

Building Skills 4.0 through University and Enterprise Collaboration

SHYFTE 4.0

WP1: Preparation

D1.4: Design teaching programs and learning materials for four domains of expertise

vs:1.0.0

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This deliverable concerns the teaching and learning program and materials. The design of the learning materials is based on the framework and skills 4.0 model defined in the deliverable D1.3 and will provide the models of skills 4.0 in the four domains.

The teaching and learning strategies for deploying the four pilots of the WP2 are also defined in this deliverable

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Further Information

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1. Introduction

Based on the conceptual learning framework and the Skills 4.0 model defined in the WP1-Task 1.4 of the Shyfte project (see deliverables D1.2 & D1.3), this document will describe the Skills 4.0 Learning Framework (section 2), the design of the learning programs, materials and method for the four domains (section 3). It will also propose the teaching and learning strategies for deploying the four pilots in each university (section 4).

Based on the conceptual learning framework and the Skills 4.0 model, the design of the learning materials will be primarily based on the two dimensions:

- The learning framework per domain: describing the Skills Sets and the modules identified according to the level of the trainees
- The program of the modules (syllabus) integrating the main following concepts:
 - Domain and sub-domains
 - Modules: title, description, keywords, outcomes, prerequisites
 - Teaching plan
 - Delivery method
 - Teaching materials
 - Equipment
 - Duration
 - Target group & target group level
 - Maturity level of the trainees
 - Skill sets
 - Type of skills: hard skills, soft skills and meta skills
 - Assessment method

2. Shyfte Skills 4.0 Learning Framework

The learning framework framed in the Shyfte Skills 4.0 Centre of Excellence Network. The Learning Centers of Excellence allow the promotion of knowledge transference of the four pilots in Asian Countries. Specifically, it will deploy and demonstrate a skills transfer infrastructure for Industry 4.0.

The learning centres are built on the basis of continuous interaction with SMEs. The objective is to enable students and employees who will be trained in these centres to work on real company data, to have at their disposal case studies, data sets, software, simulators... in order to be in line with the current and future needs of companies (see Figure 1).

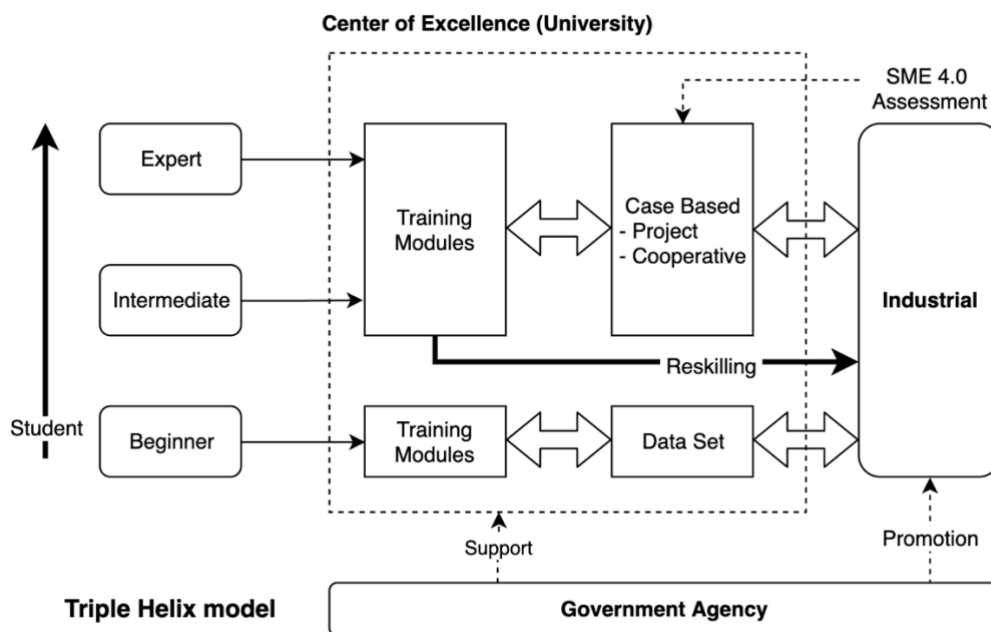


Figure 1: Learning Center of Excellence (LCE) – Learning Framework

The teaching and learning framework encloses the Computational Model for Knowledge Transfer Skills in Industry 4.0 is based on the Service Oriented Architecture (SOA). All those services are combined and organized together in order to support and implement the proposed framework.

The Learning Framework will describe, for the four domains and their sub-domains, the main Skill Sets identified, and for each of them, the different modules identified.

2.1 Domain 1 Skills 4.0 Learning Framework: Industrial Engineering & Mgt (CMU & KU)

The Learning framework for the first domain, “Industrial Engineering and Management”, is described on the two topics: “Industrial Engineering” and “Business Management”. Seven Skill Sets (SkS) are defined for the domain 1.

2.1.1 Domain 1: “Industrial Engineering” - CMU

The “Industrial Engineering” domain is composed by two sub-domains :

1. Production Management and Manufacturing System
2. Quantitative Analysis

The first sub-domain is composed by three Skill Sets (SkS):

SkS-D1-1: Smart Production Management

SkS-D1-2: Agile Manufacturing System

SkS-D1-3: Quality System 4.0

The second sub-domain is composed by one Skill Set (SkS):

SkS-D1-4: Intelligence Quantitative Analysis

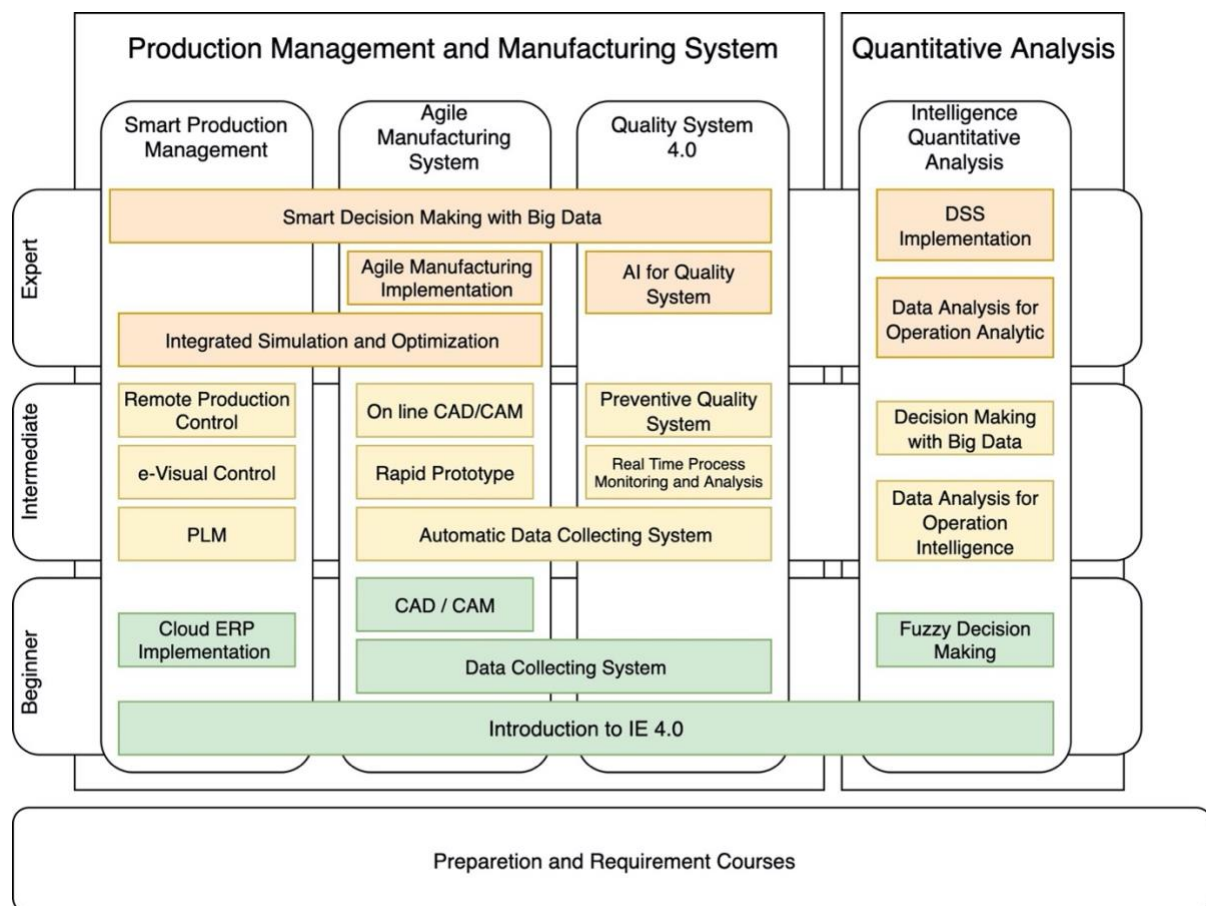


Figure 2: Learning Framework – Domain 1: Industrial Engineering

- 21 Modules are defined in this Framework for the Domain 1: Industrial Engineering
- These modules are defined based on the maturity level of the trainees. Three levels are identified: Beginners, Intermediate and Experts.
- The trainees, based on their background and knowledge, can select different modules to enhance their competencies and be upskilled.

