

## WP 1 - Gap Analysis

### Outcome 1.1 Gap Analysis working plan

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#### REVISION SHEET

Version	Date	Author (Partner/Person)	The revision reason
0.1	16/03/2018	Wichai Chattinnawat	First draft of WP1 working plan
0.2	31/05/2018	Wichai Chattinnawat	Adjusted and complete the timeline, scope of data collection and detailed deliverable outcomes for task 1.2, 1.3
0.3	11/06/2018	Wichai Chattinnawat	Approved by PEC
0.4	26/06/2018	Wichai Chattinnawat	Insertion of list of company from TU partner
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2	25/9/2018	Wichai Chattinnawat	Updated the time period of the task 1.2, 1.3 , 1.4 and 1.5. Updated the number and name of companies for industry assessment from UPB.
3	22/11/2018	Wichai Chattinnawat	Updated the report considering the evaluation from QCMB.

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## 1 Executive Summary

The MSIE4.0 project aims to develop a master program for industrial engineering aligned with needs of Industry 4.0. In order to attain this objective, at the beginning of the project is necessary to create a plan for the development of the work package 1 (WP1). WP1 is dedicated to provide a comparative analysis of the current situation concerning the MSc curricula in Industrial Engineering offered in Thailand and European partner countries universities, the identification of the gaps between the real needs of the industry, the student needs and the actual offered curricula. Within this context, the Task 1.2 plan on analysing not less than 25 programs, and the partners made it potentially possible to access the information of near 50 MSIE curricula. The learning and teaching methods being offered currently in the project partners' countries will be based on content analysis of narrative descriptions of best practices from each partner. Additionally, surveys will be used for the identification of main competences needs from an estimated number of 90 companies and more than 350 students. The results from the questionnaires, crossed with the analysis of the curricula and the project team will allow to create the gap analysis and finally the recommendations.

## 2 Introduction

WP1 is aimed to provide comparative analysis of the actual situation concerning the MSc curricula in Industrial Engineering offered in Thai and EU partner countries universities, the identification of the gaps between the real needs of the industry, the student needs and the actual offered curricula. The recommendations for the new curriculum development, are the most important deliverable working elements for the first year of the project in WP1.

Throughout the entire first year the WP1 will

- 1) identify the strengths and weaknesses, the common points, the differences and the good practices concerning curricula, teaching methods and tools in Thai and EU universities
- 2) identify the gap between the needs of industry, for being ready for Thailand 4.0, especially in capacity building, and the competence of MSc graduates from current curricula offered by Thai and EU universities
- 3) recommend the specifications and focus areas of the new proposed MSIE curriculum.

The WP1 will be led by CMU and UMinho and all partners will also participate and be responsible for tasks related to their geographical regions.

## 3 Plan for WP1-1.1 Developing a gap analysis working plan

This WP1 starts with the development of a gap analysis working plan which had been approved by the project executive committee-PEC. This is done by the WP1 leaders (CMU) and (UMinho) with the participation of the project coordinator and with the consultation of the other members of the consortium.

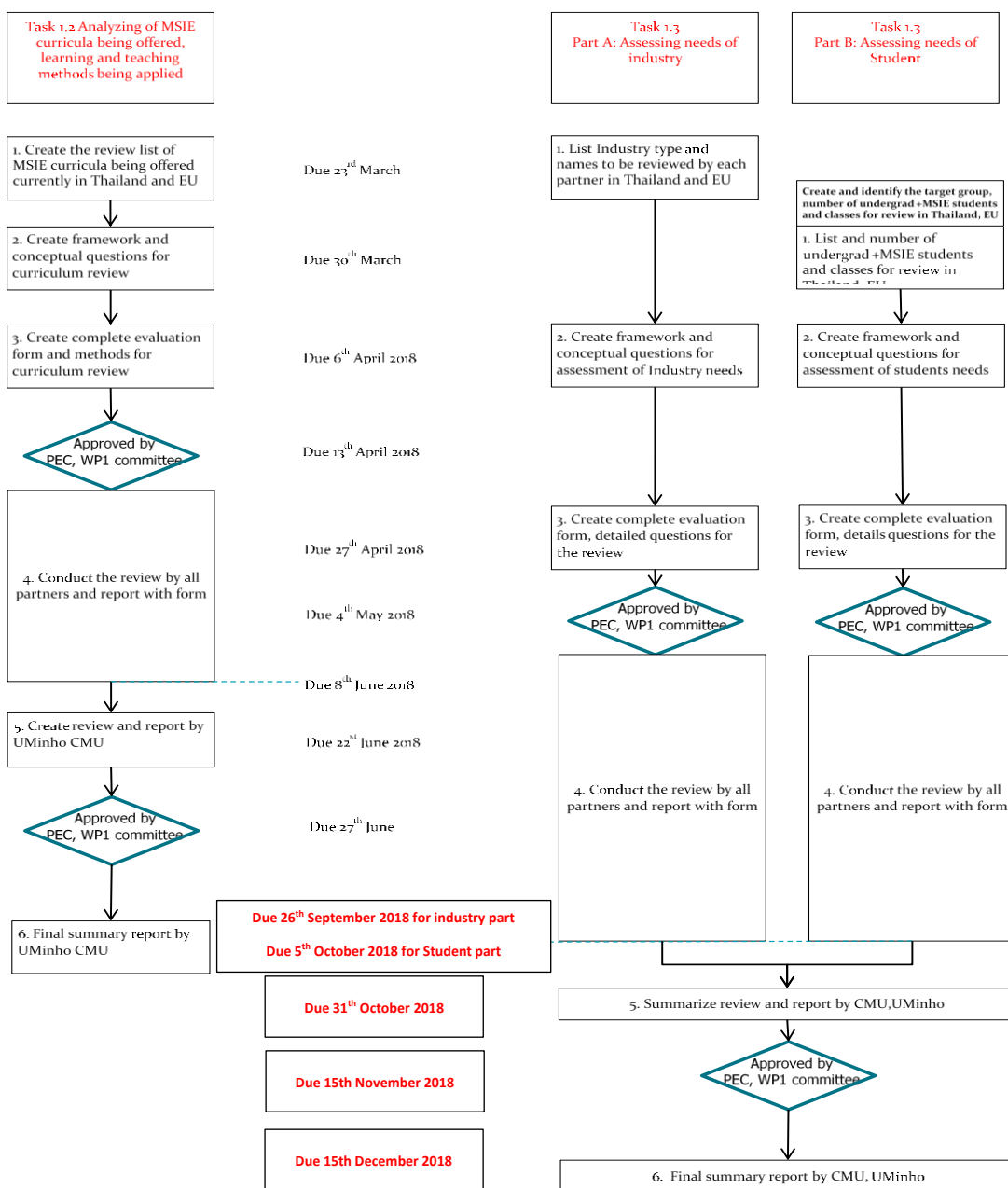


Figure 1. Working Plan Timeline and Schedule

The plan for the WP1 include the plan for the WP1 tasks, which are presented in the following sections.

