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WP1: Research development

Wichai & Rui

WORKPLAN for Project year 1

Activities														Total duraton (number of weeks)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep
Ref.nr/Sub-ref nr	Title	WPL	CWPL	TL	AIT	CMU	MUTN	TU	KKU	PSU	UPB	UM	CUT		M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Task 1.1	Develop a gap analysis working plan	CMU	UM	CMU	P	TL						P		3	3=,3X											
Task 1.2	Analyzing of MSIE curricula being offered, and of learning and teaching methods being applied	CMU	UM	UM	P	P		P			P	TL	P	8		2=,2X	2=,2X	2=,2X	2=,2X							
Task 1.3	Assessing needs of industry and students	CMU	UM	CMU		TL	P	P	P	P	P	P	P	10					2=,2X	2=,2X	2=,2X	2=,2X	2=,2X			
Task 1.4	Identifying gaps	CMU	UM	UM	P	P		P			P	TL	P	3									=,x	2=,2x		
Task 1.5	Identifying competitive factors for the curriculum	CMU	UM	CMU	P	TL		P			P	P	P	3										2=,2x	=,x	
Task 1.6	Developing recommendations for the specifications and areas of specialization for the curriculum	CMU	UM	CMU	P	TL				P	P	P	P	4											2=,2x	2=,2X
Task 3.3	Developing a web-portal for online learning	AIT	UM	AIT	TL	P					P	P		12						2=,2X	2=,2X	2=,2X	2=,2X	2=,2X	2=,2X	
Task 4.1	Developing a quality control and monitoring system	UPB	PSU	UPB	P	P		P			TL		P	7	2=,2X	2=,2X	2=,2X	=,X								
Task 4.2	Implementing the internal quality control and monitoring of the project	UPB	PSU	UPB		P	P				TL		P	5				=,X		=,X		=,X		=,X		=,X
Task 5.1	Development of a Dissemination, Exploitation and Sustainable plan,	KKU	UPB	UPB	P	P					TL	P		6	2=,X	2=,X	2=,X									
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,	KKU	UPB	AIT	TL	P			P		P	P		14	2=,X	2=,X	=	=	=	=	=	=	=	=	=	=
Task 5.3	Production of dissemination materials	KKU	UPB	KKU	P	P			TL		P	P	P	6						2=,X	2=,X					2=,X
Task 5.6	Organizing dissemination events with relevant stakeholders	KKU	UPB	KKU	P	P			TL		P	P	P	2												2=,X
Task 6.1	Development of project management and communication rules and of the partnership agreement	AIT		AIT	TL	P	P	P	P	P	P	P	P	3	3=,3X											
Task 6.2	Organizing and management of the project communication and of regular consortium meetings	AIT		AIT	TL	P	P	P	P	P	P	P	P	6	2=,2X					2=,2X						2=,2X
Task 6.3	Financial and administrative management and monitoring of the project	AIT		AIT	TL	P	P	P	P	P	P	P	P	12	=	=	=	=	=	=	=	=	=	=	=	=

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Description of WP1

- The 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,
  - the most important working elements for the first year of the project in WP1.
- Throughout the entire first year the purposes of the WP1 are:

- *1) to 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) to 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) to recommend the specifications and focus areas of the new proposed MSIE curriculum.*

- ***The WP1 will be led by CMU (P2) in close collaboration with UMinho (P8) that will co-lead and be the WP1 coordinator for EU partners. All partners will also participate and be responsible for tasks related to their geographical regions.***

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Rationale Concept of WP1

- “In the field of education, the Tyler Rationale (1949) is the most famous modernist model of curriculum development.”
- *Diana Cheng-Man Lau (2001) Analysing the curriculum development process: three models, Pedagogy, Culture and Society, 9:1, 29-44, DOI: 10.1080/14681360100200107*

- *Curriculum is a vital part of education. It is constantly evolving and is the total ‘stuff’ students take away from schools.*
- *The terms, curriculum and curriculum development imply two well-defined stages*
  - *the stage of development and the stage where the curriculum is completed.*
- *Curriculum development is not an entity that stops before going into classrooms*
- *Curriculum is not a package that stops developing in the classrooms.*
- ***It is a continuous process of constructing and modifying.***
- *Various parties contribute to this process,*
  - *government,*
  - *publishers,*
  - *parents,*
  - *Teachers*
  - *learners.*
- *Some are more powerful than others, meaning that they can influence the process at a greater extent or even control the behaviour of other parties.*
- ***Therefore, to comprehend the development process, we should not limit our study to the curriculum structure or curriculum contents,***
- ***but should be aware of the roles of different contributors***

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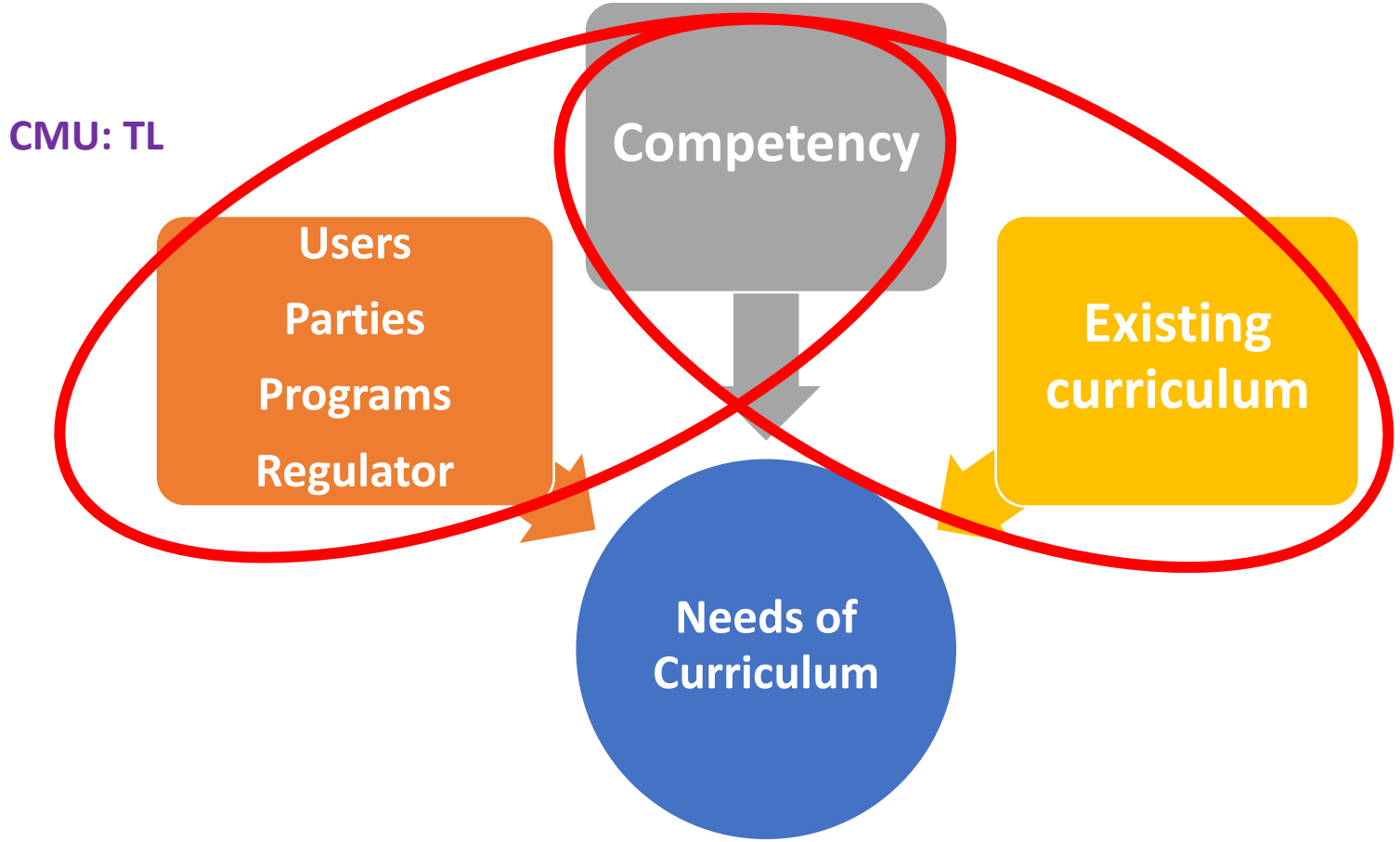
Rationale for Curriculum Development



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Rationale Concept

- As argued by Tyler (1949, p. 1):
- 4 fundamental questions, which must be answered in developing any curriculum and plan of instruction.
- – *What educational purposes should the school seek to attain?*
- – *What educational experiences can be provided that are likely to attain the purposes?*
- – *How can these educational experiences be effectively organised?*
- – *How can we determine whether the purposes are being attained?*

Tyler, R. W. (1949) Basic Principles of Curriculum and Instruction. Chicago: University of Chicago Press.