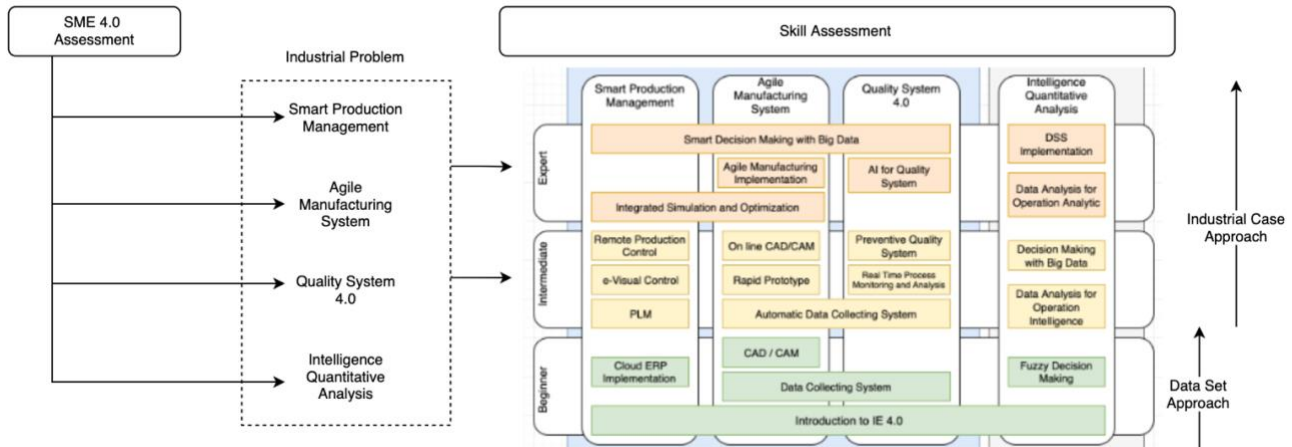


Figure 3: Learning Framework – Domain 1: Industrial Engineering – Skills Development

2.1.2 Domain 1: “Business Management” - KU

The “Business Management” domain is represented by the three following Skill Sets:

- **Sks-D1-5:** Organizational Transformation;
- **Sks-D1-6:** Digital Strategic Management;
- **Sks-D1-7:** Business Revolution for Industry 4.0.

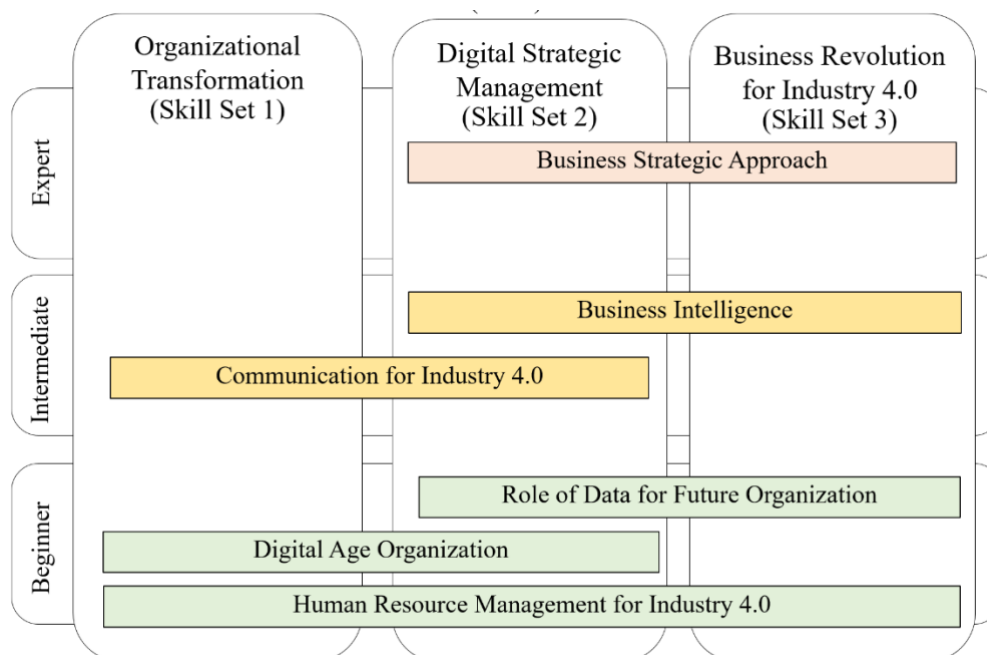


Figure 4: Learning Framework – Domain 1: Business Management

- 6 Modules are defined in this Framework for the Domain 1: Business Management
- These modules are defined based on the maturity level of the trainees. Three levels are identified: Beginners, Intermediate and Experts.
- The trainees, based on their background and knowledge, can select different modules to enhance their competencies and be upskilled.

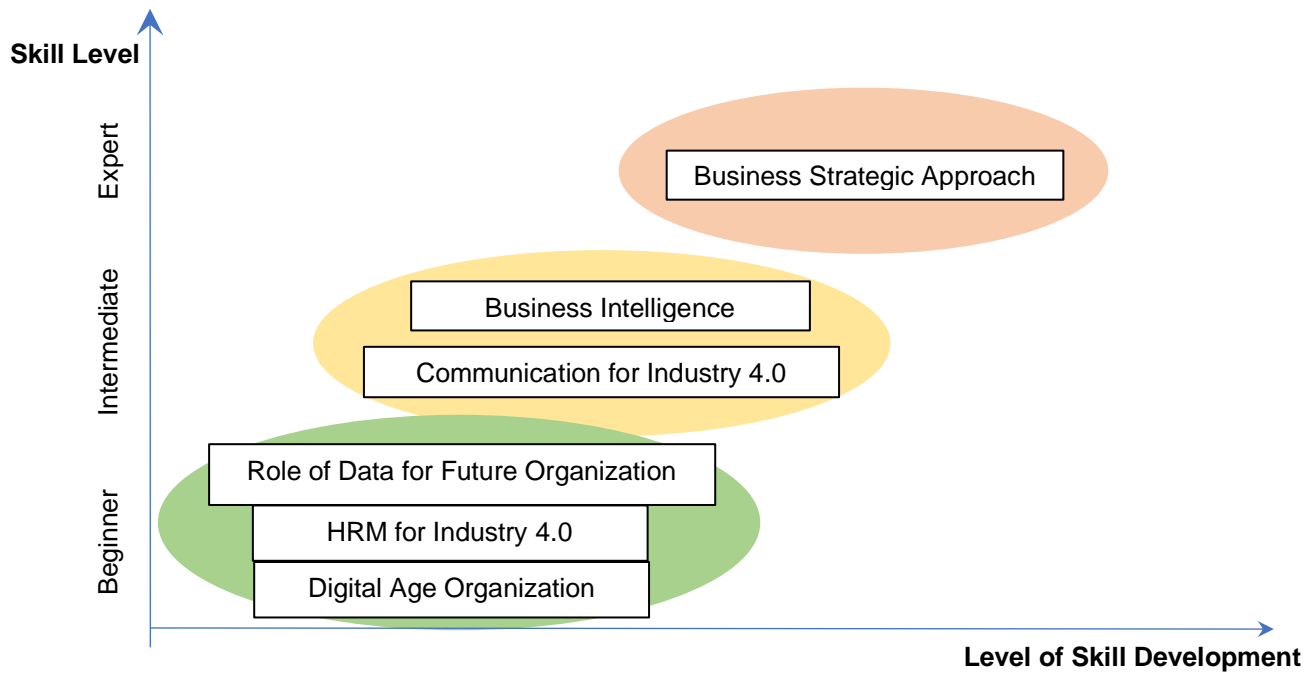


Figure 4: Learning Framework – Domain 1: Business Management Skills Development

2.2 Domain 2 Skills 4.0 Learning Framework: Software Eng. & BigData analysis (CDU & CUIT)

The Learning framework for the second domain, “Software Engineering and Big data Analytics”, is composed by the following Skill Sets (SkS):

- **SkS-D2-1:** BigData Science Analytics;
- **SkS-D2-2:** BigDataSystem Management;
- **SkS-D2-3:** Cloud Computing System;
- **SkS-D2-4:** AI for BigData Analysis.