### 3.1 Plan for WP1 - Task 1.2: Analysing of MSIE curricula being offered, and of learning and teaching methods being applied

Comprehensive analysis of MSIE curricula along with the assessment of teaching and learning methods being offered in Thailand and partners countries is conducted during the first half of the first project's year, and will be presented to the project committee during the first regular meeting. The project partners will make possible to access information of 50 programs. The final number of programs analysed will depend on the type of information that will be available.

Figure 2 presents the relation between the number of Thai and European selected programs.

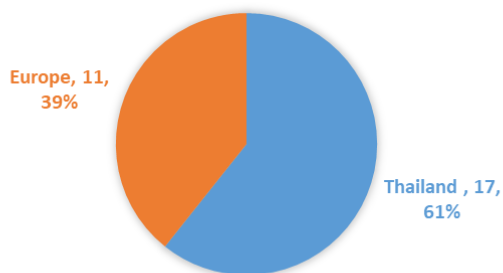
**28 UNIVERSITIES SELECTED FOR  
CURRICULUM REVIEW**

Figure 2. Universities selected for curriculum reviews, aggregated by Thailand versus Europe

Figure 3 represents the number of Thai selected programs, aggregated by regions of Thailand.

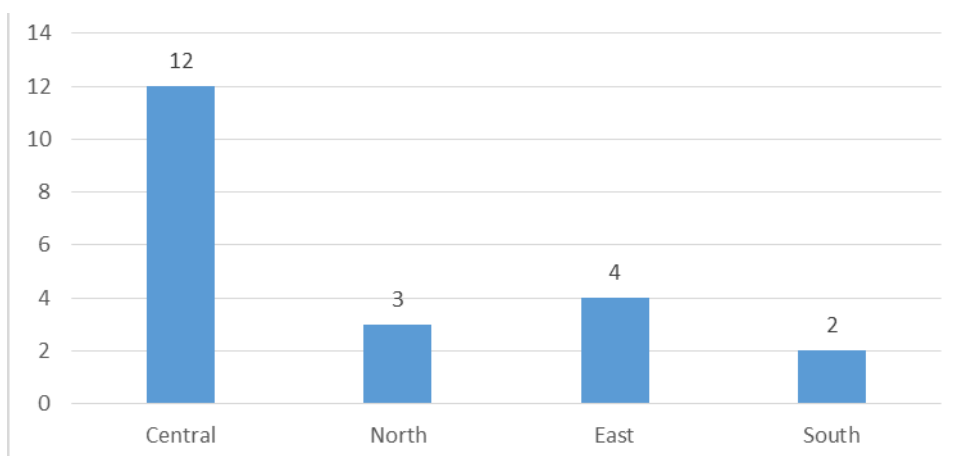


Figure 3. Number of selected Master Programs aggregated by regions of Thailand

Figure 4 represent the number of selected programs, aggregated by country

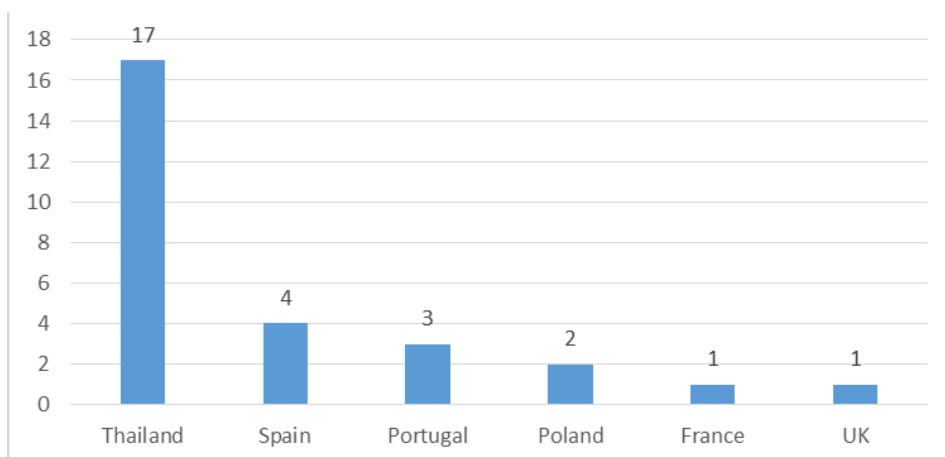


Figure 4. Number of selected Master Programs aggregated by country



Table 1 presents the list of curricula being reviewed by WP1, consisting of 22 master programs in Industrial Engineering and related areas from 17 universities in Thailand, and 29 master programs of Industrial Engineering and related areas from 11 universities in Europe.