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Rationale Concept: *4 Main components of the curriculum*

purposes

experiences

methods

evaluation

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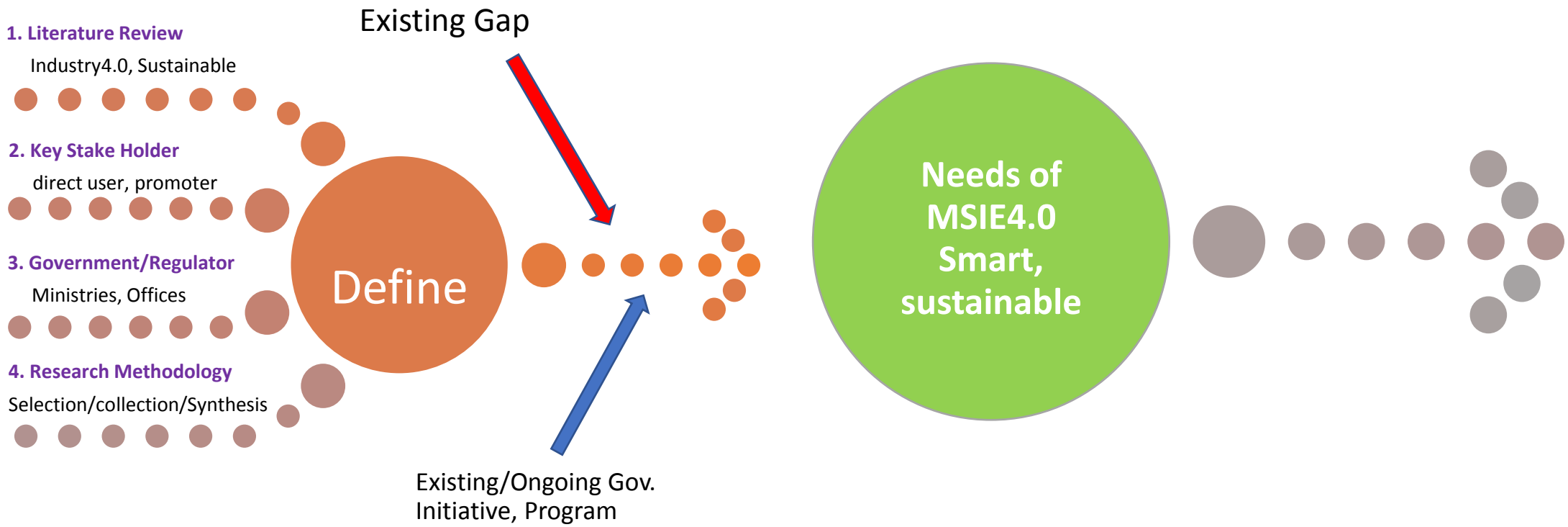
Methodology of WP1



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Methodology of WP1: 1 Literature Review

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Competency of Iindustry 4.0

A Competency Model for "Industrie 4.0" Employees

Loina Prifti[1], Marlene Knigge[1], Harald Kienegger[1], and Helmut Krcmar[1]

[1] Technical University Munich, Chair of Information Systems, Munich, Germany
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Abstract. This paper analyzes employee competencies for employees with higher education in Industry 4.0. An Industry 4.0 competency model based on a behavioral oriented approach concerning three variants, namely Information Systems, Information Technology and Engineering is developed by extending the SHL Universal Competency Framework through a structured literature review and focus groups with academic staff. The presented study contributes to research by providing a starting-point for further research regarding employee competencies for Industry 4.0. It contributes to practice as the provided competency model can be applied to Industry 4.0 job descriptions.

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- A clear definition of the competencies for I4.0 is needed

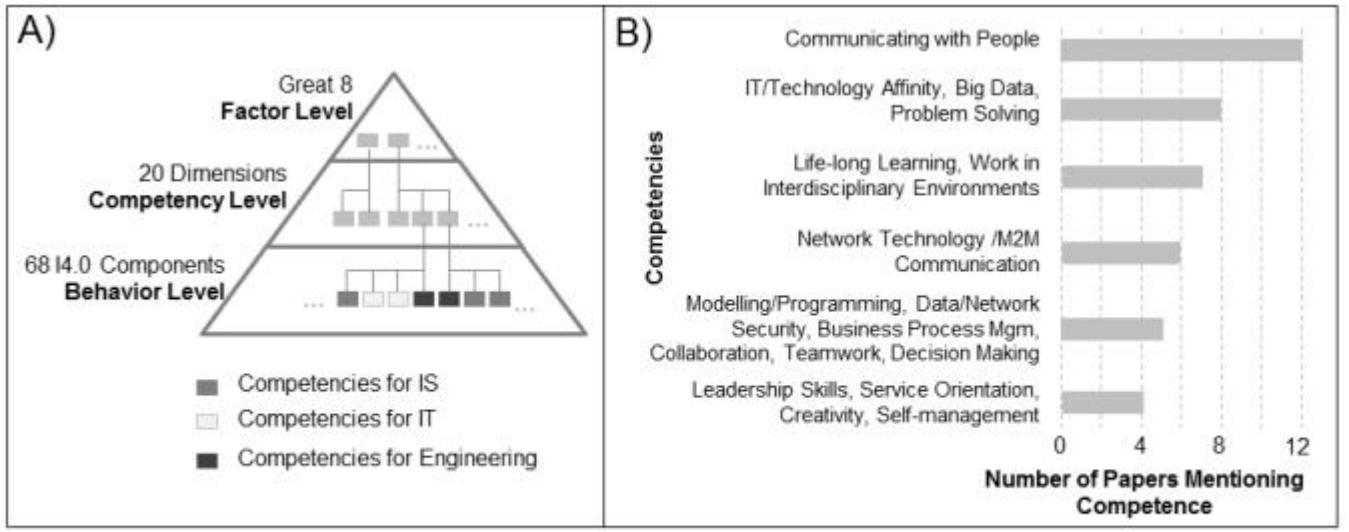

Fig 1. A) Industry 4.0 Competency Model Structure (Source: Own representation with regards to [37]); **B)** Most Mentioned Competencies in the Literature (Source: Own representation)

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Work done by

A Competency Model for "Industrie 4.0" Employees

Loina Prifti, Marlene Knigge, Harald Kienegger, and Helmut Krcmar
Technical University Munich, Chair of Information Systems, Munich, Germany

- "Industrie 4.0"; "Industry 4.0"; "Digital Transformation"; "Internet of Things"; "IoT"; "Cyber Physical Systems"; "CPS" and combined each of them with the keywords: "competence", "competency"; "skill"; "knowledge"; "attitude"; "ability"; "value"; "education".
- Our goal was to conduct an exhaustive literature search and cover the state-of-the art literature about I4.0 competencies.
- The chosen databases were ACM Digital Library, IEEE, Springer and EbscoHost3 because they cover publications from the IS, Economics, IT and Engineering discipline, as well as many Education outlets including conferences like EDUCON, REV, ICL, and Frontiers in Education that are often target outlets for publishing competency studies regarding actual topics like I4.0. The search included all articles that were published until August 2016.
- All the hits were first screened based on the title and abstract.
- In a second phase, the whole articles were screened.
- Additionally, a Google Scholar search was conducted in order to discover relevant articles from conferences and journals that were not included in the databases mentioned above.
- Here, the articles were sorted by relevance and the first 30 hits for each search string were screened.
- A backward and forward search was also conducted from the analyzed articles.
- Articles that did not include concrete competencies were excluded from our analysis.
- We had a total of 3363 hits in the database search, after the first screening 26 articles from the databases remained for further analyzes.
- Only articles where explicit competencies are mentioned were chosen.
- At the end a total of 17 that mention competencies for I4.0 or similar concepts such as IoT, were selected for further analysis. One of the articles was from the backward search.
- Since the topic is new, only little research exists.

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UMinho

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Available online at http:// www.iim.ftn.uns.ac.rs/ijiem_journal.php
ISSN 2217-2661

UDK: 005.551:371.212

An Analysis of Knowledge Areas in Industrial Engineering and Management Curriculum

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Available online at www.iim.ftn.uns.ac.rs/ijiem_journal.php
ISSN 2217-2661

UDK: 37:005

Industrial Engineering and Management Curriculum Profile: Developing a Framework of Competences

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UMinho

Defining the Industrial and Engineering Management Professional Profile: a longitudinal study based on job advertisements

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Table 1. Definition of the professional practice areas.

Area	Definition
Automation	In the industrial Automation area of practice, engineers should troubleshoot, repair and maintain automated industrial equipment, such as computer numerical control (CNC) equipment and robots (Groover, 2015; Study.com, 2016).
Economics Engineering	The application of economic principles in the engineering problem by solving process; for example, analysing the economics of different alternatives, analysing industrial costs and being involved in the financial management of organizations (Watts & Chapman, 2016).
Ergonomics and Human Factors	"Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and other methods to design in order to optimize human well-being and overall system performance" (International Ergonomics Association, 2016).
Supply Chain Management	"The design, planning, execution, control and monitoring of supply chain activities with the objective of creating net value" for industrial and service companies (APICS, 2013d).
Maintenance	Management process of organization, planning and implementation of corrective maintenance, preventive maintenance, and continuous improvement of industrial and service business organizations (IDCON, 2016).
Industrial Optimization	Industrial optimization make a link between mathematics, engineering and management, using as operations research, heuristics or simulation, for achieving the best possible solution for a problem for industrial and service companies, in terms of a specified objective (APICS, 2013c; Bangert, 2012).
Product Design	"The conversion of a need or innovation into a product, process, or service that meets both the enterprise and customer expectations. The design process consists of translating a set of functional requirements into an operational product, process or service" (APICS, 2013a; Dym et al., 2014).
Production Management	Design, improvement and management of systems that deliver products and services. This area is related with the design and improvement of production systems and the activities of production planning and control activities for the efficient and effective use of those production systems (Halevi, 2001; Martin-Vega, 2001; Vollmann et al., 2005).
Project Management	Application of "knowledge, skills, tools, and techniques to project activities to meet the project requirements" (Project Management Institute, 2013, p. 6).
Quality	"The analysis of a manufacturing system at all stages to maximize the quality of the process itself and the products it produces" (American Society for Quality, 2016).
Marketing	"The design, pricing, promotion, and distribution of goods to create transactions with businesses and consumers" (APICS, 2013b).