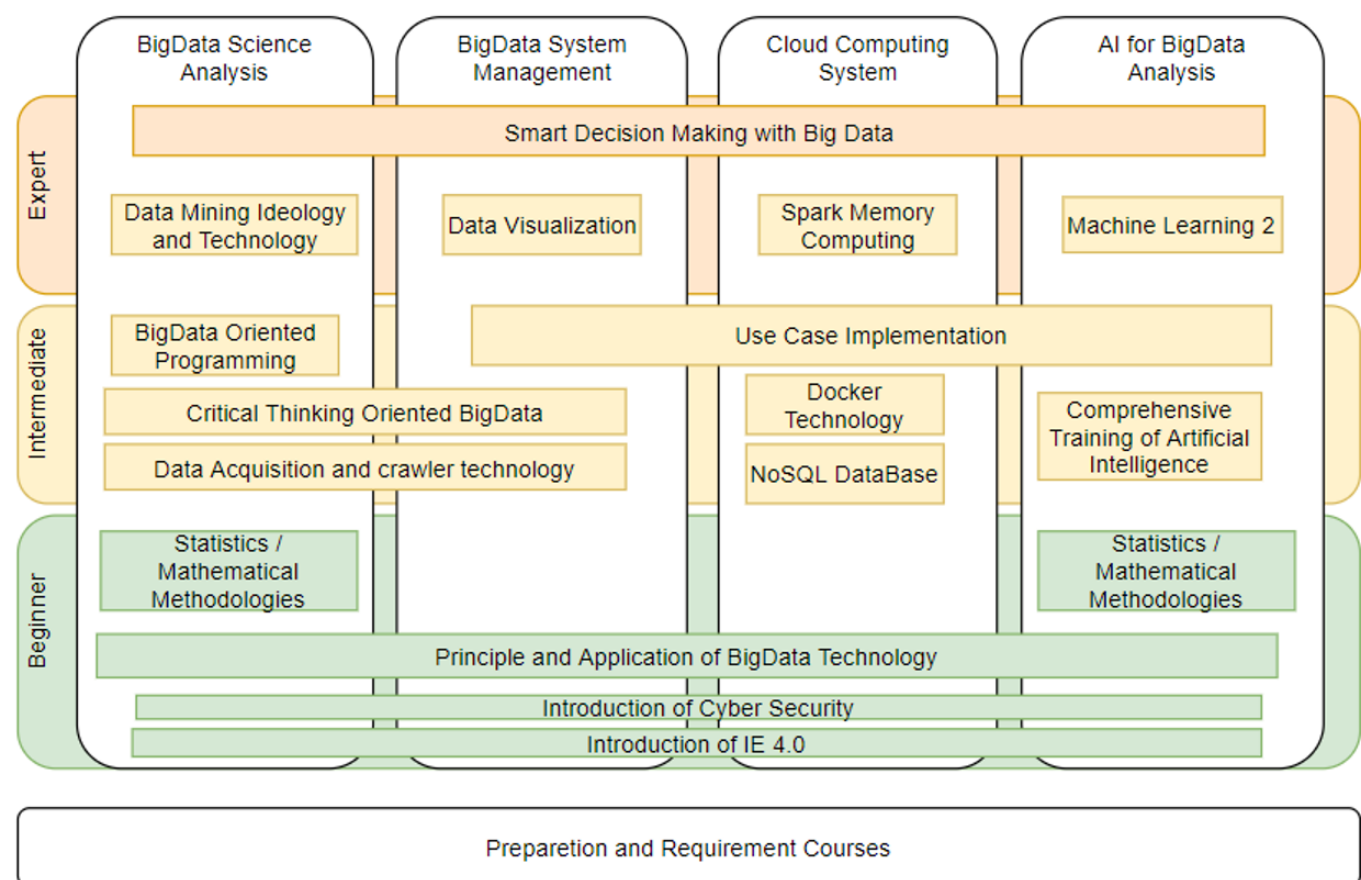


Figure 5: Learning Framework – Domain 2: Software Engineering & Big Data Analytics

- 17 Modules are identified in this Framework
- These modules are defined based on the maturity level of the trainees. Three levels are identified: Beginners, Intermediate and Experts.
- The trainees, based on their background and knowledge, can select different modules to enhance their competencies and be upskilled.

2.3 Domain 3 Skills 4.0 Learning Framework: Wireless Networks Analytics (UPM)

The Learning framework for the third domain, “Wireless Networks Analytics”, is composed by the five following Skill Sets:

- **SkS-D3-1:** Wireless Networks;
- **SkS-D3-2:** Wireless Security;
- **SkS-D3-3:** Wireless Propagation;
- **SkS-D3-4:** IoT System;
- **SkS-D3-5:** Energy Management.

SHYFTE Domain: Wireless Networks and Analytics

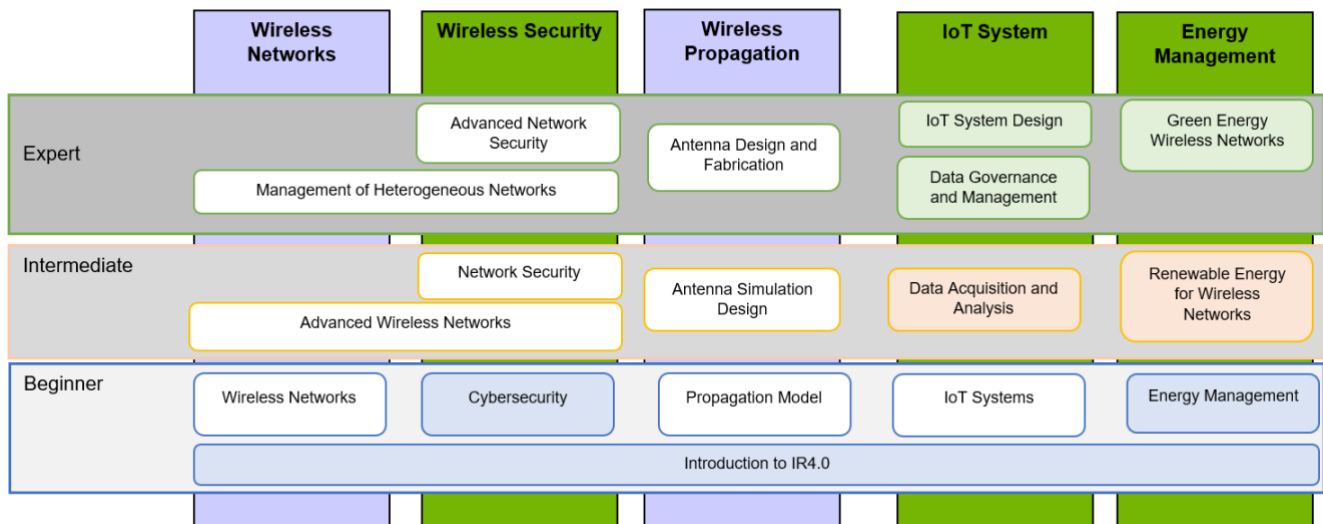


Figure 6: Learning Framework – Domain 3: Wireless Networks Analytics

- 17 Modules are identified in this Learning Framework
- These modules are defined based on the maturity level of the trainees. Three levels are identified: Beginners, Intermediate and Experts.
- The trainees, based on their background and knowledge, can select different modules to enhance their competencies and be upskilled.

2.4 Domain 4 Skills 4.0 Learning Framework: Artificial Intelligence (UPM)

The Learning framework for the fourth domain, “Artificial Intelligence”, is composed by the three main Skill Sets:

- **SkS-D4-1:** Machine Learning;
- **SkS-D4-1:** Optimization;
- **SkS-D4-1:** AI Applications.

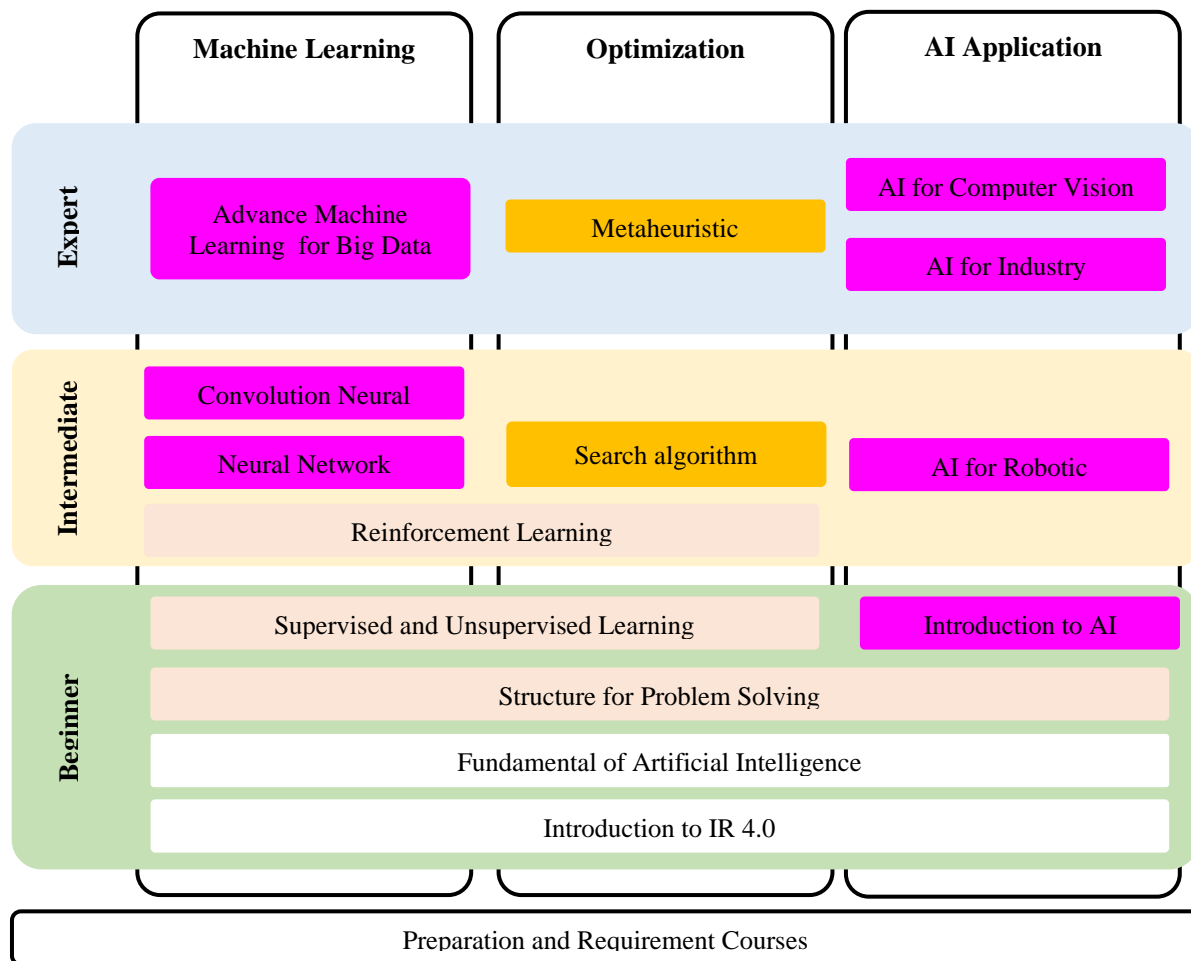


Figure 7: Learning Framework – Domain 4: Artificial Intelligence

- 14 Modules are identified in this Learning Framework
- These modules are defined based on the maturity level of the trainees. Three levels are identified: Beginners, Intermediate and Experts.
- The trainees, based on their background and knowledge, can select different modules to enhance their competencies and be upskilled.