*Table 1. List of the programs selected by each partner*

Chiang Mai University (CMU)	1. Chiang Mai University (CMU)	1. Master of Engineering Program in Industrial Engineering
	2. Naresuan University	1. Master of Engineering Program in Management Engineering
	3. Mae Fah Luang University	1. Master of Business Administration Programme in Logistics and Supply Chain Management (International Programme)
	4. Kasetsart University	1. Master degree in industrial engineering 2. Master degree in engineering management
Khon Kaen University (KKU)	1. Khon Kaen University (KKU)	1. Master of Engineering Program in Industrial Engineering
	2. Suranaree University of Technology	1. Master of Engineering (Industrial Systems and Environmental Engineering)
	3. Ubon Ratchathani University	1. Master of Engineering Program in Industrial Engineering
	4. Chulalongkorn university (CU)	1. Master of Industrial Engineering
Prince of Songkla University (PSU)	1. Prince of Songkla University (PSU)	1. Master of Engineering Program in Industrial Engineering
	2. King Mongkut's Institute of Technology Ladkrabang	1. Master of Industrial Engineering
	3. Burapha University	1. Master of Industrial Engineering
	4. Nakhon Si Thammarat Rajabhat University	1. Master of Industrial Engineering
King Mongkut's University of Technology North	1. King Mongkut's University of Technology North Bangkok	1. Master of Industrial Engineering
Thammasat University (TU)	2. King Mongkut's Institute of Technology Thonburi	1. Master of Engineering Program in Metal Forming Technology 2. Master of Engineering Program in Manufacturing System Engineering 3. Master of Engineering Program in Precision Engineering
	1. Thammasat University (TU)	1. Master of Industrial Engineering
	1. Sirindhorn International Institute of Technology (SIIT), Thammasat University	1. Master of Engineering Program in Engineering Technology 2. Master of Engineering Program in Information and Communication Technology for Embedded Systems (ICTES) 3. Master of Engineering Program in Logistics and Supply Chain Systems Engineering (LSCSE)
	1. AIT	1. Industrial Engineering and Management, Design and Manufacturing Engineering, Logistics and Supply Chain Management
UPB	1. University of Greenwich	1. Master of Engineering in Industrial Management
	1. Universitatea POLITEHNICA din Bucuresti/POLITEHNICA University of Bucharest (UPB)	1. Master of Engineering Programs in Industrial Engineering
		2. Design industrial și produse inovative/Industrial design and product innovation(DIPI)
		3. Inginerie avansată asistată de calculator/Advanced Computer Aided Engineering(IAAC)
		4. Ingineria nanostructurilor și proceselor neconvenționale/Engineering of nanostructures and nonconventional processes(INPN)
		5. Ingineria proiectării și fabricării produselor/Engineering of Design and Product Manufacturing(IPFP)
		6. Concepție integrată des systèmes technologiques/ Concepția integrată a sistemelor tehnologice/Integrated design of technological systems(CIST)
		7. Concepție și management în producție/Design and Management of Automated Production Systems(CMP)
		8. Echipamente pentru terapii de recuperare/Rehabilitation Therapies Equipments(ETR)
		9. Mașini și sisteme de producție/Machines and production systems(MSP)
		10. Tehnologii și sisteme poligrafice/Poligraphic systems and technologies(TSP)
		11. Logistică industrial/Industrial logistics(LI)
		12. Managementul întreprinderilor industriale virtuale/Management of virtual industrial enterprises(MIV)
		13. Ingineria calității/Quality Engineering(IC)
		14. Ingineria și managementul proceselor de sudare și control/Engineering and management of welding and control processes(IMPSC)
		15. Ingineria securității și sănătății în muncă/Occupational safety and health engineering(ISSM)
		16. Evaluarea calității materialelor și produselor/Quality assessment of materials and products(ECMP)
U Minho	2. Universidad Politécnica de Madrid	1. Master programe from ESCUELA TÉCNICA SUPERIOR DE INGENIEROS INDUSTRIALES(CFAC)
	3. Universitatea Tehnica Gheorghe Asachi, Iasi/Technical University Gheorghe Asachi, Iasi (U Gha Iasi)	1. Concepția și Fabricația Asistată de Calculator/Computer Assisted Design and Manufacturing(IMFM) 2. Inginerie și Management în Fabricația Mecanică/Engineering and Management in Mechanical Manufacturing
	4. ESCUELA TÉCNICA SUPERIOR DE INGENIEROS INDUSTRIALES - Universidad Politécnica de Madrid (UPM)	1. ESCUELA TÉCNICA SUPERIOR DE INGENIEROS INDUSTRIALES - Universidad Politécnica de Madrid
	1. University of Minho	1. UMinho1 - Integrated Master in Industrial Engineering and Management (MIEGI) 2. UMinho2 - Master in Engineering Systems (MES) 3. UMinho3 - Master in Industrial Engineering (MEI) – Industrial Management option
CUT	2. University of Porto	1. U.Porto - Integrated Master in Industrial Engineering and Management (MIEGI)
	3. University of Aveiro	1. UA – Master in Industrial Engineering and Management (MEGI)
	1. University: Częstochowa University of Technology, PL	1. Master Program in Management and Production Engineering
	2. University: AGH, Kraków, PL	1. MSc Program: Management and Production Engineering
	3. University: Grenoble INP, FR	1. Master in Sustainable Industrial Engineering

The task 1.2 aiming at analysing MSIE curricula being offered, and of learning and teaching methods being applied will be developed considering the following tasks:

- Task 1.2.1 Reviewing MSIE curricula being offered currently in Thailand
- Task 1.2.2 Reviewing teaching and learning methods being applied currently in Thailand
- Task 1.2.3 Reviewing MSIE curricula being offered currently in partners' countries - Task 1.2.4. Reviewing teaching and learning methods being applied in partners' countries
- Task 1.2.5 Analysing curricula, and teaching and learning methods

The output of these tasks will contribute to an understanding about the MSIE curricula in Thailand and European countries, in order to create a ground base for the identification of the gap between competences' needs for Industry 4.0 and sustainability and the academic development of Industrial Engineering master students.

According to the literature, curriculum analysis is helpful to identify aspects that are working and those that need a change (Wolf, Hill & Evers, 2006). This purpose is crucial in the context of Industry 4.0 and Sustainability, in order to prepare future engineers to face the challenges of their practice. Thus, the curriculum analysis is an essential step of this process.

It is possible to identify different approaches for curricula analysis in Higher Education (e.g. Fensham, 1977; Kirkpatrick 1998; Barnett, Parry, & Coate, 2001; Barnett & Coate, 2005; Cowan, 2006; Wolf, Hill & Evers, 2006; Wolf, 2007; Zabalza, 2009; Mesquita, 2015). These approaches include different components and processes such as: structure of the programme, educational experiences, program/ course/ class objectives, resources, learning environment, activities and strategies, course content, assessment, teacher role, institutional support, amongst other issues.

In the scope of this project, the diversity of institutions and programs to be analysed implies a definition of multiple sources and methods, as recommended by Wolf, Hill & Evers (2006). With this in mind, several types of information will be analysed in order to identify specific curricula elements, mainly concerning to the structure of the different programmes, type of educational experiences, areas of specialization, objectives / learning outcomes and innovative learning approaches with a student centred approach (i.e. active learning strategies). These elements are essentials to analyse the IE competences in the context of Industry 4.0 and Sustainability.

As planned in this task, there is the need to collect information about curriculum and about teaching and learning strategies. In the first phase the WP1 team should develop instruments for collecting information.

Figure 5 presents a schematic representation of the method that will be followed by the WP1 team, during the execution and analysis phases. Task 1.2 will collect data using forms and narratives and data will be analysed using qualitative and quantitative methods.

