures were implemented? Please, elaborate.</i></p>
<p>The workshops were organized for Thai members for WP3. A proposal was submitted and won for the sustainability of the project.</p>	<p>Auditor asked what the new project proposal was about and which partners from this project will participate in it.</p> <p>PC: The new project is "natural" continuation of this project and it concerns with extending it to the non-university sector. It is entitled: "Reinforcing Non-University Sector at the Tertiary Level in Engineering and Technology to Support Thailand Sustainable Smart Industry – ReCap – 4.0". The project partners are: 1. Asian Institute of Technology (Project Coordinator); 2. Khon Kaen University; 3. Prince of Songkla University; 4. Mahidol University 5. King Monkut's University of Technology North Bangkok; 6. Mary Immaculate College (Republic of Ireland); 7. University Politehnica of Bucharest (Romania);</p>



		8. University of Minho (Portugal). Four Thailand and two EU partners from this project will continue their collaboration on this new project, with including the two Thai and one EU universities as new partners.
13	<i>Were all the outputs, planned to be realized, implemented, in what amount and quality? If not, why? Please, elaborate.</i>	
	Yes. Outcome 3.1: Teaching materials for instructors are being developed. Most of them are completed. Outcome 3.4: Two workshops were offered by the EU partners. The third one could not be made due to the pandemic. Six public seminars were offered by EU members during their visits to Thailand for the project meetings. Outcome 5.4:	PC: The WP 5 is completed. The WP 2 is not completed in the aspect that accreditation of the proposed masters curriculum is not accredited yet. The accreditation procedures are started for all the partners, however they are very different for Thailand universities and it will take additional time to complete them all. For WP3 some course instructors did not submit all the course materials and documents yet. The WP 5 is completed.
24	<i>Is there anything you would like to add?</i>	
	As the project coordinator, I delegated tasks and authorities to WP leaders from the beginning. I have managed this project by observing and assisting when needed. When the members were not able to deliver or did not perform properly, I would normally communicate first with the WP leaders. I intervened only when the problems could not be solved by the WP leaders and/or the results were unacceptable to keep the project on track with quality. We are grateful to receive funding from the Erasmus Plus Program of the European Union. This funding has allowed us to be a small mechanism to contribute to support Thailand towards a sustainable smart industry. Since day one, several activities have been conducted under the MSIE 4.0 project that includes, but are not limited to, curriculum development, laboratory development, pilot testing of developing courses, industrial training, public seminars, and an international conference on education. Despite the difficulty and challenge, we were able to deliver the outcomes as promised in the proposal. The quality of the work is acceptable, considering the uncontrollable circumstances.	Auditor asked (referring to an answer of one PEC member) that: "there was no use of the lab gadgets for the demo/trial teaching", why is that and in which courses was the project lab used and in which not? PC: The explanation is that all the Thailand partners were asked if they want and need to use the project lab, where at first they did not express the need for it and later changed their attitude. All the Thai partners had access to the project lab, either directly (physically) or online.

QCMB members questionnaire

There was no point raised by the QCMB members to which the PC would have to give and explanation.

Team members questionnaire

12	<i>What is your general opinion on the project realization? Please elaborate.</i>
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<p>Auditor asked about problems with equipment for the lab posed by one team member.</p> <p>PC: There were financial losses induced by sharp changes in the exchange rate bat/euro, what forced the technical staff to manufacture some equipment parts instead of buying the expensive ones.</p>	
13	<p>Any suggestions on what you think that should/could be improved/ changed in project tasks/outputs? Please elaborate.</p>
<p>Here are cited some answers from the team members so that it is clear to what the OC's answer are referring.</p> <p><i>Sometime it was difficult to combine the activities of the project with the regular activities (e.g. teaching and research).</i></p> <p>PC: In the future projects the partner leaders will have to choose team members with less "regular activities" so that they would be able to devote their time to project realization.</p> <p><i>Face-to-face meetings are important ...</i></p> <p>PC: Those meetings were regularly held prior to Covid-19 outbreak. They will be returned to once the pandemic is over.</p> <p><i>Consideration should be given to the real participation of entrepreneurs in the teaching process, e.g. sharing software, working on machines in the company, etc.</i></p> <p>PC: The first step towards this is the newly proposed project "ReCap – 4.0".</p> <p><i>There should have been better communication in-between different projects. ...</i></p> <p>PC: Disagree. There were regular meetings with representatives of all the partners and WP leaders – everyone was always well informed about the future steps in the project realization. There might have been problems within teams at partner universities but the PC was not aware of any or was not informed of any.</p>	
<p>Students questionnaire</p>	
<p>There was no point raised by students to which the PC would have to give and explanation.</p>	

The second part consisted of going with PC through some points in the project realization for which the auditor considered that they needed further clarifications or answers. Here are some explanation by the PC, which are presented verbatim.