3. Shyfte Skills 4.0 Learning Programs

Based on the conceptual Learning Framework and the Skills 4.0 model defined, the design of the learning materials will be primarily based on the two dimensions:

- The Learning Framework per domain: describing the Skills Sets and the modules identified according to the level of the trainees
- The Learning Programs of the modules (syllabus) integrating the main following concepts:
 - Domain and sub-domains
 - Modules: title, description, keywords, outcomes, prerequisites
 - Teaching plan
 - Delivery method
 - Teaching materials
 - Equipment
 - Duration
 - Target group & target group level
 - Maturity level of the trainees
 - Skill sets
 - Type of skills: hard skills, soft skills and meta skills
 - Assessment method

3.1 Domain 1 Skills 4.0 Learning Programs: Ind. Engineering and Mgt

For the Domain 1, 16 modules are described (9 for the Industrial Engineering and 6 for the Business Management sub-domain).

1. Skill Set: Smart Production Management (3 Modules)
2. Skill Set: Agile Manufacturing System (5 Modules)
3. Skill Set: Quality System 4.0 (2 Modules)
4. Skill Set: Intelligence Quantitative Analysis (2 Modules)

D1: Industrial Engineering - Skill Set “Smart Production” - Module “Introduction to Industry 4.0”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
SHYFTE 4.0	Industrial Engineering and Management							
Shyfte Domain Curriculum (sub domain)	Production Management and Manufacturing System							
Skill Set	Smart Production Manag	Agile Manufacturing System						
Skill Level	Beginner							
Module Title	Introduction to Industry 4.0							
Module Acronym	Introl4							
Module Description	Introduction to Industry 4.0 concept application and case studies							
Keywords	Industry 4.0							
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
1	Intro to Industry 4.0: Background & Environments		Lecture	Case study			1	. Team working . Problem solving . Ability to work with data . Presentation . Decision making
2	Digital supply chain		Lecture	Project assignment	.Data set of current supply chain		2	
3	The Implementation challenges of Industry 4.0		Lecture	Case study			3	
4	Introduction to Smart factories		Lecture	Case study	>Clips of smart factory		3	
5	The Role of Big Data Analytic in Industry 4.0		Team working group	Case study			2	
6	Cyber Physical System and next generation of sensors		Team working group	Project assignment			2	
7	Industrial IoT - Application and case studies		Lecture	Team working group/ Case study			3	
8	Maturity assessment tool for Industry 4.0		Lecture	Team working group	>Dataset from industry >Maturity model assessment tool		2	
Meta Skills	Perspective-taking, Ability to assess situations							
Module Outcomes	Students will be able to understand the concept of Industry 4.0.		Students will be able to realize how to implement this concept to targeted industry.					
Target Group (students, workers...)	Bachelor student	Master students	SME personnels					
Target Group Level	2nd year B.IE onward	1st year M.IE onward						
Assesement Method	Assignment, Project presentation							
Teaching Material								
Equipment	Data set of interested supply chain data	Data set from Industry						
Multimedia	VDO clips fo smart factory							
Content URL								
Class requirements (equipment that participants should bring)	Computer							
Prerequisites (previous modules that student should attend)	none							
Total duration (Hrs)	18							

Table 1: Domain 1 – Syllabus Module 1: “Introduction to industry 4.0”

D1: Industrial Engineering - Skill Set “Intelligence Quantitative Analysis” - Module “Fuzzy Decision System”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
Shyfte 4.0	Industrial Engineering and Management						
Shyfte Domain Curriculum (sub domain)	Quantitative Analysis						
Skill Set	Intelligence Quantitative Analysis						
Skill Level	Beginner						
Module Title	Fuzzy Decision Making						
Module Acronym	FDM						
Module Description	Quantitative Analysis for Fuzzy Decision Making Process						
Keywords	Decision Making	Quantitative Analysis	Fuzzy	Analysis			
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material / Equipment	Duration (Hrs)	Soft Skill
	1	Decision Making Process	Lecture	Case study	. Case Study	2	. Team Working . Problem Solving and Decision Making . Analytic and Critical Thinking . Presentation
	2	Problem Formulation and Quantitative Analysis	Gamification	Project assignment	. Data set	5	
	3	Fuzzy Decision Making	Computer Workshop	Project assignment	. Data set . Decision Making Software	2	
	4	Case Base Analysis	Team working group	Project assignment	. Project Case . Decision Making Software	3	
Meta Skills	To make a decision making in various cases						
Module Outcomes	Students will be able to make smart decision making in an fuzzy environment						
Target Group (students, workers...)	Bachelor student	Master students	SME personnels				
Target Group Level	3nd year B.IE onward	1st year M.IE onward	B. Degree				
Assesement Method	Assignment, Project presentation, Case based assessment, Team working						
Teaching Material							
Equipment	Decision Making Software	Data set					
Multimedia							
Content URL							
Class requirements (equipment that participants should bring)	Computer						
Prerequisites (previous modules that student should attend)							
Total duration (Hrs)	12						

Table 2: Domain 1 – Syllabus Module 2: “Fuzzy Decision Making”

D1: Industrial Engineering - Skill Set “Agile Manufacturing System” - Module “Cloud ERP”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
Shyfte	Industrial Engineering and Management						
Shyfte Domain Curriculum (sub domain)	Production Management and Manufacturing System						
Skill Set	Agile Manufacturing System	Quality System 4.0					
Skill Level	Skills Level Beginners						
Module Title	Cloud ERP						
Module Acronym	Cloud ERP						
Module Description	This module introduces cloud solutions in ERP system for manufacturing						
Keywords	Data collection	Manufacturing system	Production process				
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill
	1 ERP concept		Lecture	Case study		1	
	2 Enterprise Systems Architecture		Lecture	Simulation game	Simulation Game	3	. Problem solving
	3 Introduction to Case Purchase and procurement Production planning Order management Warehouse management		Case Study	Game	Case study and Data set	3	Problem solving skill
	4 Cloud ERP implementation		Team working group	Project assignment	. flow process mapping software . Data set	5	Team working Communication skill Presentation skill
Meta Skills	To understand and implement ERP on the cloud platform						
Module Outcomes	the student will get an understanding of all involved Master Data in purchase and procurement, production planning, order management, warehouse management						
Target Group (students, workers...)	Bachelor student	Master students	SME personnels				
Target Group Level	3rd year B.IE onward	1st year M.IE onward					
Assesement Method	Assignment, Project presentation, Assessment rubric for teamwork						
Teaching Material							
Equipment	Simulation Software	Data set					
Multimedia							
Content URL							
Class requirements (equipment that participants should bring)	Computer						
Prerequisites (previous modules that student should attend)							
Total duration (Hrs)	12						

Table 3: Domain 1 – Syllabus Module 3: “Cloud ERP”

D1: Industrial Engineering - Skill Set “Smart Production System” - Module “Remote Production Control”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
Shyfte Domain Curriculum (sub domain)	Industrial Engineering and Management						
Skill Set	Smart Production Management						
Skill Level	Skills Level Beginners						
Module Title	Remote Production Control						
Module Acronym	Remote Prod Cont						
Module Description	Manage and control broadcast productions quickly, easily and efficiently from any location.						
Keywords	Data collection	Manufacturing system	Production process				
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill
	1 Specification of remote monitoring and control system		Lecture	Practical Exercise		1,5	
	2 Remote monitoring and control technology		Practical Exercise	Case study	Data set for practical exercise	3	Analytical skill
	3 Use case to develop remote monitoring and control system		Project assignment		Use case	4,5	Problem Solving and Decision Making . Analytic and Critical Thinking . Presentation
Meta Skills	To design control and monitoring system which is easy and efficient for managing from any location						
Module Outcomes	Students will design control and monitoring system for manufacturing						
Target Group (students, workers...)	Bachelor student	Master students	SME personnels				
Target Group Level	3rd year B.IE onward	1st year M.IE onward					
Assesement Method	Project presentation, Assessment rubric for teamwork						
Teaching Material							
Equipment		Data Set					
Multimedia							
Content URL							
Class requirements (equipment that participants should bring)	Computer						
Prerequisites (previous modules that student should attend)							
Total duration (Hrs)	9						

Table 4: Domain 1 – Syllabus Module 4: “Remote Production Control”

D1: Industrial Engineering - Skill Set “Smart Production Management” - Module “Integrated Simulation and Optimization”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
SHYFTE 4.0	Industrial Engineering and Management							
Shyfte Domain Curriculum (sub domain)	Production Management and Manufacturing System							
Skill Set	Smart Production Manag	Agile Manufacturing System						
Skill Level	Expert							
Module Title	Integrated Simulation and Optimization							
Module Acronym	SimOpt							
Module Description	Integration of simulation and optimization for Smart production and manufacturing system							
Keywords	Simulation	Optimization	Smart Production	Agile Manufacturing				
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
	1 Benefit of simulation and optimization		Lecture	Case study			3	
	2 Problem modeling and approach design		Team working group	Project assignment	. Data set		3	. Team working . Problem solving . Ability to work with data . Presentation . Decision making
	3 Integrating simulation and optimization		Team working group	Project assignment	. Data set . Simulation and Optimization software		3	
	4 Decision making		Team working group	Project assignment	. flow process mapping software . Data set		3	
Meta Skills	To make smarter decisions							
Module Outcomes	Students will be able to make smart decision using integrated simulation and optimization							
Target Group (students, workers...)	Bachelor student	Master students	SME personnels					
Target Group Level	3nd year B.IE onward	1st year M.IE onward						
Assesement Method	Assignment, Project presentation, Assessment rubric for teamwork							
Teaching Material								
Equipment	Simulation Software, Optimization Software	Data set						
Multimedia								
Content URL								
Class requirements (equipment that participants should bring)	Computer							
Prerequisites (previous modules that student should attend)								
Total duration (Hrs)	12							