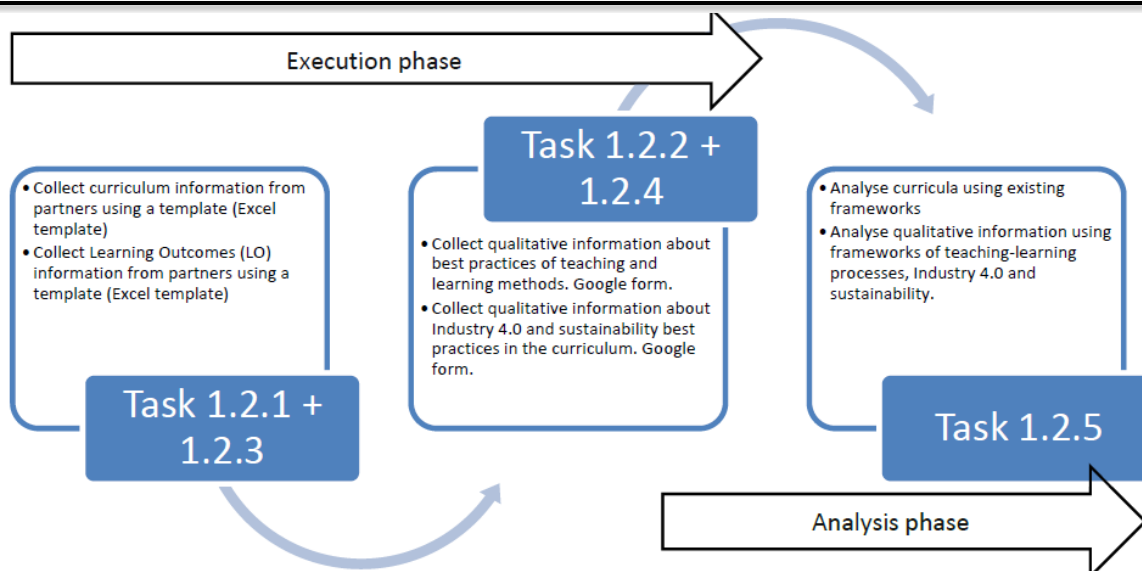


Figure 5. Execution plan of Task 1.2

An Excel template (Figure 6) is developed and is already distributed among the partners to collect information about curriculum structure, areas of specialization and learning outcomes. A form is being developed to collect information about best - practices of type of educational experiences based on innovative learning environments with a student centred approach (i.e. active learning strategies). Reviewing MSIE curricula (tasks 1.2.1 and 1.2.3) will be based on data collected from partners, using an Excel file as a template. First, we collect information from the courses, class types, hours of contact, credits and number of enrolled students. Please check next figure as an example.

YEAR	SEM	CODE	COURSE	C/E	General Scientific Area	Class type (theoretical, exercises, laboratory, tutorial)	TP	DT	OT	Credits	Hours (w/e)
4	7	UM1_47_1	Ergonomic Workplace Analysis	C	IEM		2	2		5	4
4	7	UM1_47_2	Integrated Production Management	C	IEM		2		2	5	4
4	7	UM1_47_3	Integrated Project in Industrial Engineering and Management II	C	IEM		2		1	5	3
4	7	UM1_47_4	Production Information Systems	C	IEM		2	1		5	3
4	7	UM1_47_5	Production Systems Organization II	C	IEM		2		1	5	3
4	7	UM1_47_6	Simulation	C	IEM				5	5	5
4	8	UM1_48_1	Advanced Quality Engineering and Management	C	IEM		2		1	5	3
4	8	UM1_48_2	Computer Aided Design and Computer Aided Process Planning - CAD/CAPP	C	IEM		2		1	5	3
4	8	UM1_48_3	Computer Aided Manufacturing	C	IEM		2	1		5	3
4	8	UM1_48_4	Integrated Project in Industrial Engineering and Management III	C	Complementary Sciences		2	1		5	3
4	8	UM1_48_5	Reliability and Industrial Maintenance	C	IEM		1	2		5	3
4	8	UM1_48_6	Sociology e Law of Organizations	C	IEM				5	5	5
5	9	UM1_59_1	Research Methods	C	Complementary Sciences		1	2		5	3
5	9	UM1_59_2	Option V - Lean Enterprise	E	IEM		2	1		5	3
5	9	UM1_59_3	Option VI - Design of Product Oriented Production Systems	E	IEM		2	1		5	3
5	9	UM1_59_4	Option VII - Lean Teams and Project Management	E	IEM		2	1		5	3
5	9	UM1_59_5	Master Thesis in Industrial Engineering and Management	C	IEM					0.5	40

Figure 6. Excel File Template of Task 1.2

In a second sheet, we ask information from learning outcomes in order to identify the expected competences to be developed by the graduates (Figure 7). Each partner is asked to add 4 to 6 LOs by course, if possible.

Year	Sem	Code	Course	LO
10	4	7	UMI1_47_2 Integrated Production Management	C UMI1_47_2_1 Identify the requirements for implementing the functions of Integrated Production Management (IPM).
11	4	7	UMI1_47_2 Integrated Production Management	C UMI1_47_2_2 Discuss the implications of different methods and functions of Production management.
12	4	7	UMI1_47_2 Integrated Production Management	C UMI1_47_2_3 Relate and integrate organizational processes and techniques of Integrated Production Management.
13	4	7	UMI1_47_2 Integrated Production Management	C UMI1_47_2_4 Identify, describe and analyze processes of Integrated Production Management.
14	4	7	UMI1_47_2 Integrated Production Management	C UMI1_47_2_5 Write reports and undertake oral presentations
15	4	7	UMI1_47_2 Integrated Production Management	C UMI1_47_2_6 Develop competences of communication in a foreign language
16	4	7	UMI1_47_3 Integrated Project in Industrial Engineering and Management II	C UMI1_47_3_1 Plan, develop and manage an interdisciplinary team project.
17	4	7	UMI1_47_3 Integrated Project in Industrial Engineering and Management II	C UMI1_47_3_2 Apply the contents of the courses in the context of the project.
18	4	7	UMI1_47_3 Integrated Project in Industrial Engineering and Management II	C UMI1_47_3_3 Evaluate the project proposal considering predefined criteria.
19	4	7	UMI1_47_3 Integrated Project in Industrial Engineering and Management II	C UMI1_47_3_4 Write reports and undertake oral presentations
20	4	7	UMI1_47_3 Integrated Project in Industrial Engineering and Management II	C UMI1_47_3_5 Learn how to work as a member of a team and independently
21	4	7	UMI1_47_3 Integrated Project in Industrial Engineering and Management II	C UMI1_47_3_6

Figure 7. Excel File Template of Task 1.2 (LO Summary)

The collection of data about best practices on learning methods, industry 4.0 and sustainability (tasks 1.2.2 and 1.2.4) will be done in a qualitative way, asking partners to fill a form for each best practice. These best practices can be related to student centred learning strategies (active learning), Industry 4.0 or sustainability. We expect that each project partner can fill in at least two best practices by teaching-learning strategies and two by I4.0 and sustainability. This means 4 entries by project partner. Finally, the data will be analysed using a mixed approach between a quantitative approach (descriptive statistics) and qualitative data analysis procedures. A final report will be developed.

We plan to classify (Task 1.2.5 - first) these courses using the following IEM areas of knowledge (Lima, Mesquita, Amorim, Jonker, & Flores, 2012; Mesquita, Lima, Flores, Marinho-Araujo, & Rabelo, 2015):

- |   |                                 |
|---|---------------------------------|
| 1. Production Management (including Production System Design) | 3. Quality                      |
| 2. Automation   | 5. Operations Research          |
| 4. Economics Engineering                                      | 7. Ergonomics and Human Factors |
| 6. Computer and Information Systems                           | 9. Maintenance                  |
| 8. Logistics  | 11. Sustainability              |
| 10. Project Management  | 13. Simulation                  |
| 12. Product Design  |                                 |

In a second worksheet, we plan to collect information from learning outcomes, and will classify and analyse (Task 1.2.5 - first) them using a framework of competences based on Mesquita et al. (2015) and Prifti, Knigge, Kienegger, and Krcmar (2017). This classification will be done by two researchers and reviewed by a third researcher.

Finally, a report will be developed summarizing all the information collected and the analysis developed.