The support of the laboratory to the MSIE 4.0 curriculum

Sixteen courses have been developed in this project for the new curriculum of the Master's degree program in Industrial Engineering to support Thailand's sustainable smart industry. They can be categorized into five groups: engineering management, decision science, industry 4.0 technology, design, and soft skills.

The five courses under engineering management are Enterprise Management in Digital Economy, Project Management for Industry 4.0, Smart Operation Management, Quality Management for Extended Enterprise, and Sustainable Supply Chain Management. The three courses under decision science are Applied Data Analytics, Intelligent Decision Support Systems, and Advanced Optimization: Techniques and Industrial Applications. The three courses under industry 4.0 technology are Digital Factory, Cyber-Physical Industrial Systems, and Collaborative Manufacturing Systems. The four courses under design are Additive Manufacturing for Industry 4.0, Innovative Product Design and Development, Human-Centric Design for Operator 4.0, and Customer Experience-Driven Design. The one course under soft skills is Communications and People Skills Development for Engineering Leaders.

Facilities have been developed in the second half of the project after needs were identified to ensure their support for the learning of these courses, which can be categorized into two groups: Learning Future Factory Laboratory (L2F Lab) and immersive classrooms.

The L2F Lab has been developed to provide a practical environment to support learning in a board spectrum from a system level down to the device level. Instructors can utilize this facility to support their courses in decision science, Industry 4.0 technology, and design as well as Smart Operation Management. AM space



located in the L2F Lab is equipped with 3D printers and scanners to support design learning. The main shop floor of the lab is a house for Automated Storage and Retrieval System (ASRS), Tiling Automation System, A fleet of five automatic guided vehicles (AGVs), Conveyor System, Collaborative Robots, and Collaborative Additive Manufacturing. The entire shop floor as well as individual units can support the learning of several courses including, but are not limited to, Smart Operation Management, Advanced Optimization: Techniques and Applications, Collaborative Manufacturing Systems. Sensors employed at these stations can provide real-time data for further exploitation in Digital Factory, Applied Data Analytics, and Cyber-Physical Industrial System. In addition, Tecnomatix software with sixteen pool licenses is also available for the Thai instructors to strengthen their courses with virtual world learning.

Besides, six immersive classrooms have been set up at six Thai partner universities. Each room composes of a set of three televisions and a sound bar mounted on movable TV stands reconfigured to provide an immersive feeling for students. These rooms can be used for onsite lectures and can be used for online learning when equipped with a VDO camera system. The main purpose of having these rooms is to display live activities in the L2F Lab for a better learning experience for students during the lectures.

Sustainability of the MSIE 4.0 project

Regarding the sustainability of collaboration and of the project, a couple of immediate activities have been achieved.

First, a Memorandum on Understanding (MOU) for bilateral cooperation between the UPB (University Politehnica of Bucharest, Romania) and AIT (Asian Institute of Technology in Bangkok) was signed on May 13, 2019, during the AIT president visit to Europe. This MOU is for the period of five years and is subject to extension by mutual consent of both parties.

[20 MoU AIT-UPB 2019.pdf](#)

Second, the project coordinator submitted another winning proposal to the 2020 Erasmus Plus Call for Proposal. It is the dissemination of the outcome of the MSIE 4.0 project. While the MSIE4.0 project has focused on development of the resources covering educational programs, materials, and facilities, the new project on Reinforcing Non-University Sector at the Tertiary Level in Engineering and Technology to Support Thailand Sustainable Smart Industry (ReCap 4.0) will focus on human resource development. ReCap 4.0 is a three-year project proposed to enhance the capacity and ability of the non-university sector at the tertiary level in Thailand for the effective delivery of engineering and technology knowledge and skills related to Industry 4.0 to support Thailand Sustainable Smart Industry and to strengthen a partnership among participating European and Thai universities as well as benefited non-university sector.