Table 5: Domain 1 – Syllabus Module 5: “Integrated Simulation and Optimization”

D1: Industrial Engineering - Skill Set “Agile Manufacturing System” - Module “Rapid Prototype”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
Shyfte 4.0	Industrial Engineering and Management						
Shyfte Domain Curriculum (sub domain)	Production Management and Manufacturing System						
Skill Set	Agile Manufacturing System						
Skill Level	Skills Level Intermediate						
Module Title	Rapid Prototype						
Module Acronym	Rapid Prototype						
Module Description	This course includes the machinery and techniques behind 3D printing, machining, and 2D prototyping.						
Keywords	Data collection	Manufacturing system	Production process				
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill	Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill	
	1 Rapid prototyping technology and its impact to manufacturing industry	Lecture			1	Problem solving Ability to work with data	
	2 SolidWorks Application	Lecture	Practical Exercise	Solid work software	2		
	3 3D SolidWorks Application	Team working group	Project assignment	Solid work software, Product Prototype	3		
	4 Additive manufacturing technologies	Team working group	Project assignment	3D Printing Machine	6		
Meta Skills	To be a product designer						
Module Outcomes	Students will understand the available prototyping processes, and knowledge of the machinery and tools to bring the product through the prototyping stage.						
Target Group (students, workers...)	Bachelor student	Master students	SME personnels				
Target Group Level	3rd year B.IE onward	1st year M.IE onward					
Assesement Method	Assignment, Project presentation, Assessment rubric for teamwork						
Teaching Material							
Equipment	Simulation Software	Flow process mapping software	Data set				
Multimedia							
Content URL							
Class requirements (equipment that participants should bring)	Computer						
Prerequisites (previous modules that student should attend)							
Total duration (Hrs)	12						

Table 6: Domain 1 – Syllabus Module 6: “Rapid Prototype”

D1: Industrial Engineering - Skill Set “Agile Manufacturing System” - Module “Automatic Data Collecting System”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
SHYFTE 4.0	Industrial Engineering and Management							
Shyfte Domain Curriculum (sub domain)	Production Management and Manufacturing System							
Skill Set	Agile Manufacturing Syst	Quality System 4.0						
Skill Level	Skills Level Intermediate							
Module Title	Automatic Data Collecting System							
Module Acronym	DCS							
Module Description	Modern manufacturing processes produce an enormous amount of data that, if collected and properly utilized, can provide valuable information that can aid enterprise in making business decisions and lead to significant competitive advantage. This module will make students This module will make student understand an importance of data collection system in manufacturing.							
Keywords	Data collection	Manufacturing system	Production process					
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
1	Type of data and recording devices		Lecture	Practical Assignment	Demonstration and hands on (learning by doing)		1	Decision making skill
2	Identify the source of collecting data		Team working group	Project assignment	Device assembly kits		2	Ability to work with data
3	Set up and simulate the process		Team working group	Project assignment	Device assembly kits, Data Set		2	Ability to use and interact with computes and smart machines
4	Design the data collecting system		Team working group	Project assignment	Device assembly kits and computer		2	Presentation skill Infographic communication skill
5	Collecting the data from the process		Team working group	Project assignment	Device assembly kits and computer		3	
6	Import the data to computer		Team working group	Project assignment	Device assembly kits and computer		1	
7	Display the results		Team working group	Project assignment	Infographic software/on-line sharing application		1	
Meta Skills	To be an production engineer for smart manufacturing process							
Module Outcomes	Students will design the automatic data collecting system for manufacturing							
Target Group (students, workers...)	Bachelor student	Master students	SME personnels					
Target Group Level	3rd year B.IE onward	1st year M.IE onward						
Assesement Method	Assignment, Project presentation, Assessment rubric for teamwork							
Teaching Material								
Equipment	Data collecting devices	Data collecting software	Data set					
Multimedia								
Content URL								
Class requirements (equipment that participants should bring)	Computer							
Prerequisites (previous modules that student should attend)								
Total duration (Hrs)	12							

Table 7: Domain 1 – Syllabus Module 7: “Automatic Data Collecting System”

D1: Industrial Engineering - Skill Set “Intelligence Quantitative Analysis” - Module “Decision Making with Big Data”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
SHYFTE 4.0	Industrial Engineering and Management							
Shyfte Domain Curriculum (sub domain)	Quantitative Analysis							
Skill Set	Intelligence Quantitative Analysis							
Skill Level	Intermediate							
Module Title	Decision Making with Big Data							
Module Acronym	DMBD							
Module Description	Utilizing big data in making strategic decision							
Keywords	Big Data	Decision Making	Data Analytics					
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
	1 Introduction to data analytics		Lecture	Case study			2	. Team working . Problem solving . Ability to work with data . Presentation . Decision making
	2 Big data and data preparation		Lecture	Group assignment	Business case Analytics software		4	
	3 Data analytics tools and techniques		Lecture	Group assignment	Business case Analytics software		4	
	4 Case study		Team working group	Project assignment			2	
Meta Skills	To understand the use of data to make smarter decisions							
Module Outcomes	Students will be able to perform basic big data analytics for decision making							
Target Group (students, workers...)	Bachelor student	Master students	SME personnels					
Target Group Level	3rd year B.IE onward	1st year M.IE onward						
Assesement Method	Assignment, Project presentation							
Teaching Material								
Equipment	Business case Analytics software	Data set						
Multimedia								
Content URL								
Class requirements (equipment that participants should bring)	Computer							
Prerequisites (previous modules that student should attend)								
Total duration (Hrs)	12							

Table 8: Domain 1 – Syllabus Module 8: “Decision Making with Big Data”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
SHYFTE 4.0	Industrial Engineering and Management							
Shyfte Domain Curriculum (<i>sub domain</i>)	Organizational Transformation & Digital Strategic Management & Business Revolution for Industry 4.0							
Skill Set	Human Resource Management							
Skill Level	Skills Level Beginner							
Module Title	Human Resource Management for Industry 4.0							
Module Acronym	HRM							
Module Description	Human Resource Management is a specialization within the field of Management that encompasses several functions including the recruitment, selection, and maintenance of a qualified, motivated, and productive workforce dealing with "people-related" issues, it is important that you are introduced to the major topics associated with managing people in the context for Industry 4.0. Furthermore, this course will be useful no matter what career path you pursue since it addresses issues that will have an impact on you in the workplace for Industry 4.0.							
Keywords	HR Analytical	HR4.0	skill development					
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
	1 Introducing People Management and Analytics		Lecture		Text book		6	Team working Problem solving Presentation Adaptability Collaboration
	2 Attracting the Right Talent : Strategic HR Planning, Job Analysis and Job Design, Recruitment and Selection		Lecture	Class Activity	Text book			
	3 Developing People (Training and Development) : Innovation, Knowledge, Creativity and skill development		Lecture	Team working / Case Study	Text book / Real Case			
	4 Maintaining Human Resources and Creating Value through People		Lecture	case study / Workshop	Text book / Real Case			
	5 HR transformation : HR agility, Digital Workplace,		case study	Team working	Text book / Real Case			
Meta Skills	To be a young data analyst and entrepreneur							
Module Outcomes	Students will identify each of the major HRM functions for Industry 4.0							
Target Group (<i>students, workers...</i>)	Bachelor student	Master students	SME personnels					
Target Group Level	3rd-4th year BS onward	1st-2nd year MS onward						
Assesement Method	Assignment, Project presentation							
Teaching Material								
Equipment								
Multimedia								
Content URL								
Class requirements (<i>equipment that participants should bring</i>)	Computer							
Prerequisites (<i>previous modules that student should attend</i>)								
Total duration (<i>Hrs</i>)	6							

Table 9: Domain 1 – Syllabus Module 9: “HR for industry 4.0”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
Shyfte Domain Curriculum (sub domain)	Industrial Engineering and Management							
Skill Set	Planning/Leading/Organizing/Controlling							
Skill Level	Skills Level Beginner							
Module Title	Digital Age Organization							
Module Acronym	DAO							
Module Description	This module will provide the knowledge of digital age organization regarding orgnaizational management including planning/leading/organizing/controlling and business ecosystem							
Keywords	Planning	Leading	Organizing	Controlling				
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
	1 The Knowledge of Management Process		Lecture		Documents		1	Planning/Leading/Organizing/Controlling
	2 Planning/Organizing/Leading/Controlling in the Industry 4.0		Lecture		Case Studies/Assignment		1	
	3 Business Ecosystem & Value Chain		Lecture		Case Studies/Assignment		1	
Meta Skills	To be a young data analyst and entrepreneur							
Module Outcomes	Students will understand the concept of digital age organization based on organizational management							
Target Group (students, workers...)	Bachelor student	Master students	SME personnels					
Target Group Level	3rd-4th year BS onward	1st-2nd year MS onward						
Assesement Method	Assignment							
Teaching Material								
Equipment								
Multimedia								
Content URL								
Class requirements (equipment that participants should bring)	Computer							
Prerequisites (previous modules that student should attend)								
Total duration (Hrs)	3							