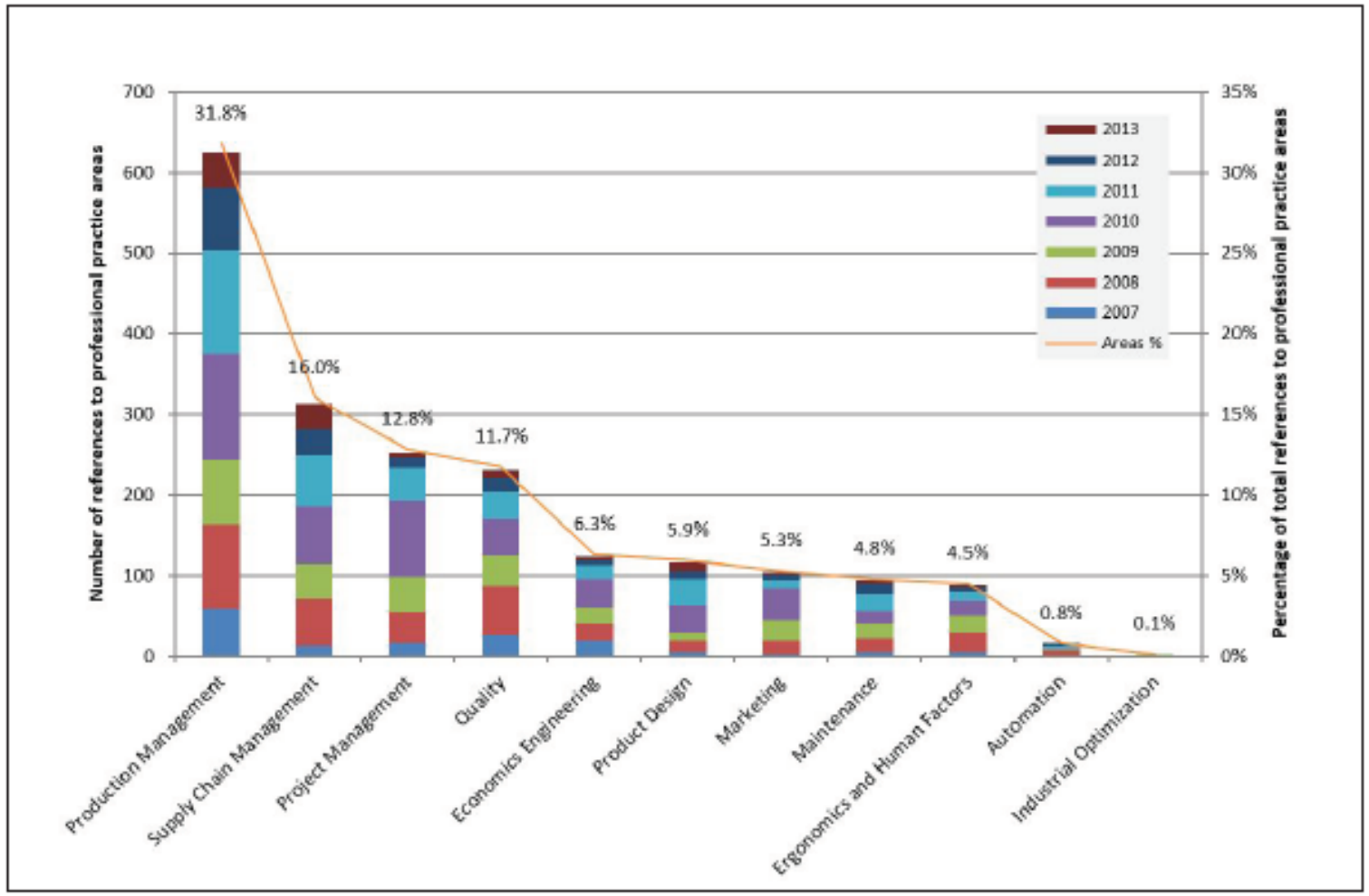

Figure 1. Job advertisements analysis: professional practice areas.

Different sources

Fraunhofer IAO

Fraunhofer IAO | Service and Human Resources Management

Fraunhofer IAO

TOPICS SERVICES SERVLAB JOBS AND CA

Service and Human Resources Management | Fraunhofer IAO . Topics . Work and Competencies in Industry 4.0

Work and Competencies in Industry 4.0

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

Global Challenge Insight Report

The Future of Jobs

Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution

January 2016

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Competency

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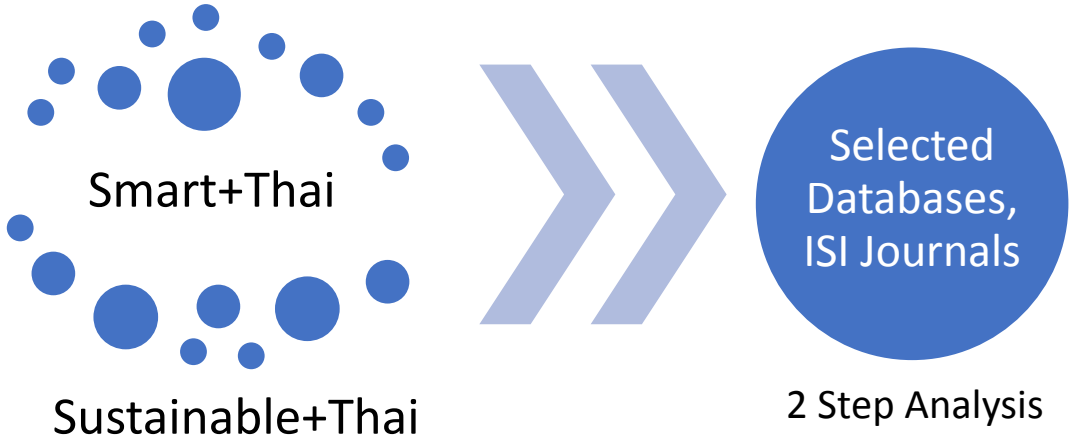
Research Methodology

- **1. Literature Review**
  - Industry 4.0
    - Team: Dr.Uttapol, Dr.Wasawat, Dr.Wimalin, Dr.Chompoonoot + *Dr.Wichai*
  - Sustainable Production :
    - Team: Dr.Sate, Dr.Rungchat, Dr.Warisa, Dr.Apichat + *Dr.Wichai*



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Additional requirement

- Doll (1993) provides a more complete view and argues for the construction of a postmodernist curriculum matrix, which contains several elements:

1. **The curriculum has to ground theory in and develop it from practice**.
2. Teachers and learners can develop their own curriculum through continuous interaction.
3. The curriculum needs to enhance self-organisation by being rich in diversity, problematics and heuristics, and a classroom atmosphere, which encourages exploration.
4. The curriculum has to empower both the teachers and the learners, thus creating an environment where they can engage in constructive dialogues.
5. The curriculum should encourage interpretation, rather than explanation of knowledge.
6. The curriculum should adopt developmental planning, which allows for greater flexibility and modification.
7. Evaluation will be an interactive process, in which feedback is provided to the learner.
8. *Communities' support is required to help the learner through constructive critiques.*

Doll, W. E. (1993) A Postmodern Perspective on Curriculum. New York: Teachers College Press.

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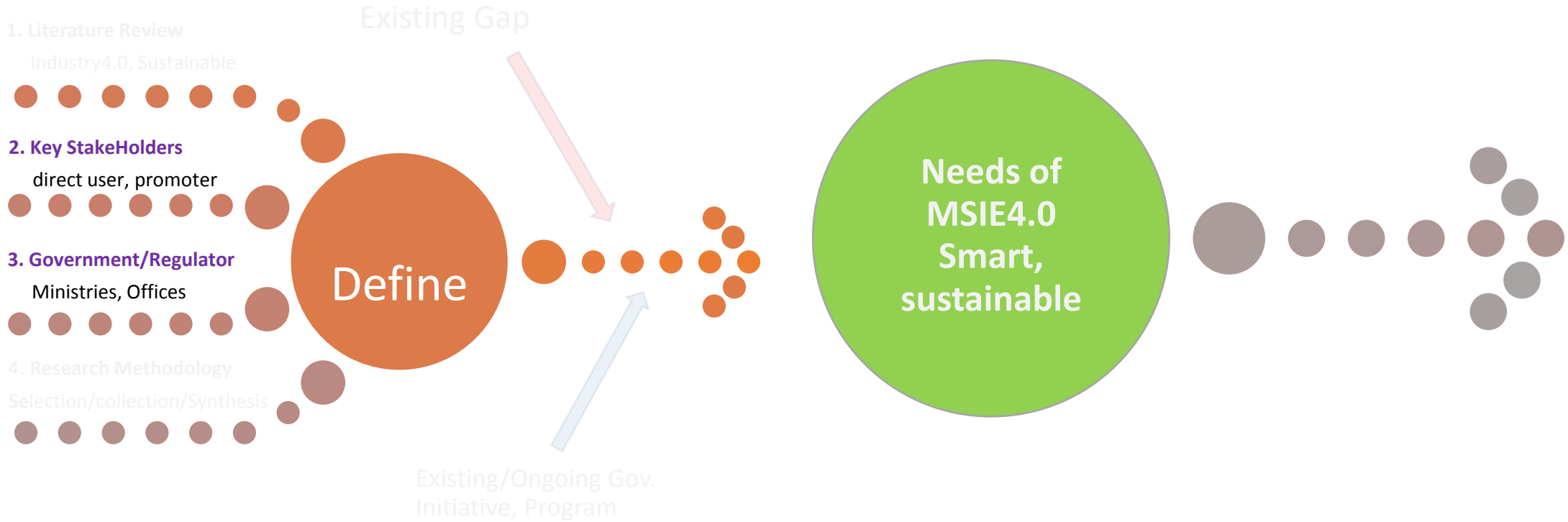
Methodology of WP1: 2 Stakeholder



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From 1st Disussion

- **Industrial partners**
- Thailand: 3 - 5 key industrial players
- Portugal: Bosch car multimedia, Continental, Leoni
- Other countries: ?