Financial Management of the MSIE 4.0 project

Financial management, especially for equipment costs, is challenging. Purchasing commercial machines to place in the L2F Lab would limit the capability of the lab to just about two to three units and would not reflect the impression of the future factory. Therefore, the development team decided to construct some units (e.g., AGVs, ASRS) and buy some units (e.g., robots, 3D printers) to use the equipment budget effectively. As a result, some amount of budget for AIT researchers was transferred to technical staff to cover the staff costs for the construction. Financial management became more difficult when the currency fluctuated widely during these three years. The value of Thai Baht relative to Euro strengthened from 38.929 Baht per Euro in January 2018 when the first installment was made to 34.404 Baht per Euro in February 2020 when the second installment occurred. Approximately 4.524 Baht per Euro difference has led to about 1.77 M Baht lost in the second installment (40% of the total budget), which could be used to buy almost two more robots easily. The COVID-19 pandemic has also affected the availability of components. Therefore, the development of some units (e.g., the collaborative Additive Manufacturing) was put on hold until the availability of the fund and the parts were checked and confirmed to ensure the completion of the units. In the end, the expense for the equipment costs



was about 5% over the budgets, which is still in the 10% budget transfer between categories that the project coordinator can operate without requesting permission to the project advisor.

As in the Mid-term Audit report, it should be noticed that the auditor's opinion is that the Project Coordinator was managing this project in a very responsible manner, paying attention to all the details, as well as the project as a whole.

It should be emphasized again that all the team members, including PEC, QCMB and students, were expressing admiration and gratitude to the Project Coordinator for the ways in which he was executing this role.

3.4.2 The Project Executive Committee members, WP leaders and Tasks leaders

Interviews with managerial staff of the project were done on November 02 to 04.2020.

[07 Audit Plan \(Final Audit\) with Meeting ID.pdf](#)

The following remarks and conclusions are results of those interviews.

As the first, certain point was cleared with a PEC member who answered with "I was not informed" to several questions of his respective questionnaire. That point was also raised in interview with the PC. It turned out that there was a misunderstanding of the questions by the PEC member and that he was well informed about the project realization, except that he emphasized that he could not have been informed about all the project details, especially of those happening at other partner institutions.

WP2 – Curriculum Development I: Curriculum Structure and Courses

Outcome 2.1. A modernized curriculum for Master's degree in Industrial Engineering

For page 10, Section 4.3., the question, referring to rules for establishing the course teams, was why the third rule was imposed. The answer by the task leaders was that in this way the EU partners' members were acting as consultants of the Thai partners' course teams.

The auditor's opinion is that this is an example of good practice and that it should be followed in other projects of this type.

Outcome 2.2. Syllabuses for all courses in the curriculum

Auditor suggested that the pagination of this outcome's report should be continuous throughout the whole report and not starting at page 1 for each Annex, since that is causing confusion for the reader.

Outcome 2.3. Pilot teaching in modernized MSc at partner universities

Auditor asked why is this outcome presented in form of the PPT screen shots and in the usual "form". The answer is that this is not a report per se, but list of presented courses.

Outcome 2.4. Assessment of pilot test of the key courses and improved courses

Auditor asked about Table 2, whether the number of students attending the course and number of students that answered to survey about the course were the same. The answer was that it depended from course to course. For some courses, all the students attending the course answered to a survey and for some they did not.

Outcome 2.5. (Preparation for) Accreditation of the curriculum



The main point raised by the auditor was about the accreditation procedure, since from the report it could be seen that at some Thailand partner universities the accreditation procedure is far more advanced than in some others. It is explained that the governing structures of the Thailand universities are not unique, thus the accreditation procedure at some universities has to go through two steps (University's governing bodies) and at some other universities through three steps. After the procedures are finished at the university level, the accreditation is continued at the national level. However, some of the universities do not even need that last step.

WP3 – Curriculum Development II: Modernization of Teaching Methods and Tools for Innovative MSc Programmes

Outcome 3.3. V class Online Learning Platform

The Virtual Class Online Learning Platform is completed. The content of the learning platform is well presented in this report. It also contains five annexes that include Teachers Manual for the Virtual classroom, Students Manual for the Virtual classroom, Questionnaire survey, Student's Evaluation form and Lecturer's Evaluation form.