Table 10: Domain 1 – Syllabus Module 10: “Digital Age Organization”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
Shyfte	Industrial Engineering and Management						
Shyfte Domain Curriculum (sub domain)	Digital Strategic Management & Business Revolution for Industry 4.0						
Skill Set	New Media Literacy						
Skill Level	Skills Level Beginner						
Module Title	Role of Data for Future Organization						
Module Acronym	ROD						
Module Description	Data is critical for effective and efficient business operations, and managers need to understand why they need data and how data impacts the business. This module will explain how to acquire the right quality of data that is suitable for the organization in order to deliver timely insights when required by the managers. Also, this module will allow students to understand how to design databases and basic functions of SQL.						
Keywords	Database	SQL	Data Management				
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill
	1 The Importance of Data in Business		Lecture	Case study		5	Problem solving Analytical skill
	2 Database design for Business function.		Lecture	Case assignment	Database		
	3 Database normalization.		Lecture and Demonstration	Case assignment	Database		
	4 SQL functions.		Lecture and Demonstration	Case assignment	Database and SQL software		
Meta Skills	To be a young data analyst and entrepreneur						
Module Outcomes	Students will understand how to design the database to suit the requirements from customers. Also, they can design a database and use basic SQL to improve many business processes.						
Target Group (students, workers...)	Bachelor student	Master students	SME personnels				
Target Group Level	3rd-4th year BS onward	1st-2nd year MS onward					
Assesement Method	Assignment						
Teaching Material							
Equipment	Database Software	SQL software	Data set				
Multimedia							
Content URL							
Class requirements (equipment that participants should bring)	Computer						
Prerequisites (previous modules that student should attend)							
Total duration (Hrs)	5						

Table 11: Domain 1 – Syllabus Module 11: “Role of Data for Future Organisations”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
Shyfte 4.0	Industrial Engineering and Management						
Shyfte Domain Curriculum <i>(sub domain)</i>	Digital Strategic Management & Business Revolution for Industry 4.0						
Skill Set	Communication						
Skill Level	Skills Level Intermediate						
Module Title	Communication for Industry 4.0						
Module Acronym	COM						
Module Description	Communication for Industry 4.0, which is essentially a focus on communication within two-person relationships. This course presents concepts essential to understanding the complex dynamics that go into constructing and maintaining our relationships, offering a multitude of research-based insights that will help students better understand themselves, their relationship partners, and relationship dynamics. The concepts presented here can be applied to relationships of all types--personal and professional: family, friends, romantic partners, co-workers, and supervisors. This module combines the science of data visualization with the art of graphic design to help you communicate complex information more accurately and effectively. By transforming data sets into visual graphics						
Keywords	Communication	Organizational Communication	Data Visualization				
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill	Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill	
1	Interpersonal Communication	Lecture	Case study	Text book	9	Team working Problem solving Presentation Adaptability Collaboration Communication	
2	Group Communication	Lecture	Case study	Text book			
3	Organizational Communication	Lecture	Class Activity	Text book / Real Case			
4	Communication Strategies :	Lecture	Project assignment	Text book / Real Case			
5	Data Visualization	Workshop		Text book			
Meta Skills	To be a young data analyst and entrepreneur						
Module Outcomes	Students will understand self-concept and its relationship to communication , Recognize and describe appropriate strategies for self-disclosure and learn how to tell data stories with visualizations.						
Target Group <i>(students, workers...)</i>	Bachelor student	Master students	SME personnels				
Target Group Level	3rd-4th year BS onward	1st-2nd year MS onward					
Assesement Method	Assignment, Project presentation, Assessment for teamwork, Workshop						
Teaching Material							
Equipment	Computer						
Multimedia							
Content URL							
Class requirements <i>(equipment that participants should bring)</i>	Computer						
Prerequisites <i>(previous modules that student should attend)</i>							
Total duration (Hrs)	9						

Table 12: Domain 1 – Syllabus Module 12: “Communication for industry 4.0”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
SHYFTE 4.0	Industrial Engineering and Management							
Shyfte Domain Curriculum (sub domain)	Digital Strategic Management & Business Revolution for Industry 4.0							
Skill Set	Decision-making skills	Data analytics skills						
Skill Level	Skills Level Intermediate							
Module Title	Business Intelligence							
Module Acronym	BI							
Module Description	Business intelligence involves analyzing data sets and software programs to help organizations make better business decisions. In this module, the student will understand the concept of Business Intelligence and the different types of Business Intelligence tools in the current market. Also, they will familiarize with “Power BI” (Business Intelligence software) to make effective decisions for companies based on data.							
Keywords	Business Intelligence	Making decision						
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
1	The evolution of Business Intelligence		Lecture	Case study		1	Analytical Skill Problem solving Presentation	
2	Business Intelligence tools in the market		Lecture	Case study		1		
3	Power BI - Introduction and Implementation		Lecture and Demonstration	Assignment	Power BI software Data set	1		
4	Power BI – Presentation of Dashboard		Lecture and Demonstration	Assignment	Power BI software Data set	1		
5	Power BI – Analysis of market data		Lecture and Demonstration	Assignment	Power BI software Data set	1		
Meta Skills	To be a young data analyst and entrepreneur							
Module Outcomes	Students will understand the importance and different levels of Business Intelligence for organizations. The students will have ability to have hands-on experience with “Power BI” to analyze data and use the insights to support decision-making.							
Target Group (students, workers...)	Bachelor student	Master students	SME personnels					
Target Group Level	3rd-4th year BS onward	1st-2nd year MS onward						
Assesement Method	Assignment							
Teaching Material								
Equipment	Power BI	Data set	Data set					
Multimedia								
Content URL								
Class requirements (equipment that participants should bring)	Computer							
Prerequisites (previous modules that student should attend)								
Total duration (Hrs)	5							

Table 13: Domain 1 – Syllabus Module 13: “Business Intelligence”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus					
Shyfte	Industrial Engineering and Management					
Shyfte Domain Curriculum (sub domain)	Organizational Transformation					
Skill Set	Teamwork/Decision Making/Complex Problem Solving					
Skill Level	Skills Level Expert					
Module Title	Business Strategic Approach					
Module Acronym	BSA					
Module Description	This module will provide the knowledge of digital business strategic approach for the industry 4.0					
Keywords	Business Model	Leading	New Product Development			
Topics / Teaching Plan	Topics		Teaching Plan			
	Hard Skill		Delivery Method (gamification, case study, simulation...)	Teaching Material	Duration (Hrs)	Soft Skill
1	The Role and Impact of Industry 4.0 on the Business Strategy / Digital Business Strategy		Business Cased Article Software for business simulation game Equipment for Smart Classroom	Documents	3	Teamwork/Decision Making/Complex Problem Solving
2	Key Performance Indicator / Key Objective Results for Digital Firms		Teaching Document/ Slide		3	
Meta Skills	To be a young data analyst and entrepreneur					
Module Outcomes	Students will understand how to develop the digital business strategy in the environment of industry 4.0					
Target Group (students, workers...)	Bachelor student	Master students	SME personnels			
Target Group Level	3rd-4th year BS onward	1st-2nd year MS onward				
Assesement Method	Assignment, Project presentation					
Teaching Material						
Equipment	Computer					
Multimedia						
Content URL						
Class requirements (equipment that participants should bring)	Computer					
Prerequisites (previous modules that student should attend)						
Total duration (Hrs)	6					

Table 14: Domain 1 – Syllabus Module 15: “Business Strategic Approach”

3.2 Domain 2 Skills 4.0 Learning Programs: Software Engineering and Big data analysis

In the Learning framework for the second domain, “Software Engineering and Big data Analytics”, four modules are described in detail:

SkS-D2-1: BigData Science Analytics (5 Modules)

- **SkS-D2-2: BigDataSystem Management (4 Modules)**
- **SkS-D2-3: Cloud Computing System (4 Modules)**
- **SkS-D2-4: AI for BigData Analysis (4 Modules)**


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
Shyfte 4.0	Software Engineering and Big data analysis							
Shyfte Domain Curriculum (<i>sub domain</i>)	BigData Science Analysis,BigData System Management, Cloud Computing System							
Skill Set	BigData tool kits	BigData Mining						
Skill Level	Beginner							
Module Title	Principle and Application of BigData Technology							
Module Acronym	PABT							
Module Description	This module introduces the principle technology of BigData. By using an online experiment platform, students will grasp the knowledge of HDFS, HBase, MapReduce by a series of experiments on class. Students should have Java programming skill and familiar with Unix operating system before this module.							
Keywords	Hadoop	HDFS	Hbase	MapReduce				
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
1	Understand the framework of Hadoop		Lecture	discussion-based seminar	Slides		2hrs	Basic theory of industry application Presentation skill; Ability to implement projects
2	Ability of HDFS programming		Lecture	lab	Slides & experimental platform		4hrs	
3	Ability of HBase programming		Lecture	lab	Slides & experimental platform		4hrs	
4	Ability of MapReduce Programming		Lecture	lab	Slides & experimental platform		8hrs	
5								
Meta Skills	To be a senior programmer of BigData							
Module Outcomes	Students will design a bigdata system by using HDFS, HBase, and MapReduce							
Target Group (<i>students, workers...</i>)	Bachelor student	Master students	SME personnels					
Target Group Level	2nd year B.IE onward	1st year M.IE onward						
Assesement Method	Assignment, Project presentation, Assessment rubric for teamwork							
Teaching Material	Lecture, case study, team working							
Equipment	Data collection system	Experimental System						
Multimedia								
Content URL								
Class requirements (<i>equipment that participants should bring</i>)	Computer							
Prerequisites (<i>previous modules that student should attend</i>)								
Total duration (<i>Hrs</i>)	18hrs							

Table 15: Domain 2 – Syllabus Module 1: “Principal and Application of BigData Technology”