- Many reports from big global consulting company

- We can also draw some of information to construct the questionaire

- We will use both external reports in relation with the questionaire

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Users/Parties/Regulator

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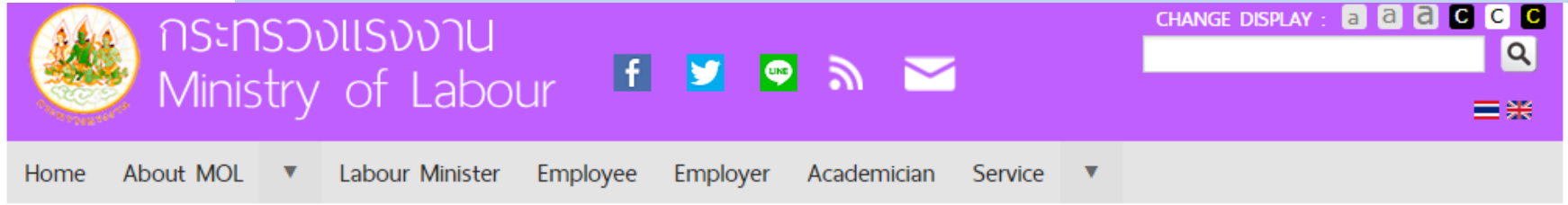
Users/Parties/Regulator



Ministry of Labour launches project to increase labor productivity to SMEs 4.0. Focus on increasing labor productivity to Thailand 4.0

Submitted by 9expert on Dec 21, 2017

Date: Thursday, 21 December 2017

Ministry of Labour H.E.Police General Adul Saengsingkaew was the president of STEM Workforce Towards SME 4.0 to increase labor productivity for working people in SMEs andOTOP and to reduce losses in the production process of goods and services at Phoenix 1-6 Impact Exhibition Muang Thong Thani, Nonthaburi. The Government, under the leadership of General Prayut Chunocha, has placed importance on the foundation of national development for stability, prosperity and sustainability by setting up a 20-year national strategy in line with the 12th National Economic and Social Development Plan to Thailand 4.0. The Ministry of Labor has set up a national human development strategy for 20 years, focusing on the task of increasing labor productivity to Thailand 4.0 for SMEs as Brain power. For Thai people to has a lot of work to do and create a career, earn money by announcing policies and goals. "High potential labor force and good life quality will lead the country to sustainable security."

Services menu

- Electronic services
- Library

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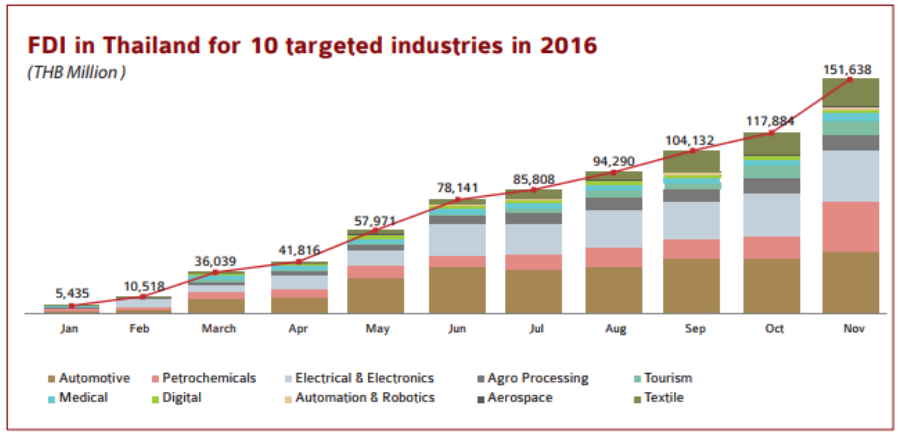
BOI: New Industry Sectors in Thailand

Thailand is focusing on becoming a value-based and innovation-driven economy by moving from producing commodities to innovative products; emphasizing on promoting technology, creativity, and innovation in focused industries and from a production-based to a service-based economy.



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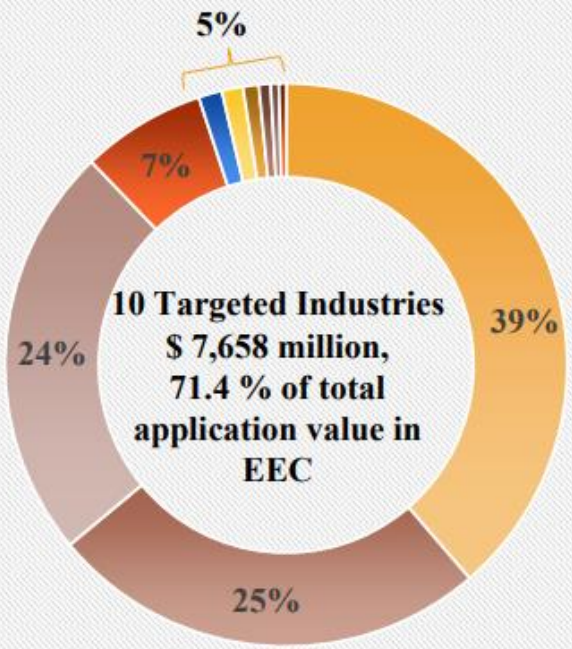
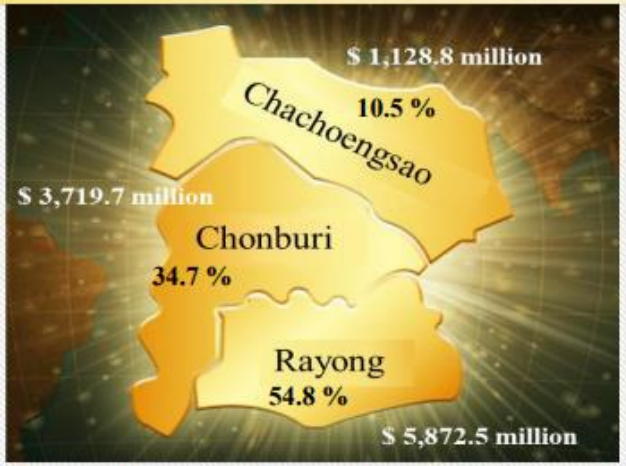
BOI Statistics

Applications for investment promotion in EEC since Jan 2015 - Jun 2017 valued at $ 10,721 million, 36% of total application value





- Next-Generation Automotive $ 2,974 million
- Smart Electronics $ 1,945 million
- Biochemical, Petrochemicals & Eco-friendly Products $ 1,834 million
- Food for the Future $ 550 million
- Affluent, Medical & Wellness Tourism $ 104 million
- Medical Hub $ 94 million
- Aviation $ 70 million
- Enabling Services $ 52 milion
- Automation and Robotics $ 36 million

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Programs

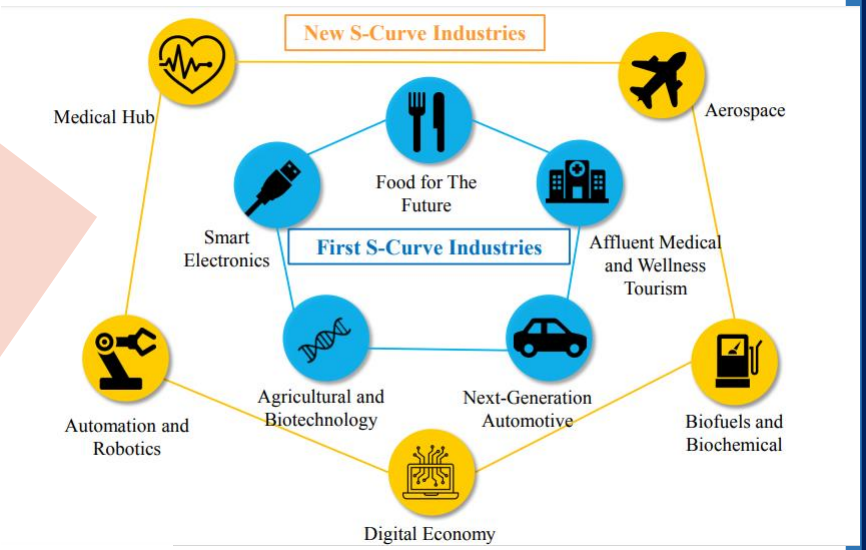
HRD Program	
Talent Mobility Program (TM)	Provides collaborative research-matching services between the public and private sector.
Work Integrated Learning (WiL)	Provides collaborative educational services between educational institutes and the private sector in the form of Public Private Partnerships (PPP).
Dual Vocational Training (DVT)	Vocational educational institutes forming agreements with private firms, to create effective curriculums, training, testing, and evaluation for students to gain practical working experiences
Co-operative Education (for gradate study, university and college)	structured method of combining classroom-based education with practical work experience. provides academic credit for structured job experience.