Outcome 3.4. Training of Staff on new tool and best practice exchange on modern teaching methods

The two workshops were held as planned, while the third one planned for 2020 in Bucharest, could not have been held due to the Covid-19 epidemic outbreak.

The report on this outcome was presented incomplete, the final pages missing. The auditor was later provided with the completed report.

WP5 – Dissemination and Exploitation of Project Results

The general remark by the auditor was that all the reports are marked as "status: draft" (except for 5.1 which was already finished earlier).

The explanation by the WP5 leader was that those reports are waiting for the final approval by the QCMB and PEC.

Outcome 5.2. Creating a project website

Auditor had a general remark on "Executive summary" section wording, since it was not properly presented. The matter was resolved on interview. The report was a draft version and language corrections will be entered in the final version.

Outcome 5.3. Production and dissemination of project materials

The auditor asked when the Exhibition of Science and modern technology celebrating 60th Anniversary of the KMTUNB University was held. The date of the exhibition was 22.03.2019. This data should be entered into the Outcome 5.2 report. Auditor also remarked the some of the figures in the report were not visible when the file is printed, which is probably the consequence of the improper formatting of figures when they are entered into the text. The proper formatting is "in-line with text".

Outcome 5.4. Publications in professional journals, newspapers, magazines and brochures, social media



The auditor asked about the "distribution" of tasks on publishing of project materials and results. The WP 5 leader explained that almost all the partners evenly contributed to this activity.

Outcome 5.5. Developing joint short-term courses in the field of Industrial Engineering in cooperation with industry for professionals

The remark by auditor was related to some errors in the text. Text on page 9, beginning of the Section 3 contained some unfinished sentences. It was explained that this was an error due to publishing the text from Word to PDF format. It will be corrected in the final version of the report. The remark of several figures not being visible when printed applied here, as well.

Outcome 5.6. Organizing dissemination events with relevant stakeholders

The Introduction section of report on this outcome was poorly written. The WP leader promised to correct the mistakes.

Outcome 5.7. Organizing the final dissemination-sustainability conference

The report on this outcome is complete, still with several points to be emphasized, which by the auditor's opinion deserve so. All the workshops and activities are well documented.

The suggestion by auditor is that all the documents related to the conference, line flyers, information brochures, explanations, etc. should be presented as annexes to this very good report. The WP leader agreed.

3.4.3 The Project Quality Control and Monitoring Board members

Interview with the QCMB board members was done on 04.11.2020.

[07 Audit Plan \(Final Audit\) with Meeting ID.pdf](#)

WP4 Quality Plan for implementation of the project

The interview also included going through some distinctive answers by the QCMB members; however, there were no points of disagreement with auditor's conclusions presented in Summary of the QCMB members' answers to their respective questionnaires.

The Chair of the QCMB pointed that people were restricted in communication since March of 2020 due to the Covid-19 pandemic practically only to online communication. She personally prefers the face-to-face communication since then people work better as a team. She also expressed appreciation to other QCMB, as well as team members, for supplying her with information so that she was able to follow all the quality procedures and prepare reports.

Other QCMB members also expressed their appreciation for the teamwork, especially those that were participating in this type of a project for the first time. They found the experience quite challenging since the project was "ambitious and big". Another member pointed out the good collaboration and exchange of knowledge between people from different cultures as a valuable experience.

In general, all the QCMB members were working hard, were glad to work together as a team and appreciated each other's help.

The conclusion by the auditor is that the QCMB was doing a very good job since controlling the quality of the project realization and results is the most responsible task.

3.4.4 The project team members



Interview with the team members was done on 04.11.2020.

[07 Audit Plan \(Final Audit\) with Meeting ID.pdf](#)

The team members interviewed included Final Conference organizers, project administrative members and the training seminars instructors.

The interview also included going through some distinctive answers from the respective questionnaires.

Conference organizers informed about the conference fee, which was different for the online and on-site participants (100 and 120 Euros, respectively, the second in Thai bahts). There were two main sponsors of the conference, Western Digital and the KKU University. The administrative and technical staff, working on conference preparation and during it, did not have to pay the conference fee and they were provided with accommodation.

There was no exhibition organized during the conference, but participants from Thailand were offered the tour of the conference lab.

The technical staff at the conference consisted of members from the Asian Institute of Technology and Khon Kaen University.

The project administrative workers thought that their workload was adequate and delegated according to their field of work.