### 3.2 Plan for WP1 - Task 1.3: Assessing needs of industry and student

The comprehensive analysis of needs of industry and students (all partners will conduct a survey with companies assigned in their regions in the list and with the help of the Associated Partners. They will also conduct survey with prospective students in their regions. The tasks of this activity will be classified as following

- Task 1.3.1 Preparing a survey form for identifying the needs of industry for MSIE graduates to support their success in Thailand 4.0 and Industry 4.0
- Task 1.3.2 Preparing a survey form for the needs of prospective students for preparing them for Thailand 4.0 and Industry 4.0
- Task 1.3.3 Conducting survey for companies and organizations in the list
- Task 1.3.4 Conducting survey from students
- Task 1.3.5 Identifying the needs of industry and students

The total number of program being reviewed is 28, so the total estimation of student population is at least 375 master students from all partners. Therefore to have minimal 10% error margin of error, the total sampling size to be 385. Then each partner should have at least 40 students for each partner.

The estimated number of SME companies in Thailand is higher than 30,000. By assuming that the high impact SME in Thailand is at least 1,000, the sampling table of YAMANE indicates that the minimum of 91 companies shall be listed based on the 10% error.

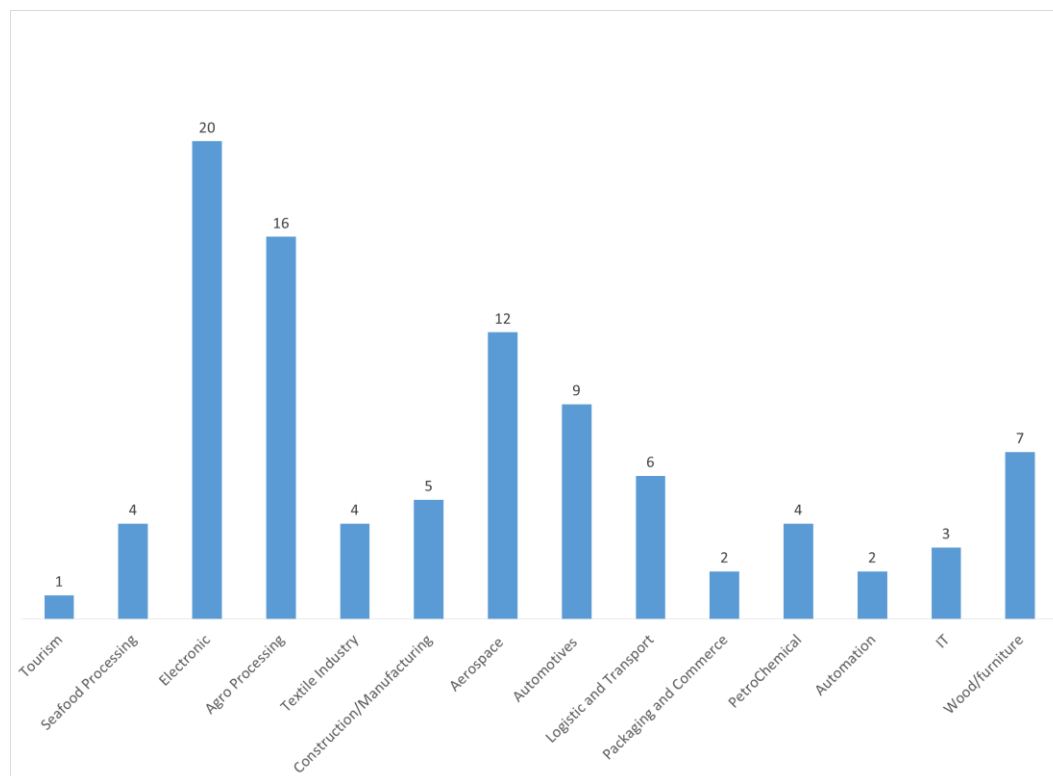
The WP1 searches for the first and the new S-curves of groups of companies. The WP1 decided to focus on only the following 4 groups:

- 1) Next – Generation Automotive
- 2) Smart Electronics
- 3) Agriculture and Biotechnology
- 4) Food for the Future.

The specific names of the companies for all study group in Thailand were created and given to all partners for approval. The total of 95 companies are listed by the following clusters:

Tourism	Seafood Processing	Electronic
Agro Processing	Textile Industry	Construction/Manufacturing
Aerospace	Automotives	Logistic and Transport
Packaging and Commerce	PetroChemical	Automation
IT	Wood/furniture	

Figure 8 presents the 95 companies that are planned to be surveyed, classified by industrial sector.



*Figure 8. Number of companies planned to be surveyed, classified by industrial sectors*

The list of companies planned to be surveyed is discriminated in Table 2

*Table 2. List of Industry Clusters and Companies for Industry Assessment*

University	Cluster	Company
Chiang Mai University (CMU)	Wood Processing	Suksawad
	Seafood Processing	CP group
	Electronic	Hana Microelectronics Public Co., Ltd. (Lamphun)
		Murata Electronics (Thailand) Ltd.
		Fujikura Electronics(Ltd) Thailand
	Agro Processing	Betagro Agro Industry Co.,Ltd
		Northern Food Company Limited
		Pepsi-Cola Thai Trading Co.,Ltd.
	Textile Industry	Performance Manufacturing (Thailand) Ltd.
		Pattaya Lamphun Co., Ltd.
		Onsmooth Thai Co.,Ltd.
	Aerospace	Zodiac AirCatering Equipment (Thailand) Ltd.
	Automotives	Keihin (Thailand) Co., Ltd.
		Toyota Thailand
Prince of Songkla University (PSU)	Logistic and Transport	Logistics of 7/11 Thailand
		IT
		Datamars (Thailand) Ltd.
		Wood Processing
	Rubber Processing	APK Furnishing Parawood
		Xunthai Parawood
		SWP Parawood
		Panel Plus
	Tourism	Rubber Processing
		Michelin
		Sritrang Agro Industry
		Siam Sempermed
	Seafood Processing	PKCD
		MANA
Khon Kaen University (KKU)	Electronic	KIANG HUAT SEA GULL TRADING FROZEN FOOD PUBLIC Co., Ltd.
		Chotiwat Manufacturing Co.,Ltd.
	Agro Processing	Panasonic Electric Works (Khon Kaen) Co.,LTD
		Seagate Technology (Thailand) Ltd.
	Textile Industry	Kalasin Mit Sugar Co.,Ltd
		Mondelez (Thailand) Co.,Ltd
	Logistic and Transport	CP Ram (Khon Kaen)
		NK Apparel Co., Ltd.
	Packaging and Commerce	Thai Beverage Logistics Co., Ltd.
		Cho Thavee Public Co., Ltd.
King Mongkut's University of Technology North	Electronic	Thai Containers Khonkaen Co., Ltd.
		Siam Global House Plc. (Khon Kaen)
		Ronda Thailand
		Daikin Industries (Thailand) LTD.
	Automotives	Samsung Thailand (Thailand) LTD.
		TOSHIBA THAILAND (Thailand) LTD.
		Komatsu Seiki (Thailand) Co., Ltd.
		Ford Thailand
	Logistic and Transport	Nissan Motor (Thailand) Co., Ltd.
		DHL(Thailand) Co., Ltd.
AIT	Electronic	Grand Home Mart.Co., Ltd.
		DKSH (Thailand) Co., Ltd
		SVI