	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
Shyfte Domain	Software Engineering and Big data analysis							
Shyfte Domain Curriculum (sub domain)	AI for Bigdata Analysis							
Skill Set	BigData tool kits	BigData Mining						
Skill Level	Intermediate							
Module Title	Comprehensive Training of Artificial Intelligence							
Module Acronym	CTAI							
Module Description	The module of "Comprehensive Training of Artificial Intelligence" is a comprehensive frontier discipline, which is an important discipline to teach the professional knowledge of artificial intelligence and the related machine learning topic. On the basis of the fundamental ability of mathematics and programming, this module gives a comprehensive explanation of several branches of artificial intelligence in terms of supervised learning, unsupervised learning, semi-supervised learning, data dimensionality reduction, and recommended algorithms. By teaching artificial intelligence course, students can master the basic principles of artificial intelligence technology. It can also enhance students' logical thinking ability and experimental practice ability. Moreover, it is a key module for students to master the principles, methods and technologies for computer vision, deep learning and also other major research fields.							
Keywords	Supervised learning	Unsupervised learning	Semi-supervised learning	Data dimensionality reduction	Recommended algorithm			
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
1	Skills of solving Supervised learning Problems		Lecture	Training cases Experimental learning	Slides Data set(UCI)& Experimental platform		4hrs	.Team working .Complex Problem solving .Ability to work with Bigdata .Presentation skill .Infographic communication
2	Skills of solving Unsupervised learning Problems		Lecture	Training cases Experimental learning	Slides Data set(UCI)& Experimental platform		4hrs	
3	Skills of solving Semi-supervised learning Problems		Lecture	Training cases Experimental learning	Slides Data set(UCI)& Experimental platform		4hrs	
4	Able to conduct BigData reduction		Lecture & Team working group	Team working group + Project assignment	Slides Data set(UCI)& Experimental platform		4hrs	
5	Able to solve Recommendation issues		Lecture & Team working group	Team working group + Project assignment	Slides Data set(UCI)& Experimental platform		4hrs	
Meta Skills	To be a senior Data Analyst of Bigdata							
Module Outcomes	Students are able to analyze complex issues related to Supervised learning, Unsupervised learning,Semi-supervised learning, data reduction, and recommendation problems							
Target Group (students, workers...)	Bachelor student	Master students	SME personnels					
Target Group Level	2nd year B.IE onward	1st year M.IE onward						
Assesement Method	Assignment, Project presentation, Assessment rubric for teamwork							
Teaching Material	Lecture, case study, team working							
Equipment	Data analysis system	Experimental System						
Multimedia								
Content URL								
Class requirements (equipment that participants should bring)	Computer							
Prerequisites (previous modules that student should attend)								
Total duration (Hrs)	20hrs							

Table 16: Domain 2 – Syllabus Module 2: “Comprehensive Training of AI”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
Shy SHYFTE 4.0	Software Engineering and Big data analysis						
Shyfte Domain Curriculum (sub domain)	BigData Science Analysis,BigData System Management						
Skill Set	Decision Making Based BigData		Analyze BigData	Team Working			
Skill Level	Intermediate						
Module Title	Critical Thinking Oriented BigData						
Module Acronym	CTOB						
Module Description	Most current issues of big data focus on addressing the technical, managerial and social challenges, with little reference to critical thinking that could significantly aid to guarantee the quality of data and lead to rational decision-making. This module will make students build up consciousness of critical thinking and, through case studies and group-based activities, clearly understand the relationship of critical thinking and big data analytics, inspiring them to apply thinking skills to deal with the big data challenges.						
Keywords	Big data	Critical thinking	Data quality	Decision making			
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill
	1 Define critical thinking oriented Big data.		Lecture	question & discussion	Slides	1hrs	Team working; Communication; Complex problem solving; Ability to work with Big data
	2 Identify and classify a preliminary set of critical thinking skills under the conception of Big data.		Lecture/case study	discussion-based seminar	Slides & lecture notes	3hrs	
	3 Examine and verify the data quality from the perspective of BigData analysis.		Lecture/case study	Team working group + Project activity	Slides & lecture notes	4hrs	
	4 Apply critical thinking skills and analyze the affecting factors of data quality based on decision making cases.		Lecture/case study	Team working group + Project activity	Slides & lecture notes	4hrs	
Meta Skills	To be a senior data Analyst of deep insight.						
Module Outcomes	Students will be able to critically analyze and evaluate data quality, making rational decisions.						
Target Group (students, workers...)	Bachelor student	Master students	SME personnels				
Target Group Level	2nd year B.IE onward	1st year M.IE onward					
Assesement Method	Assignment, Project presentation, Assessment rubric for teamwork						
Teaching Material	Lecture, seminar, team working						
Equipment							
Multimedia							
Content URL							
Class requirements (equipment that participants should bring)	computer	paper & pen					
Prerequisites (previous modules that student should attend)							
Total duration (Hrs)	12hrs						

Table 17: Domain 2 – Syllabus Module 3: “Critical thinking Oriented BigData”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
SHYFTE 4.0	Software Engineering and Big data analysis							
Shyfte Domain Curriculum (sub domain)	BigData Science Analysis,BigData System Management, Cloud Computing System,AI for Bigdata Analysis							
Skill Set	BigData tool kits	BigData Analysis						
Skill Level	Expert							
Module Title	Smart Decision Making with BigData							
Module Acronym	SDMB							
Module Description	This module mainly introduces common data analysis knowledge and skills as well as intelligent decision-making based on data analysis. Through the learning of this module, students can master the process of data analysis, commonly used data analysis methods, data visualization methods and main decision-making models, so as to lay a good foundation for data analysis of smart decision-making based on big data.							
Keywords	Data analysis method	decision-making model	Data visualization					
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
	1 Background knowledge of smart decision making		Lecture	Training cases Experimental learning	Slides		2hrs	..Knowledge of statistical analysis .. Data mining skills ..Presentation skill ..Team working
	2 Data and data processing		Lecture	Training cases Experimental learning	Slides		4hrs	
	3 Data modeling and analysis		Lecture	Training cases Experimental learning	Slides		4hrs	
	4 Visual analysis		Lecture	Team working group	Slides& Experimental platform		2hrs	
	5 Case analysis		Lecture & Team working group	Team working group + Project assignment	Slides& Experimental platform		4hrs	
Meta Skills	To be a senior Data Analyst of Bigdata							
Module Outcomes	Students master common data analysis methods and data visualization methods, and can use a reasonable decision-making model to complete smart decision-making							
Target Group (students, workers...)	Bachelor student	Master students	SME personnels					
Target Group Level	2nd year B.IE onward	1st year M.IE onward						
Assesement Method	Assignment, Project presentation, Assessment rubric for teamwork							
Teaching Material	Lecture, case study, team working							
Equipment	Data analysis system	Experimental System						
Multimedia								
Content URL								
Class requirements (equipment that participants should bring)	Computer							
Prerequisites (previous modules that student should attend)								
Total duration (Hrs)	16hrs							

Table 18: Domain 2 – Syllabus Module 4: “Smart Décision Making with BigData”

3.3 Domain 3 Skills 4.0 Learning Programs: Wireless Networks Analytics

6 Modules are defined in the Learning framework “Wireless Networks Analytics”. It is composed by five following Skill Sets:

- **SkS-D3-1: Wireless Networks (3 Modules)**
- **SkS-D3-2: Wireless Security (1 Modules)**
- **SkS-D3-3: Wireless Propagation (3 Modules)**
- **SkS-D3-4: IoT System (2 Modules)**
- **SkS-D3-5: Energy Management (3 Modules)**


		SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
SHYFTE Domain Curriculum (sub domain)		Wireless Network and Analytics						
SHYFTE Domain Curriculum (sub domain)		Not Applicable						
Skill Set	Energy Management							
Skill Level	Beginners							
Module Title	Introduction to Energy Management							
Module Acronym	ECOXXX							
Module Description	This module will cover the core concept of Energy Management System, Energy Management System Standards (EnMS) and energy efficiency in Engineering projects. Participants will also be exposed to the EnMS in a Project Life Cycle with actual case study.							
Keywords	Energy Management	Energy Efficiency	Project Life Cycle					
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
1	Energy Management Systems		Lecture	Group discussion	Video on Energy Management Systems. https://video.search.yahoo.com/search/vid/eo7fr-mcafee&p=Introduction+to+energy+management+systems+videos#id=5&vid=e01de0edbb5da742c3413caf57ed8059&action=view		1	Team work Presentation Infographic communication
2	Energy Management Systems Standards (EnMS)		Case study	Group discussion	Case study on ISO50001 Energy Management Systems. https://video.search.yahoo.com/search/vid/eo7fr-mcafee&p=energy+management+standards+video+youtube#id=3&vid=ebb722da009808197adb3951beca4367&action=view		1	
3	Energy Efficiency in Engineering Projects		Case study	Group discussion	Video on energy efficiency in engineering projects. URL		2	
4	EnMS in Project Life Cycle		Case study	Project assignment	Case study on selected project life cycle. URL https://video.search.yahoo.com/search/vid/eo7fr-mcafee&p=energy+management+system&fr=mcafee#id=4&vid=13c2b9c0fc2e71168fea4e9a345439d4&action=view		2	
Meta Skills	To be a wireless network engineer							
Module Outcomes	Participants will be able to explain the need for Energy Management in Engineering Systems							
Target Group (students, workers...)	Master students	SME personnels						
Target Group Level	Not applicable							
Assesment Method	Project report, Project presentation, Assessment rubric for teamwork							
Teaching Material								
Equipment	None							
Multimedia	Lecture notes							
Content URL	Video and case study report URL							
Class requirements (equipment that participants should bring)	Computer							
Prerequisites (previous modules that student should attend)	Introduction to IR4.0							
Total duration (Hrs)	6							