The laboratory equipment was installed in time due to diligent work of technicians. They expressed originality in manufacturing some parts instead of purchasing the more expensive ones.

The training instructors gave information on individual short-courses that they were delivering.

The training materials were available at participants' disposal, both as through the online access and as brochures.

All the trainers were very satisfied with trainees' attitudes, especially in expressed desire to have more active participation, not merely listening to lectures, but to get involved in discussions.

The suggestion was also to get to use the laboratory practically, not just online (as soon as the epidemic situation would allow).

For some instructors this was the first time that they actually had to organize lectures online, which they found as useful and challenging experience.

3.4.5 Students

Interview with students was held on 05.11.2020.

[07 Audit Plan \(Final Audit\) with Meeting ID.pdf](#)

The students present at this online interview were mainly those who did not fill-in the students' questionnaire, so the auditor was able to get more answers that are different. There were five students present, from four Thai universities.

One student suggested that the link between the actual lab and the virtual lab should be created, so that students would be able to benefit from use of both.

The students who attended the "Digital factory" (course #6) were satisfied that they could transfer the knowledge that they obtained during the visits to the real factories to their "own" digital factories and then propose the changes (improvements) to the first ones based on the knowledge they acquired in the course.



Some students had a good suggestion that teachers/instructors should check the knowledge of students before they are to take some course. Students coming from different backgrounds do not possess the same level of knowledge and there could be difficulties in their following the course at the same pace as others.

Mainly all the students agreed (both through questionnaire's answers and at the interviews) that the course materials they were provided with were adequate, some available before the classes, some after, as available to download or in a printed form.

They all considered the project web site as "an interesting and useful textbook".

3.5 Virtual tour of the project laboratory

The virtual tour of the project's laboratory for the auditor was organized on 05.11.2020.

07 Audit Plan (Final Audit) with Meeting ID.pdf

<https://msie4.ait.ac.th/learning-future-factory-laboratory-and-immersive-classrooms/>

The Virtual laboratory tour consisted of the two phase. As the first, the Project Coordinator, Professor Pisut Koomsap have presented the V-class presentation control room from where the online courses were delivered. The three monitors are for the teacher, one for lecturing (the central one, what students in the real classroom can see), the second for presenting the PPT slides (or the white board) and the third for the control of the classroom.

This control room was already used for workshops offered for trainees from industry.

Students are provided with microphones, so the communication with the instructor is two-way, i.e. they can ask questions and answer when asked by the teacher.

The second part of the tour was the tour of the laboratory.

At the entrance, the two billboards are placed, informing the visitors about the MSIE4.0 project and about the PAEE/ALE 2020 conference.

The first station of the lab is collaborative adaptive manufacturing. The student was explaining the collaborative process demonstrating how two machines are learning how to work together.

Then, a student showing the control center of the laboratory, where all the stations could be seen. It presents controlling the multi-movements along the given paths.

The following was the control of the two collaborative robots, followed by demonstration of collaboration between a robot and a human.

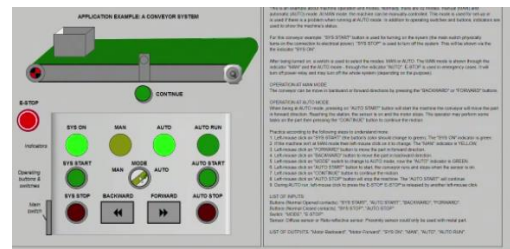
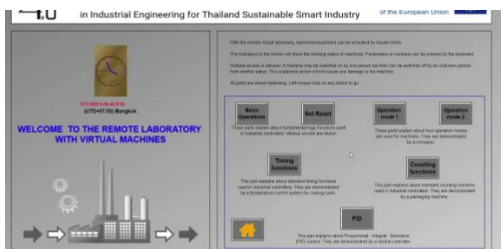
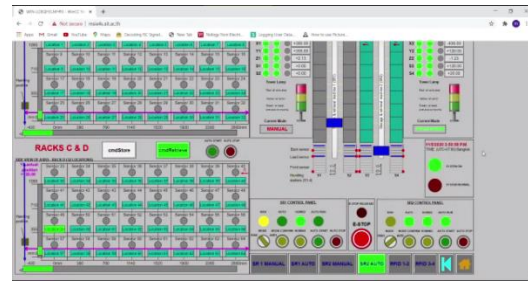
The synchronizing between the simulation and the real movement of a robot was presented next.