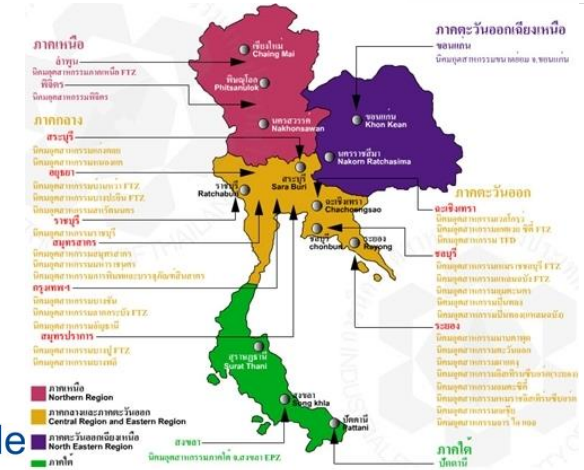
Users

New S Curve

High Impact

SME





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THAILAND ECONOMY-AT-A-GLANCE

Demographics

US$ = 36.07THB

Population (2016)
68 M

ASEAN population (2016)
633 M

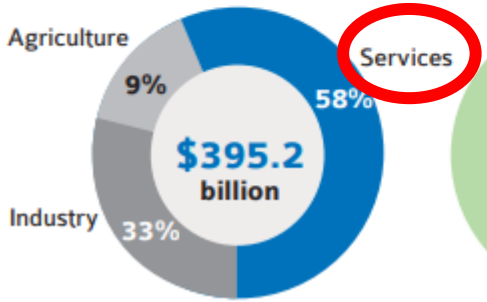
Literacy rate (2015)
97%

Minimum wage (2016)
300 Baht/day
8.32 US$/day

Source: United Nations

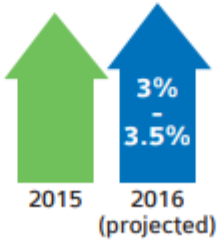
Gross Domestic Product

GDP by sector 2015

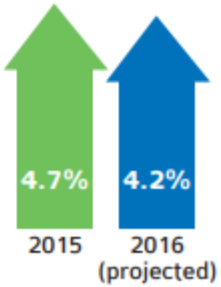


GDP/Capita projected (2016)

GDP growth (% yoy)



Total investment growth (% yoy)



Source: NESDB

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โครงการพัฒนาระเบียงเศรษฐกิจพิเศษภาคตะวันออก " EEC"

การพัฒนาระเบียงเศรษฐกิจพิเศษภาคตะวันออก EEC โดยบูรณาการเชื่อมโยงด้านโครงสร้างพื้นฐาน การคมนาคมขนส่ง ทางบก ราง น้ำ และอากาศ มุ่งเน้นการจัดสรรทรัพยากรธรรมชาติอย่างสมดุล เพื่อการพัฒนาอย่างยั่งยืน

Rubber City

Another optional area for investor, rubber city is full with key infrastructure, a reliable transportation logistics network (land, water and air) for smooth connections and product deliveries. As a bonus, Thailand's friendly people and sophisticated educational and health care facilities help make living here more comfortable for foreign entrepreneurs.

Special Economic Zone

Area designated by the Policy Committee on Special Economic Zone Development to be SEZs and infrastructure supported by the Thai government as well as investment privileges promotion, management of foreign workers who commute daily, one-stop service center and other necessary services.

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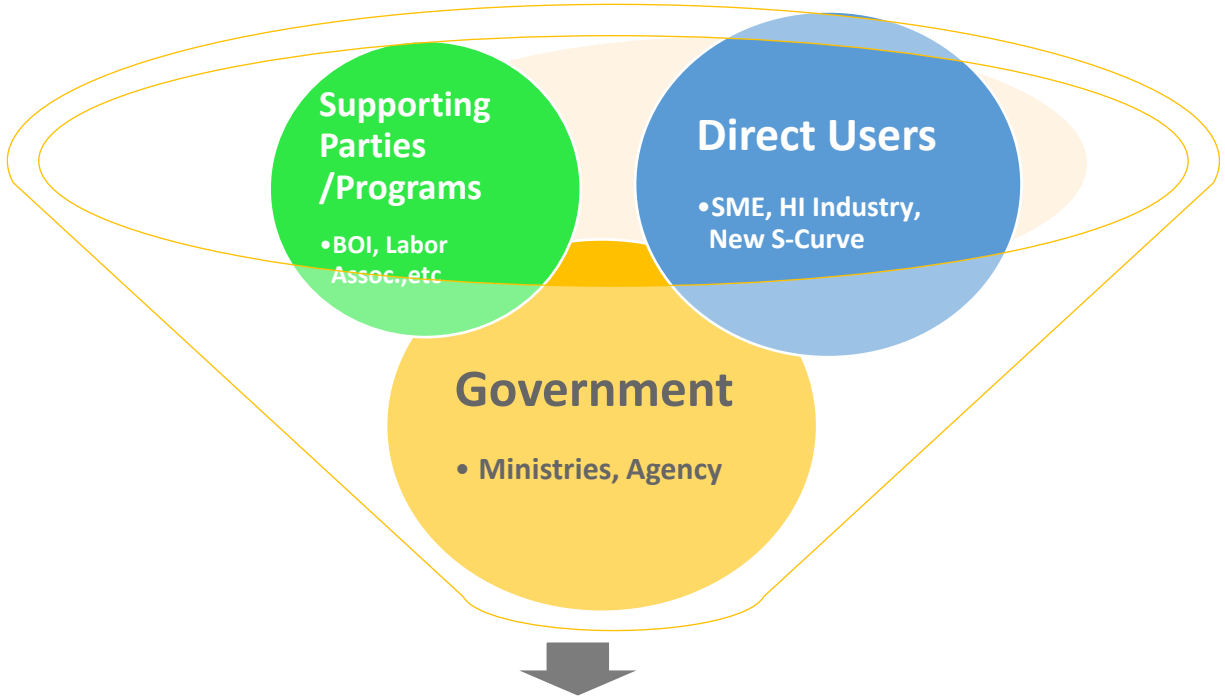
Ref.nr	Name of organisation	Type of institution	City	Country	Role in the project
1	The Federation of Thai Industries	Non-profit organization	Bangkok	Thailand	Providing input on industry needs, connection to industry in the network for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
2	Kohler (Thailand) Public Co., Ltd.	Private company	Bangkok	Thailand	Providing input on industry needs, connection to business partner for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
3	Western Digital (Thailand) Co., Ltd.	Private company	Ayutthaya	Thailand	Providing input on industry needs, connection to business units in the Western Digital for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
4	HGST (Thailand) Ltd.	Private company	Prachin Buri	Thailand	Providing input on industry needs, connection to business partners for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
5	Southern Industrial Estate	Government Agency	Songkhla	Thailand	Providing input on industry needs, connection to business partners for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
6	Rajburi Sugar Group of companies	Private company	Bangkok	Thailand	Providing input on industry needs, connection to companies in the Group for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
7	CP Group	Private company	Bangkok	Thailand	Providing input on industry needs, connection to companies in the Group for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
8	Group Renault Romania	Private group of companies	Bucharest	Romania	Assessing industry needs. Curricula evaluation. Exploitation of Project Results.
9	Unison Engine Components Bucharest S.A. – General Electric Aviation	Private company	Bucharest	Romania	Assessing industry needs. Curricula evaluation. Exploitation of Project Results.
10	"Prof. Constantin Popovici" Foundation	Public Industrial Engineering Foundation	Bucharest	Romania	WP 1 – Gap analysis. Workshop organisation. Developing a quality control and monitoring system. Dissemination of Project Results
11	ALUMNI IMST Association	Public Industrial Engineering Association	Bucharest	Romania	Assessing industry needs. Curricula evaluation. Dissemination and Exploitation of Project Results
12	Students Association from Faculty IMST - ASIMST	Public Industrial Engineering Students Association	Bucharest	Romania	Assessing students needs and learning methods. Pilot tests of key courses. Workshop organisation. Dissemination and Exploitation of Project Results
13	Leoni Portugal	Private company	Guimaraes	Portugal	Providing input on industry needs, connection to business partners for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
14	Bosch Car Multimedia	Private company	Braga	Portugal	Providing input on industry needs, connection to business partners for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
15	Continental – Industria Textil do Ave. SA	Private company	Lousado	Portugal	Providing input on industry needs, connection to business partners for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
16	Regional Development Agency (RDA)	Public Agency	Częstochowa	Poland	Assistance in addressing the companies with assessment of industrial needs WP1-1.4 and verification of curriculum WP2-2.4. Assistance in dissemination of project results in the group of companies and institutional units WP5

Methodology



Focus Group

- Inclusive for Sectors (Industry , Service, Agriculture),
- Inclusive for Geography
- Selection Process

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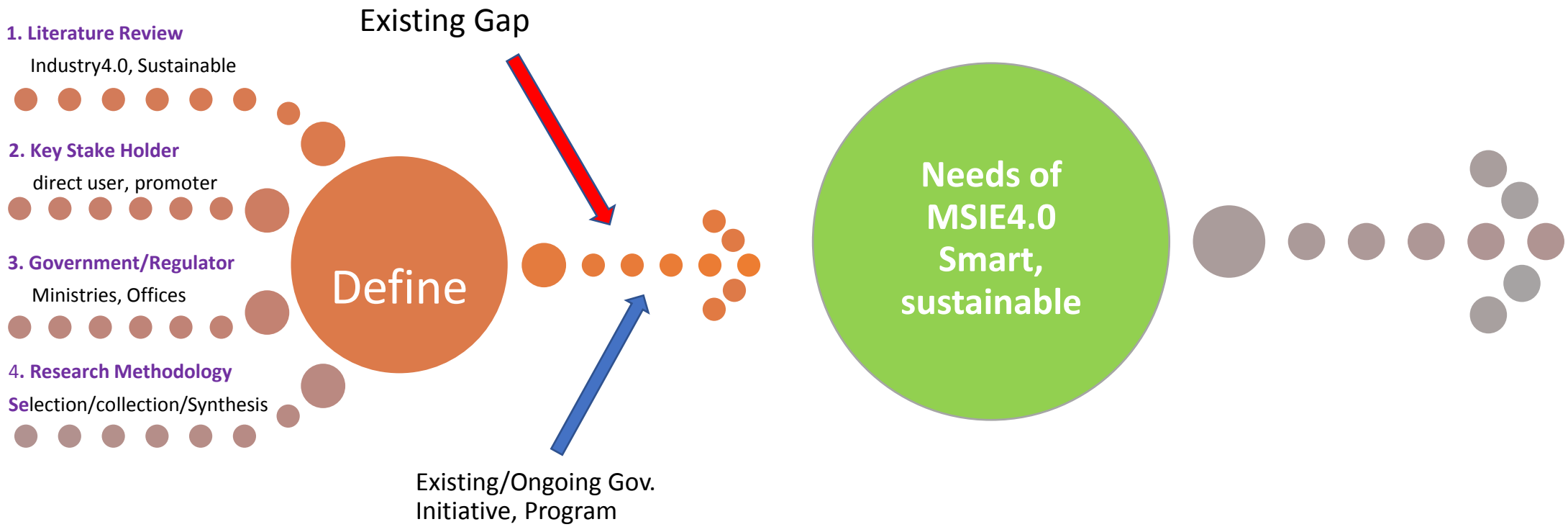
Methodology of WP1