University	Cluster	Company
UPB	Electronic	MicroElectronica Voluntari
		Felix Electronic Services Bucharest
		Benchmark Romania
	Aerospace	TurboMecanica Bucharest
		Unison Engine Components Bucharest – General Electric Aviation
		Avioane Craiova
	Automotive	Group Renault Romania
		Ford - Craiova Engine Plant
		Pirelli Romania
	Petro Chemical	Cameron Romania
	UPetrom 1 Mai Ploiesti	
	UPet Targoviste	
CUT	Electronic	Whirlpool
		Electrolux (Sosnowiec)
		Bosch und Siemens (BSH)
	Aerospace	Wielton
		ZF/TRW
Thammasat University (TU)		Linex
	Electronics	Mitsubishi Electric Asia (Thailand)
		jyelectric
		GE-general Electric
	Construction/Manufacturing	Kohler (Thailand) Public Co., Ltd.
		Paper Green Co., LTD
		SCG
		Chavakon Co.,LTD
		CPAC
	Agro Processing	Cargrill Thailand
		Malinee Food Products
	Automotive	Michelin
	Petro Chemical	PTT
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	Wood/furniture	WOODTECT
	SB Furniture	
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UMinho	Automotive	Bosch Car-Multimedia systems
		Continental ITA
		Leoni
		Continental Mabor
		PREH
	Automation	Critical
		ITEC
	IT	Primavera

The WP1 team adapted the questionnaires from the “Industry 4.0 Readiness” study that was commissioned by the IMPULS Foundation of the German Engineering Federation (VDMA) and conducted by IW Consult (a subsidiary of the Cologne Institute for Economic Research) and the Institute for Industrial Management (FIR) at RWTH Aachen University.

This questionnaires has 3 parts divided by 23 pages:

1. Definitions of Industry 4.0, Industry 4.0 Adoption Scope and Readiness Scheme (p 1-4)
2. Business Background (p 5)
3. Part 1: Industry 4.0 Adoption Scope (page 6-11)
  - 1. Business strategy, Business Models, Product & Service Portfolio
  - 2. Transversal & Domain related Competences: Employee



#### 4. Part 2 : Industry 4.0 Readiness Scheme (page 12-23)

##### 1. Smart products & Co-created Design:

-To what extent can your products be controlled with IT, making it possible for them to communicate and interact with higher-level systems along the value chain?

##### 2. Smart factory (Intelligent Manufacturing System):

-To what extent does your company have digitally integrated and automated production based on cyber-physical systems?

##### 3. Smart operations (Controlling, Adjusting & Monitoring Process Real Time):

-To what extent are the processes and products in your company digitally modelled and capable of being controlled through ICT systems and algorithms in a virtual world?

##### 4. Data driven services (Integrated Business & Operational Data Management):

-To what extent do you offer data-driven services that are possible only through the integration of products, production, and customers?

### **3.3 Plan for WP1 - Task 1.4: Identifying gaps**

Regarding comprehensive analysis of needs of industry and students (WP1-1.3), all partners will also conduct survey with prospective students in their regions. The outcome of this activity will be available at the end of M9 for gap analysis (WP1-1.4), for identifying competitive factors for the curriculum (WP1-1.5).

- Task 1.4.1 Comparing the needs of industries in Thailand and European partners' countries
- Task 1.4.2 Identifying gaps between the needs of industry and the competence of MSIE graduates

Based on the questionnaires derived in WP1-1.3, the identifying gaps will be based on the questionnaires consisting of 4 parts

1. What knowledge to learn?
2. What skill to acquire?
3. What experience to undertake?
4. What transversal competences to develop?

Based on the answers collected with the questionnaires, the gap analysis will be developed potentially using Quality Function Deployment (QFD) to

- 1<sup>st</sup> define the competency + professional practice: interviews (exploratory) and questionnaire
- 2<sup>nd</sup> look at the boundary, key players who are going to use IE in Thailand
- 3<sup>rd</sup> use QFD with those key players to identify their needs (not only IE but the needs for business competitiveness)



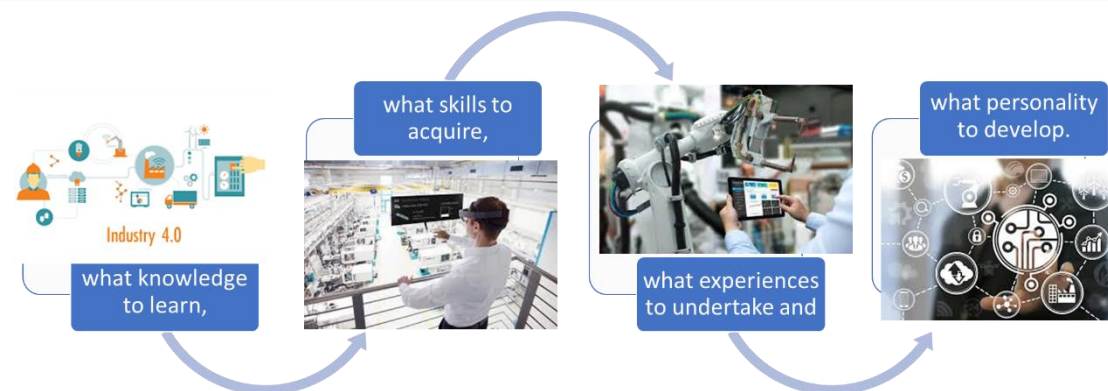


Figure 9. Illustration of the steps to be developed for the identification of the competences' gap

### 3.4 Plan for WP1 - Task 1.5: Identifying competitive factors for the curriculum

An analysis of gaps between the actual competence of MSc graduates in Industrial Engineering and the real needs of industry for Thailand 4.0 and Industry 4.0 and in EU countries referring to Europe 2020 goals will be made and presented in a form of a report. This will be used as the basis for the identification of factors that will contribute for a competitive curriculum. Thus, based on a wide analysis of the target group needs, the identified gaps and on world trends and developments in Industrial Engineering, the factors that will provide competitive advantage to the curriculum will be identified and presented in a form of a report who will be a part of the a WP1 progress report.

### 3.5 Plan for WP1 - Task 1.6: Developing recommendations for the specifications and areas of specialization for the curriculum

Based on a wide analysis of the target group needs, the identified gaps and on world trends and developments in Industrial Engineering, the factors that will provide competitive advantage to the curriculum, it will be possible to develop a set of recommendations for the development of the MSIE 4.0 curriculum.

## 4 WP 1 deliverables

The most important working elements and deliverables for the first year of the project in WP1 are:

- 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

The representation of the main deliverables are presented in the remaining of this section.