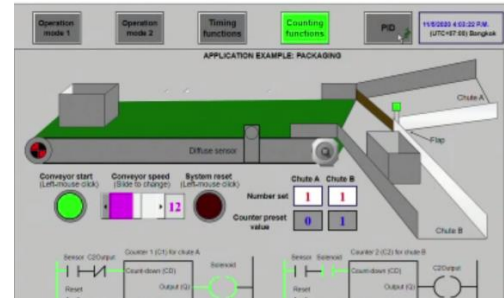
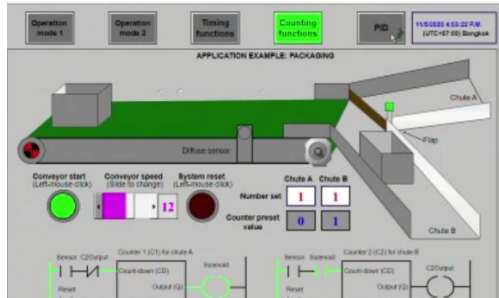
The plan is to extend this to six units working simultaneously.

The most impressive was the automated storage system, with alternating paths for packages.

All in all, the presentation of the laboratory was impressive and proved that the project team did a very good job in establishing it as such.

Some screen shots from auditor's computer are to testify to that statement.





The virtual laboratory tour was followed by the audit closing session with the Project Coordinator.

[07 Audit Plan \(Final Audit\) with Meeting ID.pdf](#)

Auditor expressed appreciation for excellent organization of the online audit interviews, virtual lab tour and for providing all the documents necessary for obtaining the full picture on the project realization.

Several points were discussed with the Project Coordinator on some errors in some reports on outcomes that were not communicated to the Work Package leaders. The PC took as his obligation to convey those remarks to respective persons.

It is auditor's duty to express gratitude to the Project Coordinator, project administrator Mrs. Supapan Chaiprapat, the PEC and QCMB and Team members and students for helping to get adequate, honest and precise information on project realization, so that the auditor was able to prepare this report in time and hopefully successfully.



4 Audit conclusions and recommendations

Based on reviewed documentation and online interviews with project team members, as well as based on virtual tour of the project laboratory and interviews with students of the pilot courses, the auditor came up with the following conclusions.

Audit objective (related to online interviews with project management and the team members) was met in accordance with the audit plan, including the virtual tour of the project laboratory.

Some general remarks on the project data, which were noticed at the Mid-term audit of the project realization, apply at this final audit, as well:

The Workload distribution between packages and activities is well balanced (WP1 – 16 %, WP2 – 16 %, WP3 – 28 %, WP4 – 11 %, WP5 – 13 % and WP6 – 15 %).

The same goes for the workload distribution between the staff categories (Teachers/trainers – 58 %, Technical – staff 26 %, Administrative staff – 8 % and Management staff – 8 %).

The budget is also evenly distributed between partners, without extremely larger amount kept for the Coordinating University.

The budget distribution to Work Packages is also commendable, since the largest amounts are allocated to the most important Work Packages and equipment purchasing.

The original Work plan from the project proposal was adjusted during the first year, since it was better suited to execution of the project realization in this form. Some further small adjustments were inevitable for such a voluminous project and, as some of the EU partners had put it, complex project.

The project management was executed according to adopted procedures in accordance with the adopted Project Management and Communication Plan.



It is the auditor's opinion that the Project Coordinator was managing this project very well, with extreme responsibility and paying attention to all the details, as well as the project as a whole. This was the conclusion at the Mid-term evaluation of the project and it should be reiterated now.

It should be emphasized that all the team members again expressed admiration and gratitude to the Project Coordinator for the ways in which he was managing this project.

The general conclusion is that the Project Coordinator, members of the PEC and QCMB, as well as other team members (administrative and technical staff) were, at any moment, quite sure that the project was being executed properly. Furthermore, it is their general opinion that the project outcomes are going to be beneficial, not only for the participating Thailand universities, but to the Thailand academic community and industry as a whole. There were number of proposals for extending the scope of the project application to other Thailand universities, maybe even to universities in the region.

It should be mentioned that the project already has the "spin-offs".

The Romanian partner, University Politehnica of Bucharest (UPB), has already introduced the Master's program with a similar curriculum as the program predicted as the outcome of this project.