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From 1st Meeting

- **Analysis**
- **QFD Quality Function Deployment**
- *1st We define the competency + professional practice: interviews (exploratory) and questionnaire*
- *2nd look at the boundary, key players who are going to use IE in Thailand*
- *3rd we use QFD with those key players to identify their needs (not only IE but the needs for business cometitiveness)*
- if we know that car industry is now aiming for Iot+4.0 in the workshop then we should equip our IE with those knowledge
- **1st We define the competency + professional practice: interviews (exploratory) and questionnaire**

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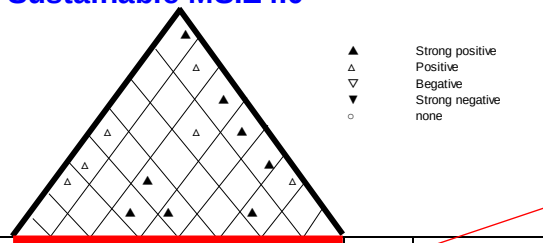
Some Idea of QFD

Wichai HOQ for Smart, Sustainable MSIE4.0



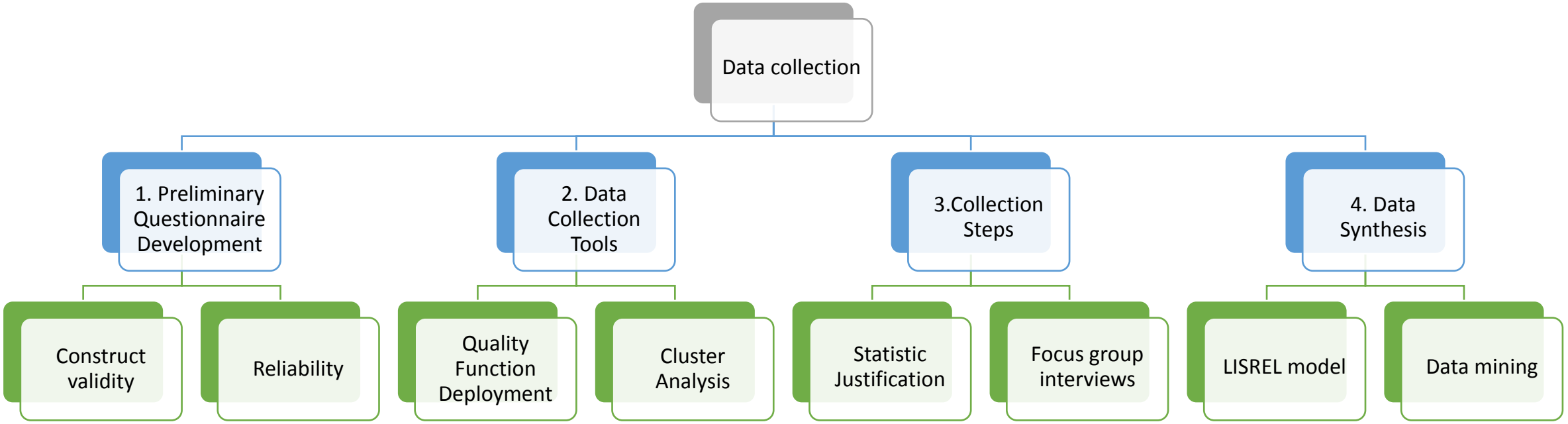
0 no relationship, 1 weak , 3 mild, 9 strong

Industry	Impotant Weight	IoT, Digital Factory	Quality 4.0	Sustainable Production System	Digital SCM	Sensors, Automation	Footprints	Adv. Fabrication	OM. OR	ผลการประเมิน (Evaluation)	เป้าหมาย (Target)	อัตราส่วนการปรับปรุง (Improv. Ratio)	ยอดขาย (Sale)	Demanded Quality Importancre	% Demanded Quality Importancre
Strong Knowledge in IE&SCM	0.06	9	9	1	3	9	3	3	3	2	5	2.5	1	0.15	4%
Strong Knowledge in I4.0, Sustainabiity	0.1	1	9	1	1	9	1	1	3	2	5	2.5	1	0.25	7%
Industrial Management Skill	0.08	0	1	0	1	1	1	1	0	1					
Business, entrepreneurship	0.14	3	3	9	3	3	1	1	3	1	5	5	1	0.7	18%
Management of I4.0 Technology	0.12	3	3	3	9	3	1	1	3	1	5	5	1	0.6	16%
Management of Sustainability Technology	0.08	1		3	3	9	1	1	3	1					
Personal Experiences	0.12	1	1	1	9	3	9	3	1	1	5	5	1	0.6	16%
professional profile	0.1	0	1	3	3	1	3	9	1	1	5	5	1	0.5	13%
problem solving, work assigned achievemen	0.1	0	3	3	1	1	1	3	3	1	5	5	1	0.5	13%
industry specific, SME	0.1	3	9	3	3	3	1	1	9	1	5	5	1	0.5	13%
Weighted Importance		**2**	**3.842**	**3.579**	**4.5**	**3.105**	**2.605**	**2.711**	**3.211**						
% Importance		*8%*	*15%*	*14%*	*18%*	*12%*	*10%*	*11%*	*13%*						
Measured Performance															
Desired Target															
Rank		8	2	3	1	5	7	6	4						
Select		○	✔✔	✓✓	✔✔	✓	○	○	✓						

Industry Need

Lit Review+Rui Work

4. Research Tools



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UNESCO (1996) 4 ‘pillars:

UNESCO (1996) Learning: the treasure within. Paris: UNESCO.

what knowledge to learn,

what skills to acquire,

what experiences to undertake and

what personality to develop.

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Demographic of Industries
(Size, Type, Impact,location,etc)

what knowledge requires

what skills to acquire,

what experiences to undertake and

what personality to develop

Industry Need

- Automation
- Economics Engineering
- Ergonomics and Human Fact
- Supply Chain Management
- Maintenance
- Industrial Optimization
- Product Design
- Production Management
- Project Management
- Quality
- Marketing

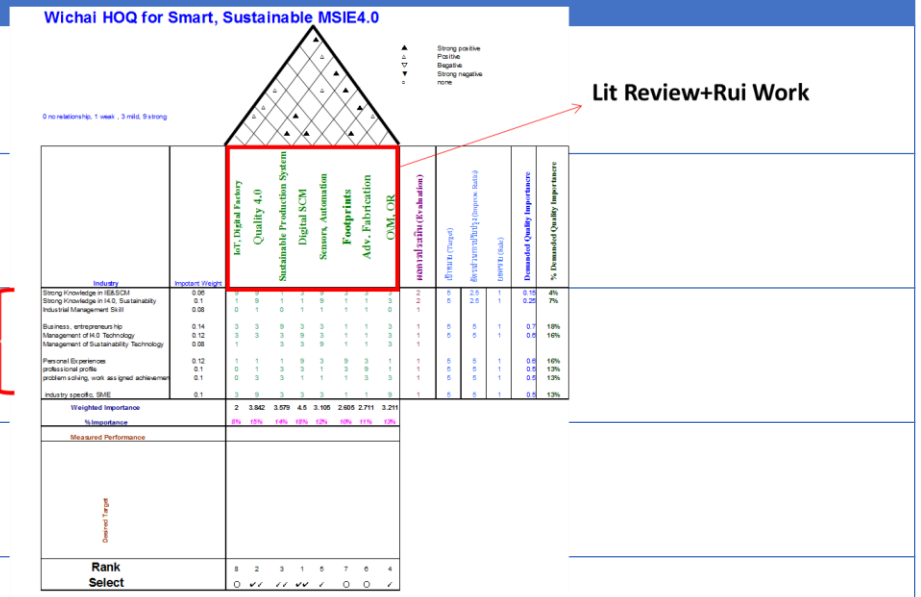

Table 1. Definition of the professional practice areas.

Area	Definition
Automation	In the industrial Automation area of practice, engineers should troubleshoot, repair and maintain automated industrial equipment, such as computer numerical control (CNC) equipment and robots (Greaver, 2015; Study.com, 2016).
Economics Engineering	The application of economic principles in the engineering problem by solving process; for example, analysing the economics of different alternatives, analysing industrial costs and being involved in the financial management of organizations (Watts & Chapman, 2016).
Ergonomics and Human Factors	"Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and other methods to design in order to optimize human well-being and overall system performance" (International Ergonomics Association, 2016).
Supply Chain Management	"The design, planning, execution, control and monitoring of supply chain activities with the objective of creating net value" for industrial and service companies (APICS, 2012d).
Maintenance	Management process of organization, planning and implementation of corrective maintenance, preventive maintenance, and continuous improvement of industrial and service business organizations (IDCON, 2016).
Industrial Optimization	Industrial optimization make a link between mathematics, engineering and management, using as operations research, heuristics or simulation, for achieving the best possible solution for a problem for industrial and service companies, in terms of a specified objective (APICS, 2013c; Bangert, 2012).
Product Design	"The conversion of a need or innovation into a product, process, or service that meets both the enterprise and customer expectations. The design process consists of translating a set of functional requirements into an operational product, process or service" (APICS, 2013a; Dym et al., 2014).
Production Management	Design, improvement and management of systems that deliver products and services. This area is related with the design and improvement of production systems and the activities of production planning and control activities for the efficient and effective use of those production systems (Halevi, 2001; Martin-Vega, 2001; Vollmann et al., 2005).
Project Management	Application of "knowledge, skills, tools, and techniques to project activities to meet the project requirements" (Project Management Institute, 2013, p. 6).
Quality	"The analysis of a manufacturing system at all stages to maximize the quality of the process itself and the products it produces" (American Society for Quality, 2016).
Marketing	"The design, pricing, promotion, and distribution of goods to create transactions with businesses and consumers" (APICS, 2013b).