### WORKPLAN for project year 1

Activities		Total duration (number of weeks)	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Ref.nr/ Sub-ref nr	Title													
Task 1.1	Develop a gap analysis work plan	3	3=,3x											
Task 1.2	Analyzing of MSIE curricula being offered, and of learning and teaching methods being applied	10		2=,2x	2=,2x	2=,2x	2=,2x	2=,2x						
Task 1.3	Assessing needs of industry and students	10					2=,2x	2=,2x	2=,2x	2=,2x	2=,2x			
Task 1.4	Identifying gaps	3									=,x	2=,2x		
Task 1.5	Identifying competitive factors for the curriculum	3										2=,2x	=,x	
Task 1.6	Developing recommendations for the specifications and areas of specialization for the curriculum	4											2=,2x	2=,2x
Task 3.3	Developing a web-portal for online learning	12						2=,2x	2=,2x	2=,2x	2=,2x	2=,2x	2=,2x	
Task 4.1	Developing a quality control and monitoring system	7	2=,2x	2=,2x	2=,2x	=,x								
Task 4.2	Implementing the internal quality control and monitoring of the project	5				=,x		=,x		=,x		=,x		=,x
Task 5.1	Development of a Dissemination, Exploitation and Sustainable plan,	6	2=,2x	2=,2x	2=,2x									
Task 5.2	Creating a project website and maintaining it throughout the project lifetime to support the dissemination strategy, and communication and collaboration among partners,	14	=,2x	=,2x	x	x	x	x	x	x	x	x	x	x
Task 5.3	Production and dissemination of project materials,	6						=,2x	=,2x					=,2x
Task 5.6	Organizing dissemination events with relevant stakeholders	2												=,2x
Task 6.1	Finalizing management structure	3	3=,3x											
Task 6.2	Organizing kick-off and regular consortium meetings	6	2=,2x					2=,2x						2=,2x
Task 6.3	Monitoring and controlling the project	12	x	x	x	x	x	x	x	x	x	x	x	x

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### Task 1.1 Developing a gap analysis working plan

- Task 1.1.1 Forming a working group for WP1
- Task 1.1.2 Creating a list of curricula to be reviewed
- Task 1.1.3 Setting up criteria for evaluation
- Task 1.1.4 Creating a list of companies and organizations for survey
- Task 1.1.5 Preparing an execution plan

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### Task 1.2 Analysing of MSIE curricula being offered, and of learning and teaching methods being applied

- Task 1.2.1 Reviewing MSIE curricula being offered currently in Thailand
- Task 1.2.2 Reviewing teaching and learning methods being applied currently in Thailand
- Task 1.2.3 Reviewing MSIE curricula being offered currently in partners' countries
- Task 1.2.4. Reviewing teaching and learning methods being applied in partners' countries
- Task 1.2.5 Analysing curricula, and teaching and learning methods

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### Task 1.3 Assessing needs of industry and students

- Task 1.3.1 Preparing a survey form for identifying the needs of industry for MSIE graduates to support their success in Thailand 4.0 and Industry 4.0
- Task 1.3.2 Preparing a survey form for the needs of prospective students for preparing them for Thailand 4.0 and Industry 4.0
- Task 1.3.3 Conducting survey for companies and organizations in the list
- Task 1.3.4 Conducting survey from students
- Task 1.3.5 Identifying the needs of industry and students

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### Task 1.4 Identifying gaps

- Task 1.4.1 Comparing the needs of industries in Thailand and European partners' countries
- Task 1.4.2 Identifying gaps between the needs of industry and the competence of MSIE graduates

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### Task 1.5 Identifying competitive factors for the curriculum

### Task 1.6 Developing recommendations for the specifications and areas of specialization for the curriculum

## Deliverables/results/outcomes

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### Task 1.1 Developing a gap analysis working plan

- Task 1.1.1 Forming a working group for WP1
- Task 1.1.2 Creating a list of curricula to be reviewed
- Task 1.1.3 Setting up criteria for evaluation
- Task 1.1.4 Creating a list of companies and organizations for survey
- Task 1.1.5 Preparing an execution plan

Expected Deliverable/Results/Outcomes	Work Package and Outcome ref.nr	1.1.	
	Title	Gap Analysis working plan	
	Type	<input type="checkbox"/> Teaching material <input type="checkbox"/> Learning material <input type="checkbox"/> Training material	<input type="checkbox"/> Event <input checked="" type="checkbox"/> Report <input type="checkbox"/> Service/Product
	Description	A working plan containing: a) A list with WP1 working group members and responsibilities among the project partners, a list with companies, organizations, student associations and other stakeholders who will be the involved in the survey. b) Specific MSc curricula in MIE to be reviewed in Thailand and in EU partners' countries c) Criteria for evaluation d) templates and documents for the analyses e) Procedures and rules for the analyze process and for the control and quality assurance of the results f) Planning of the Gap Analysis activities.	
	Due date	M1	
Target groups	Languages	English	
	<input checked="" type="checkbox"/> Teaching staff <input type="checkbox"/> Students <input type="checkbox"/> Trainees <input type="checkbox"/> Administrative staff <input type="checkbox"/> Technical staff <input type="checkbox"/> Librarians <input type="checkbox"/> Other		
	If you selected 'Other', please identify these target groups. (Max. 250 characters)		
Dissemination level	<input type="checkbox"/> Department / Faculty <input checked="" type="checkbox"/> Institution	<input checked="" type="checkbox"/> Local <input type="checkbox"/> Regional	<input checked="" type="checkbox"/> National <input checked="" type="checkbox"/> International

### Deliverables/results/outcomes

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#### Task 1.2 Analysing of MSIE curricula being offered, and of learning and teaching methods being applied

- Task 1.2.1 Reviewing MSIE curricula being offered currently in Thailand
- Task 1.2.2 Reviewing teaching and learning methods being applied currently in Thailand
- Task 1.2.3 Reviewing MSIE curricula being offered currently in partners' countries
- Task 1.2.4. Reviewing teaching and learning methods being applied in partners' countries
- Task 1.2.5 Analysing curricula, and teaching and learning methods

Expected Deliverable/Results/Outcomes	Work Package and Outcome ref.nr	1.2.	
	Title	Comprehensive analysis of MSIE curricula being offered in Thailand and in EU partner countries	
	Type	<input type="checkbox"/> Teaching material <input type="checkbox"/> Learning material <input type="checkbox"/> Training material	<input type="checkbox"/> Event <input checked="" type="checkbox"/> Report <input type="checkbox"/> Service/Product
	Description	A comprehensive analysis of MSIE curricula being offered currently in Thailand and EU partners' countries will be made. This report in a form of a SWOT analyse will identify the strengths and weaknesses in Thai and EU universities, the common points, but also the differences. The aim of this outcome is to identify the main good practices and aspects in the EU and Thai universities' curricula's in order to be included in the new foreseen curricula. The report will emphasis on the This report will be a part of the first WP1 progress report presented at the second PEC meeting.	
	Due date	M6	
Target groups	Languages	English, Thai	
	<input checked="" type="checkbox"/> Teaching staff <input type="checkbox"/> Students <input type="checkbox"/> Trainees <input type="checkbox"/> Administrative staff <input type="checkbox"/> Technical staff <input type="checkbox"/> Librarians <input type="checkbox"/> Other		
	If you selected 'Other', please identify these target groups. (Max. 250 characters)		
Dissemination level	<input type="checkbox"/> Department / Faculty <input checked="" type="checkbox"/> Institution	<input checked="" type="checkbox"/> Local <input type="checkbox"/> Regional	<input checked="" type="checkbox"/> National <input checked="" type="checkbox"/> International