Due to the mutual collaboration on this project, the Romanian and Polish partner universities have prepared the proposal for another project in the area similar to Industry 4.0.

An agreement was signed on official collaboration between the Asian Institute of Technology (AIT) – the Project Coordinating University and University Politehnica of Bucharest (UPB), which was agreed upon during the training visit of the Thailand project team members to UPB.

[20 MoU AIT-UPB 2019.pdf](#)

Above all, the Project Coordinator has proposed and obtained the new project in the same field, with practically extending the project results to the Thailand non-university sector. The project "Reinforcing Non-University Sector at the Tertiary Level in Engineering Technology to Support Thailand Sustainable Smart Industry – ReCap 4.0" was approved by the Erasmus+ programme for implementation period of 3 years.

<https://msie4.ait.ac.th/msie-4-0-hands-a-baton-to-recap-4-0/>

Some of the partner universities, participating in realization of this project, will be partners in the new project realization, as well.

Some the EU team members expressed their opinion that this project, due to its topic, would have been hard to execute even for the EU universities with long-term experience in realization of educational projects such as this one and that the Thailand project team has done, as they had put it, "an excellent pioneering job".

What specifically concerns the quality control of the project realization, the auditor's conclusion is that the QCMB members have done a very good job. Control of the project realization and results control is the most responsible task for any project. The precise procedures were developed for realization of the quality control of each task, activity, outcome and deliverable. Some of these procedures were common for several Work Packages and some were specific only to certain ones, since that depended on the nature of each Work Package.

Dissemination and Exploitation of the project results were executed according to the DES plan (DESP). The success of these activities is illustrated by the number of promotional activities (seminars and workshops), as well as number of articles, related to the project topic (Industry 4.0) presented at scientific conferences. When presenting their articles, the team members were also distributing the project promotional materials to scientific meetings' participants. Total of 38 scientific publications were produced during the project realization, including scientific articles published in journals or presented at conferences and/or seminars.



Total of 10 pilot courses were delivered to students (though 9 were planned to be) out of 16 courses developed within the project Master's program curriculum. Again, one more course than 15 planned was developed. From surveys conducted among students could be concluded that they were satisfied with the courses that they attended, what is more important they found that the knowledge and skills that they gained were useful for their both future studies and eventual employment.

What concerns the project Laboratory that was visited via the virtual tour, it is obvious that its development and status are very good at present and that the project realization since the Mid-term evaluation helped in its completion. The laboratory equipment was "enriched" with numerous devices, machines, computer and robotic equipment, as well as accompanying software, some was purchased and some was developed by students and project team members. Thus prepared laboratory will be a valuable contribution in delivering several courses from the projects Master's curriculum.

Some of the auditor's suggestions, proposed during the Mid-term project evaluation, were accepted and implemented by the project team. The suggestion that was realized is increasing the accessibility of the project teaching and learning platform.

Some suggestions could not be realized, like accreditation of the project curriculum with some renowned EU Higher education accreditation agency, since the program has first to be accredited in Thailand.

The accreditation of the project Master's curriculum is the only project activity that is still "ongoing" and will be probably realized after the project completion. The reason for that is the fact that the accreditation procedures for Thailand higher education is not unique and it differs from university to university. Some universities have two, some three steps that the program has to go through (i.e. approval by university's governing bodies) before being submitted to the national accreditation body of Thailand. Thus, some of the project partner universities already have their program accredited and offered to students within this school year (2020/2021); some will probably be able to do so for the next school year (2021/2022).

At the end, the auditor is compelled to emphasize that the Covid-19 pandemic caused problems in project realization. The epidemic became an excuse for many individuals or even companies for not completing their jobs. This was not the case with this project team. Taking into account that since March of 2020, there was no direct person-to-person communication possible between the project team members from EU and Thailand partners, they did a great job. Switching to almost all online or the so-called "hybrid" communication forms, the project team managed to organize all the activities planned for this period, even organized the project final conference, with renowned key-note speakers and participants from different countries.

One workshop, planned to be held at University Politehnica in Bucharest, Romania and the project PEC final meeting were not held, due to pandemic restrictions on travelling. That did not have major impact on the project realization, which by the auditor's opinion was successfully executed.

Ruzica Nikolic
Auditor

Professor Ruzica Nikolic, PhD

In Žilina,

November 30. 2020.