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WORKPLAN for Project year 1

Activities														Total duraton (number of weeks)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep
Ref.nr/Sub-ref nr	Title	WPL	CWPL	TL	AIT	CMU	MUTN	TU	KKU	PSU	UPB	UM	CUT		M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Task 1.1	Develop a gap analysis working plan	CMU	UM	CMU	P	TL						P		3	3=,3X											
Task 1.2	Analyzing of MSIE curricula being offered, and of learning and teaching methods being applied	CMU	UM	UM	P	P		P			P	TL	P	8		2=,2X	2=,2X	2=,2X	2=,2X							
Task 1.3	Assessing needs of industry and students	CMU	UM	CMU		TL	P	P	P	P	P	P	P	10					2=,2X	2=,2X	2=,2X	2=,2X	2=,2X			
Task 1.4	Identifying gaps	CMU	UM	UM	P	P		P			P	TL	P	3									=,x	2=,2x		
Task 1.5	Identifying competitive factors for the curriculum	CMU	UM	CMU	P	TL		P			P	P	P	3										2=,2x	=,x	
Task 1.6	Developing recommendations for the specifications and areas of specialization for the curriculum	CMU	UM	CMU	P	TL				P	P	P	P	4											2=,2x	2=,2X
Task 3.3	Developing a web-portal for online learning	AIT	UM	AIT	TL	P					P	P		12						2=,2X	2=,2X	2=,2X	2=,2X	2=,2X	2=,2X	
Task 4.1	Developing a quality control and monitoring system	UPB	PSU	UPB	P	P		P			TL		P	7	2=,2X	2=,2X	2=,2X	=,X								
Task 4.2	Implementing the internal quality control and monitoring of the project	UPB	PSU	UPB		P	P				TL		P	5				=,X		=,X		=,X		=,X		=,X
Task 5.1	Development of a Dissemination, Exploitation and Sustainable plan,	KKU	UPB	UPB	P	P					TL	P		6	2=,X	2=,X	2=,X									
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,	KKU	UPB	AIT	TL	P			P		P	P		14	2=,X	2=,X	=	=	=	=	=	=	=	=	=	=
Task 5.3	Production of dissemination materials	KKU	UPB	KKU	P	P			TL		P	P	P	6						2=,X	2=,X					2=,X
Task 5.6	Organizing dissemination events with relevant stakeholders	KKU	UPB	KKU	P	P			TL		P	P	P	2												2=,X
Task 6.1	Development of project management and communication rules and of the partnership agreement	AIT		AIT	TL	P	P	P	P	P	P	P	P	3	3=,3X											
Task 6.2	Organizing and management of the project communication and of regular consortium meetings	AIT		AIT	TL	P	P	P	P	P	P	P	P	6	2=,2X					2=,2X						2=,2X
Task 6.3	Financial and administrative management and monitoring of the project	AIT		AIT	TL	P	P	P	P	P	P	P	P	12	=	=	=	=	=	=	=	=	=	=	=	=

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Description of WP1

- The 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,
  - the most important working elements for the first year of the project in WP1.
- Throughout the entire first year the purposes of the WP1 are:

- *1) to 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) to 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) to recommend the specifications and focus areas of the new proposed MSIE curriculum.*

- ***The WP1 will be led by CMU (P2) in close collaboration with UMinho (P8) that will co-lead and be the WP1 coordinator for EU partners. All partners will also participate and be responsible for tasks related to their geographical regions.***

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Tasks

☑ CMU : TL

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

☑ UMinho : TL

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

☑ CMU : TL

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

☑ UMinho : TL

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

☑ CMU : TL

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

☑ CMU : TL

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	☐ Teaching material ☐ Learning material ☐ Training material	☐ Event ☒ Report ☐ 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	
	Languages	English	
Target groups	☒ Teaching staff ☐ Students ☐ Trainees ☐ Administrative staff ☐ Technical staff ☐ Librarians ☐ Other		
	If you selected 'Other', please identify these target groups. (Max. 250 characters)		
Dissemination level	☐ Department / Faculty ☒ Institution	☒ Local ☐ Regional	☒ National ☒ International

Deliverables/results/outcomes

☑ UMinho : TL

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	☐ Teaching material ☐ Learning material ☐ Training material	☐ Event ☒ Report ☐ 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	
	Languages	English, Thai	
Target groups	☒ Teaching staff ☐ Students ☐ Trainees ☐ Administrative staff ☐ Technical staff ☐ Librarians ☐ Other		
	If you selected 'Other', please identify these target groups. (Max. 250 characters)		
Dissemination level	☐ Department / Faculty ☒ Institution	☒ Local ☐ Regional	☒ National ☒ International

Content

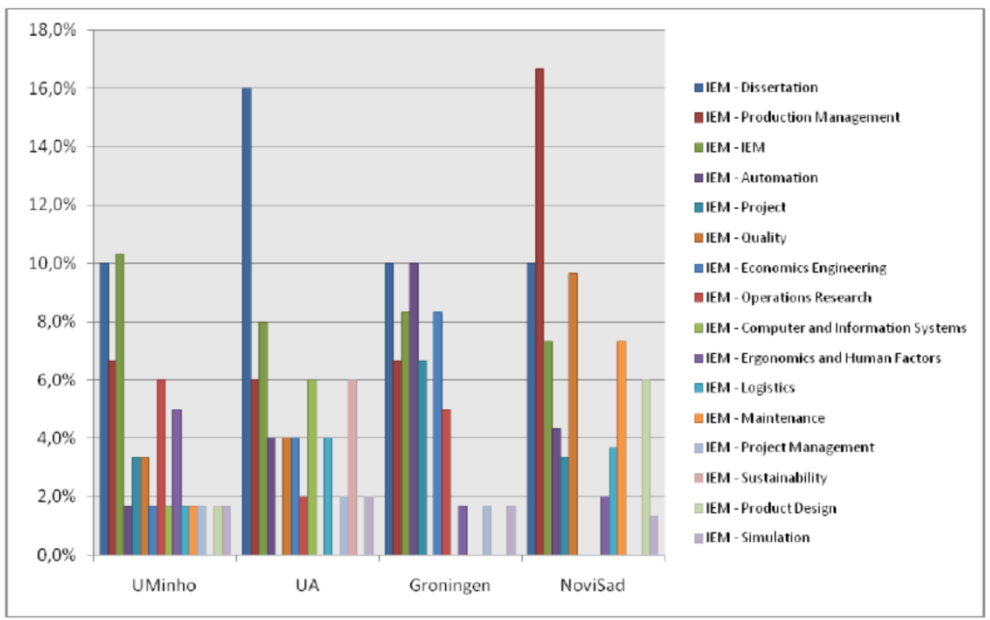


Figure 2. Curriculum knowledge areas analysis based on IEM specific areas

Deliverables/results/outcomes

☑ CMU : TL

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	☐ Teaching material ☐ Learning material ☐ Training material	☐ Event ☒ Report ☐ 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	
	Languages	English, Thai	
Target groups	☒ Teaching staff ☐ Students ☐ Trainees ☐ Administrative staff ☐ Technical staff ☐ Librarians ☐ Other		
	If you selected 'Other', please identify these target groups. (Max. 250 characters)		
Dissemination level	☐ Department / Faculty ☒ Institution	☒ Local ☐ Regional	☒ National ☒ International

Questionnaire structure Identifying Needs

Demographic of Industries
(Size, Type, Impact,location,etc)

what knowledge requires

what skills to acquire,

what experiences to undertake and

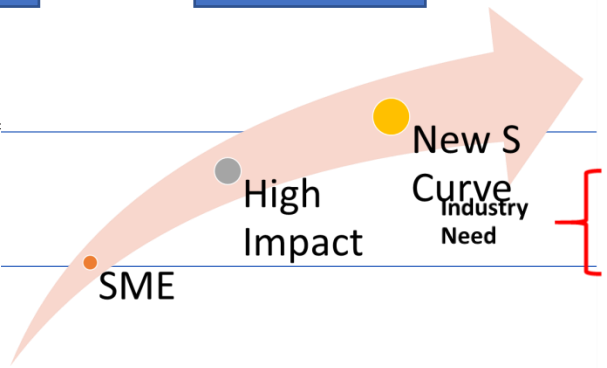
what personality to develop

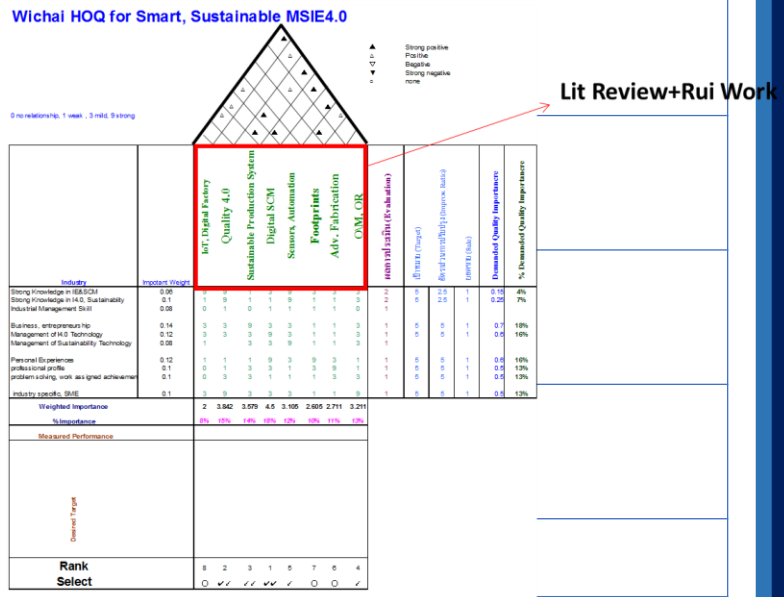
Others key factors

IE Job Factors

- Automation
- Economics Engineering
- Ergonomics and Human Fact
- Supply Chain Management
- Maintenance
- Industrial Optimization
- Product Design
- Production Management
- Project Management
- Quality
- Marketing