### Deliverables/results/outcomes

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#### Task 1.3 Assessing needs of industry and students

- Task 1.3.1 Preparing a survey form for identifying the needs of industry for MSIE graduates to support their success in Thailand 4.0 and Industry 4.0
- Task 1.3.2 Preparing a survey form for the needs of prospective students for preparing them for Thailand 4.0 and Industry 4.0
- Task 1.3.3 Conducting survey for companies and organizations in the list
- Task 1.3.4 Conducting survey from students
- Task 1.3.5 Identifying the needs of industry and students

Expected Deliverable/Results/Outcomes	Work Package and Outcome ref.nr	1.3.	
	Title	Assessment of learning and teaching tools and methods in Thailand and in EU partner countries	
	Type	<input type="checkbox"/> Teaching material <input type="checkbox"/> Learning material <input type="checkbox"/> Training material	<input type="checkbox"/> Event <input checked="" type="checkbox"/> Report <input type="checkbox"/> Service/Product
	Description	Following the same analyse schema a comprehensive analysis of teaching and learning methods being applied currently in Thailand and EU partners' countries, in a form of a report, will be achieved with the same target groups and it will be a part of the first WP1 progress report.	
	Due date	M6	
Target groups	Languages	English, Thai	
	<input checked="" type="checkbox"/> Teaching staff <input type="checkbox"/> Students <input type="checkbox"/> Trainees <input type="checkbox"/> Administrative staff <input type="checkbox"/> Technical staff <input type="checkbox"/> Librarians <input type="checkbox"/> Other		
	If you selected 'Other', please identify these target groups. (Max. 250 characters)		
Dissemination level	<input type="checkbox"/> Department / Faculty <input checked="" type="checkbox"/> Institution	<input checked="" type="checkbox"/> Local <input type="checkbox"/> Regional	<input checked="" type="checkbox"/> National <input checked="" type="checkbox"/> International

Deliverables/results/outcomes

**Task 1.4 Identifying gaps**

- Task 1.4.1 Comparing the needs of industries in Thailand and European partners' countries
- Task 1.4.2 Identifying gaps between the needs of industry and the competence of MSIE graduates

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Expected Deliverable/Results/Outcomes	Work Package and Outcome ref.nr	1.4.	
	Title	Analysis of needs of industry and students	
	Type	<input type="checkbox"/> Teaching material <input type="checkbox"/> Learning material <input type="checkbox"/> Training material	<input type="checkbox"/> Event <input checked="" type="checkbox"/> Report <input type="checkbox"/> Service/Product
	Description	A comprehensive analysis of the needs of industry for MSIE graduates to support their success in Thailand 4.0 and Industry 4.0 and of the needs of students for preparing them for Thailand 4.0 and Industry 4.0. Also concerning the EU industry and student needs, in a form of a report, will be achieved and it will be a part of the second WP1 progress report.	
	Due date	M9	
	Languages	English, Thai	
Target groups	<input checked="" type="checkbox"/> Teaching staff <input type="checkbox"/> Students <input type="checkbox"/> Trainees <input type="checkbox"/> Administrative staff <input type="checkbox"/> Technical staff <input type="checkbox"/> Librarians <input type="checkbox"/> Other		
	If you selected 'Other', please identify these target groups. (Max. 250 characters)		
Dissemination level	<input type="checkbox"/> Department / Faculty <input checked="" type="checkbox"/> Institution	<input checked="" type="checkbox"/> Local <input type="checkbox"/> Regional	<input checked="" type="checkbox"/> National <input checked="" type="checkbox"/> International

Deliverables/results/outcomes

**Task 1.5 Identifying competitive factors for the curriculum**

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Expected Deliverable/Results/Outcomes	Work Package and Outcome ref.nr	1.5.	
	Title	Gaps between the needs and graduates' competences	
	Type	<input type="checkbox"/> Teaching material <input type="checkbox"/> Learning material <input type="checkbox"/> Training material	<input type="checkbox"/> Event <input checked="" type="checkbox"/> Report <input type="checkbox"/> Service/Product
	Description	An analysis of gaps between the actual competence of MSc graduates in Industrial Engineering and the real needs of industry for Thailand 4.0 and Industry 4.0 and in EU countries referring to Europe 2020 goals will be made and presented in a form of a report and it will be a part of the second WP1 progress report.	
	Due date	M10	
	Languages	English, Thai	
Target groups	<input checked="" type="checkbox"/> Teaching staff <input type="checkbox"/> Students <input type="checkbox"/> Trainees <input type="checkbox"/> Administrative staff <input type="checkbox"/> Technical staff <input type="checkbox"/> Librarians <input type="checkbox"/> Other		
	If you selected 'Other', please identify these target groups. (Max. 250 characters)		
Dissemination level	<input type="checkbox"/> Department / Faculty <input checked="" type="checkbox"/> Institution	<input checked="" type="checkbox"/> Local <input type="checkbox"/> Regional	<input checked="" type="checkbox"/> National <input checked="" type="checkbox"/> International

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Expected Deliverable/Results/Outcomes	Work Package and Outcome ref.nr	1.6.	
	Title	Competitive factors for the curriculum	
	Type	<input type="checkbox"/> Teaching material <input type="checkbox"/> Learning material <input type="checkbox"/> Training material	<input type="checkbox"/> Event <input checked="" type="checkbox"/> Report <input type="checkbox"/> Service/Product
	Description	Based on a wide analyse of the target group needs, the identified gaps and on world trends and developments in the Industrial Engineering, the factors that will provide competitive advantage to the curriculum will be identified and presented in a form of a report who will be a part of the second WP1 progress report.	
	Due date	M11	
	Languages	English, Thai	
Target groups	<input checked="" type="checkbox"/> Teaching staff <input type="checkbox"/> Students <input type="checkbox"/> Trainees <input type="checkbox"/> Administrative staff <input type="checkbox"/> Technical staff <input type="checkbox"/> Librarians <input type="checkbox"/> Other  If you selected 'Other', please identify these target groups. (Max. 250 characters)		
Dissemination level	<input type="checkbox"/> Department / Faculty <input checked="" type="checkbox"/> Institution	<input checked="" type="checkbox"/> Local <input type="checkbox"/> Regional	<input checked="" type="checkbox"/> National <input checked="" type="checkbox"/> International