Industry Factors





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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

☑ UMinho : TL

Expected Deliverable/Results/ Outcomes	**Work Package and Outcome ref.nr**	**1.4.**	
	Title	Analysis of needs of industry and students	
	Type	☐ Teaching material ☐ Learning material ☐ Training material	☐ Event ☒ Report ☐ 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	☒ Teaching staff ☐ Students ☐ Trainees ☐ Administrative staff ☐ Technical staff ☐ Librarians ☐ Other		
	If you selected 'Other', please identify these target groups. (Max. 250 characters)		
Dissemination level	☐ Department / Faculty ☒ Institution	☒ Local ☐ Regional	☒ National ☒ International

Deliverables/results/outcomes

Task 1.5 Identifying competitive factors for the curriculum

☑ CMU : TL

Expected Deliverable/Results/ Outcomes	**Work Package and Outcome ref.nr**	**1.5.**	
	Title	Gaps between the needs and graduates' competences	
	Type	☐ Teaching material ☐ Learning material ☐ Training material	☐ Event ☒ Report ☐ 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 t will be a part of the second WP1 progress report.	
	Due date	M10	
	Languages	English, Thai	
Target groups	☒ Teaching staff ☐ Students ☐ Trainees ☐ Administrative staff ☐ Technical staff ☐ Librarians ☐ Other		
	If you selected 'Other', please identify these target groups. (Max. 250 characters)		
Dissemination level	☐ Department / Faculty ☒ Institution	☒ Local ☐ Regional	☒ National ☒ International

Deliverables/results/outcomes

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

☑ CMU : TL

Expected Deliverable/Results/ Outcomes	**Work Package and Outcome ref.nr**	**1.6.**	
	Title	Competitive factors for the curriculum	
	Type	☐ Teaching material ☐ Learning material ☐ Training material	☐ Event ☒ Report ☐ 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	☒ Teaching staff ☐ Students ☐ Trainees ☐ Administrative staff ☐ Technical staff ☐ Librarians ☐ Other		
	If you selected 'Other', please identify these target groups. (Max. 250 characters)		
Dissemination level	☐ Department / Faculty ☒ Institution	☒ Local ☐ Regional	☒ National ☒ International

Deliverables/results/outcomes

Expected Deliverable/Results/ Outcomes	**Work Package and Outcome ref.nr**	**1.7.**	
	Title	Recommendations for specifications and areas of specialization for the curriculum	
	Type	☐ Teaching material ☐ Learning material ☐ Training material	☐ Event ☒ Report ☐ Service/Product
	Description	The most important outcome of WP1 will be a report with the main conclusions concerning the actual gaps between the information developed for developing a proposed curriculum.	
	Due date	M12	
	Languages	English, Thai	
Target groups	☒ Teaching staff ☐ Students ☐ Trainees ☐ Administrative staff ☐ Technical staff ☐ Librarians ☐ Other		
	If you selected 'Other', please identify these target groups. (Max. 250 characters)		
Dissemination level	☐ Department / Faculty ☒ Institution	☒ Local ☐ Regional	☒ National ☒ International

Ref.nr	Name of organisation	Type of institution	City	Country	Role in the project
1	The Federation of Thai Industries	Non-profit organization	Bangkok	Thailand	Providing input on industry needs, connection to industry in the network for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
2	Kohler (Thailand) Public Co., Ltd.	Private company	Bangkok	Thailand	Providing input on industry needs, connection to business partner for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
3	Western Digital (Thailand) Co., Ltd.	Private company	Ayutthaya	Thailand	Providing input on industry needs, connection to business units in the Western Digital for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
4	HGST (Thailand) Ltd.	Private company	Prachin Buri	Thailand	Providing input on industry needs, connection to business partners for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
5	Southern Industrial Estate	Government Agency	Songkhla	Thailand	Providing input on industry needs, connection to business partners for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
6	Rajburi Sugar Group of companies	Private company	Bangkok	Thailand	Providing input on industry needs, connection to companies in the Group for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
7	CP Group	Private company	Bangkok	Thailand	Providing input on industry needs, connection to companies in the Group for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
8	Group Renault Romania	Private group of companies	Bucharest	Romania	Assessing industry needs. Curricula evaluation. Exploitation of Project Results.
9	Unison Engine Components Bucharest S.A. – General Electric Aviation	Private company	Bucharest	Romania	Assessing industry needs. Curricula evaluation. Exploitation of Project Results.
10	"Prof. Constantin Popovici" Foundation	Public Industrial Engineering Foundation	Bucharest	Romania	WP 1 – Gap analysis. Workshop organisation. Developing a quality control and monitoring system. Dissemination of Project Results
11	ALUMNI IMST Association	Public Industrial Engineering Association	Bucharest	Romania	Assessing industry needs. Curricula evaluation. Dissemination and Exploitation of Project Results
12	Students Association from Faculty IMST - ASIMST	Public Industrial Engineering Students Association	Bucharest	Romania	Assessing students needs and learning methods. Pilot tests of key courses. Workshop organisation. Dissemination and Exploitation of Project Results
13	Leoni Portugal	Private company	Guimaraes	Portugal	Providing input on industry needs, connection to business partners for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
14	Bosch Car Multimedia	Private company	Braga	Portugal	Providing input on industry needs, connection to business partners for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
15	Continental – Industria Textil do Ave. SA	Private company	Lousado	Portugal	Providing input on industry needs, connection to business partners for interview and disseminate project materials and news, providing feedbacks on gap analysis, specifications of the curriculum, participating in dissemination events and conference.
16	Regional Development Agency (RDA)	Public Agency	Częstochowa	Poland	Assistance in addressing the companies with assessment of industrial needs WP1-1.4 and verification of curriculum WP2-2.4. Assistance in dissemination of project results in the group of companies and institutional units WP5

WORKPLAN for Project year 1

Activities														Total duraton (number of weeks)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep
Ref.nr/Sub-ref nr	Title	WPL	CWPL	TL	AIT	CMU	MUTN	TU	KKU	PSU	UPB	UM	CUT		M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Task 1.1	Develop a gap analysis working plan	CMU	UM	CMU	P	TL						P		3	3=,3X											
Task 1.2	Analyzing of MSIE curricula being offered, and of learning and teaching methods being applied	CMU	UM	UM	P	P		P			P	TL	P	8		2=,2X	2=,2X	2=,2X	2=,2X							
Task 1.3	Assessing needs of industry and students	CMU	UM	CMU		TL	P	P	P	P	P	P	P	10					2=,2X	2=,2X	2=,2X	2=,2X	2=,2X			
Task 1.4	Identifying gaps	CMU	UM	UM	P	P		P			P	TL	P	3									=,x	2=,2x		
Task 1.5	Identifying competitive factors for the curriculum	CMU	UM	CMU	P	TL		P			P	P	P	3										2=,2x	=,x	
Task 1.6	Developing recommendations for the specifications and areas of specialization for the curriculum	CMU	UM	CMU	P	TL				P	P	P	P	4											2=,2x	2=,2X
Task 3.3	Developing a web-portal for online learning	AIT	UM	AIT	TL	P					P	P		12						2=,2X	2=,2X	2=,2X	2=,2X	2=,2X	2=,2X	
Task 4.1	Developing a quality control and monitoring system	UPB	PSU	UPB	P	P		P			TL		P	7	2=,2X	2=,2X	2=,2X	=,X								
Task 4.2	Implementing the internal quality control and monitoring of the project	UPB	PSU	UPB		P	P				TL		P	5				=,X		=,X		=,X		=,X		=,X
Task 5.1	Development of a Dissemination, Exploitation and Sustainable plan,	KKU	UPB	UPB	P	P					TL	P		6	2=,X	2=,X	2=,X									
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,	KKU	UPB	AIT	TL	P			P		P	P		14	2=,X	2=,X	=	=	=	=	=	=	=	=	=	=
Task 5.3	Production of dissemination materials	KKU	UPB	KKU	P	P			TL		P	P	P	6						2=,X	2=,X					2=,X
Task 5.6	Organizing dissemination events with relevant stakeholders	KKU	UPB	KKU	P	P			TL		P	P	P	2												2=,X
Task 6.1	Development of project management and communication rules and of the partnership agreement	AIT		AIT	TL	P	P	P	P	P	P	P	P	3	3=,3X											
Task 6.2	Organizing and management of the project communication and of regular consortium meetings	AIT		AIT	TL	P	P	P	P	P	P	P	P	6	2=,2X					2=,2X						2=,2X
Task 6.3	Financial and administrative management and monitoring of the project	AIT		AIT	TL	P	P	P	P	P	P	P	P	12	=	=	=	=	=	=	=	=	=	=	=	=

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Conclusion

- What we need from all Partners
  - *List and confirmation of Industry contact (data collection)*
  - *List of MS IE Curriculum in Eus*

  Feb

  - *External&Internal Sources of Industry needs, 21st professional profiles*

  Feb

  - *Questionnaire Feedback*

  mid of Apr

  - *Questionnaire sending out and collection*

  May

  - Recommendations for specifications and areas of specialization for the curriculum

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Thank You

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Industrial Engineering for Thailand Sustainable Smart Industry