Table 19: Domain 3 – Syllabus Module 1: “Introduction to Cybersecurity”

		SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus					
SHYFTE 4.0		Wireless Network and Analytics					
Shyfte Domain Curriculum (sub domain)		Not Applicable					
Skill Set		Energy Management					
Skill Level		Intermediate					
Module Title		Renewable Energy for Wireless Networks					
Module Acronym		ECCXXX					
Module Description		This course will describe energy management topics related to Wireless Networks such as energy harvesting, wireless power transfer (WPT) and simultaneous wireless information and power transfer (SWIPT). Lectures and invited lectures will highlight topics in the current industry practices and a workshop on issues between spectral efficiency and energy efficiency will be covered.					
Keywords		Energy management		Energy efficiency		Spectral efficiency	
Topics / Teaching Plan		Topics		Teaching Plan			
		Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material	
						Duration (Hrs)	
						Soft Skill	
1		Introduction to Renewable Energy in Wireless Communications		Lecture		Group discussion	
						Lectures (by Course Coordinator) and Invited Lectures (by Industry Players), url : https://www.youtube.com/watch?v=SdZODbTO10	
2		Energy Harvesting in Wireless Communications		Case study		Group work	
						Case study on energy harvesting for IoT	
3		The Concept of Wireless Power Transfer (WPT)		Lecture		Project assignment	
						Use case on WPT for 5G	
4		Simultaneous Wireless Power Transfer (SWIPT)		Lecture		Project assignment	
						Use case on SWIPT for 5G	
Meta Skills		To be a wireless network engineer with energy management skills and knowledge					
Module Outcomes		Students will be able to use the concept of energy management to design and operate wireless networks					
Target Group (students, workers...)		Master students		SME personnels			
Target Group Level		Not applicable					
Assesement Method		Project report, Project presentation, Assessment rubric for teamwork					
Teaching Material							
Equipment		None					
Multimedia		Lecture notes					
Content URL		Video and case study report URL					
Class requirements (equipment that participants should bring)		Computer					
Prerequisites (previous modules that student should attend)		Introduction to Energy Management					
Total duration (Hrs)		15					

Table 20: Domain 3 – Syllabus Module 2: “Renewable Energy for Wireless Networks”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
Wireless Network and Analytics								
Shyfte Domain Curriculum (sub domain)	Not Applicable							
Skill Set	Energy Management							
Skill Level	Expert							
Module Title	Green Energy Wireless Network							
Module Acronym	ECCXXX							
Module Description	The greening of telecommunication has gained significant attention to improve energy efficiency and reduce the environmental impact. This module will focus on the sustainability in wireless networks, the importance of sustainable telecommunication and how SME business can be model for energy efficiency based on wireless energy usage. Last but not least this module introduces some wireless energy optimisation techniques to be applied to the model.							
Keywords	Green Energy	Distributed System	Cloud	Wireless Network	Renewable Energy	Energy Management		
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
1 Sustainability in telecommunication network	Lecture		Group discussion using edtech tools (Kahoot/Padlet/etc)		. Video on IoT applications- URL of video:xxx		3	Team Work, Problem Solving and Critical Thinking and Presentation Skill
2 Sustainable business telecommunication business model	Problem based learning		Group work and gamification		Energy Management in Wireless Sensor Networks : https://hal.archives-ouvertes.fr/hal-01283728/document		5	
3 Wireless Energy Usage and Modelling							5	
4 Wireless Energy Optimisation Techniques	Blended Learning		Group discussion using Kahoot/Padlet		give material to learn on this on their own, start class with Kahoot.		5	
Meta Skills	To be a wireless network manager							
Module Outcomes	Participants will be able to: 1- explain the concept of energy management in general. 2- model energy usage based on data provided for sustainable business model. 3- apply appropriate techniques for energy optimisation based on the model identified.							
Target Group (students, workers...)	Master students	SME personnels						
Target Group Level	Not applicable							
Assesement Method	Project report, Project presentation, Assessment rubric for teamwork							
Teaching Material								
Equipment	Matlab							
Multimedia	Lecture notes	URL						
Content URL	Video and case study report URL	https://hal.archives-ouvertes.fr/hal-01283728/document						
Class requirements (equipment that participants should bring)	Computer							
Prerequisites (previous modules that student should attend)	Renewable Energy for Wireless Networks							
Total duration (Hrs)	18							

Table 21: Domain 3 – Syllabus Module 3: “Green Energy Wireless Networks”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
Wireless Network and Analytics							
Shyfte Domain Curriculum (sub domain)	Not applicable						
Skill Set	IoT System						
Skill Level	Intermediate						
Module Title	Data Acquisition and Analysis						
Module Acronym	ECCXXXX						
Module Description	This course will cover the IoT framework for data acquisition and analysis to solve the problem. Participants will be learning about the programming framework for IoT, cloud infrastructure and data management. Advanced concepts such as distributed data analysis and fog computing will be covered toward the end of the course.						
Keywords	IoT framework	Cloud	Distributed system	Fog computing			
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill	Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill	
1	Programming Framework of IoT	Lecture	Group discussion	. Video on IoT available framework- URL of video: 1. https://www.youtube.com/watch?time_continue=224&v=w6ygDCTSOug&feature=emb_logo 2. https://www.youtube.com/watch?v=Urwbe	1	.Problem Solving .Critical thinking .Team work . Presentation . Infographic communication	
2	IoT cloud infrastructure	IoT hands-on project	Group work	. LoRA kits, Cloud server	3		
3	IoT Data and Knowledge Management	IoT hands-on project	Group work	. LoRA kits, Cloud server	3		
4	Distributed Data Analysis	IoT hands-on project	Group work	. Matlab toolbox	3		
5	Opportunities and Challenges	Case study	Group discussion	. Video on IoT opportunities and challenges - URL of video: 1. https://www.youtube.com/watch?v=x-KBN5cPGww 2. https://www.youtube.com/watch?v=Pwc0cX43sec	1		
6	Fog Computing	Lecture	Group discussion	. Video on Fog computing - URL of video:1. https://www.youtube.com/watch?v=K2vLNtVJcQE 2. https://www.youtube.com/watch?v=jLW67YtZy	1		
Meta Skills	To be a wireless network engineer						
Module Outcomes	Participants will be able to build a basic IoT data acquisition and perform data analysis		Participants will be able to understand the opportunities and challenges of IoT system				
Target Group (students, workers...)	Master students	SME personnels					
Target Group Level	Not applicable						
Assessment Method	Project report, Project presentation, Assessment rubric for teamwork						
Teaching Material							
Equipment	LoRa kits	Matlab toolbox	Cloud server				
Multimedia	Lecture notes						
Content URL	Video URL						
Class requirements (equipment that participants should bring)	Computer						
Prerequisites (previous modules that student should attend)	Introduction to IoT						
Total duration (Hrs)	12						

Table 22: Domain 3 – Syllabus Module 4: “Data Acquisition and Analysis”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
Wireless Network and Analytics							
Shyfte Domain Curriculum (sub domain)	Not applicable						
Skill Set	IoT System						
Skill Level	Expert						
Module Title	Data Governance and Management						
Module Acronym	ECCXXX						
Module Description	Data governance and management is a vital system in IoT that involves accessibility, relevance, integrity, and security. This module will cover the critical concept of IoT Data Security, Privacy and Trust, IoT architecture and interoperability. Participants will also learn about the standard consideration, performance and security challenges in IoT. Lastly, an exercise on building the security In From bottom up will be provided.						
Keywords	Data management	Data governance	IoT interoperability				
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill	Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill	
1	IoT Data Security, Privacy and Trust	Lecture	Role play	.Role play scene setup .Article/video on IoT data security, privacy and trust - URL of article/video: 1.https://medium.com/@iotap/internet-of-things-security-and-privacy-78bc0a41881b 2. https://www.coursera.org/lecture/iot/lecture-3-2-risks-privacy-and-security-GnJON,	1	.Problem Solving .Critical thinking .Team work . Presentation . Infographic communication	
2	IoT Standards, Architectures and Interoperability	Problem based learning	Group work	. LoRA kits, Cloud server	2		
3	Standard Considerations	Problem based learning	Group work	. LoRA kits, Cloud server	1		
4	Performance and Security in IoT	Problem based learning	Group work	. LoRA kits, Cloud server	2		
5	Security Challenges	Problem based learning	Group work	. LoRA kits, Cloud server	2		
6	Building Security In From the Bottom Up	Problem based learning	Group work	. LoRA kits, Cloud server	3		
Meta Skills	To be a wireless network manager						
Module Outcomes	Participants will be able to manage data and security issues in IoT system		Participants will be able to design IoT system from bottom up				
Target Group (students, workers...)	Master students	SME personnels					
Target Group Level	Not applicable						
Assessment Method	Project report, Project presentation, Assessment rubric for teamwork						
Teaching Material							
Equipment	LoRA kits	Matlab toolbox	Cloud server				
Multimedia	Lecture notes	Role play scene setup					
Content URL	Video URL						
Class requirements (equipment that participants should bring)	Computer						
Prerequisites (previous modules that student should attend)	Data acquisition and analysis						
Total duration (Hrs)	11						

Table 23: Domain 3 – Syllabus Module 5: “Data Governance and Management”


		SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus									
SHYFTE Domain Curriculum (sub domain)		Wireless Network and Analytics									
Skill Set		Not Applicable									
Skill Level		Beginner									
Module Title		Introduction to Cybersecurity									
Module Acronym		ECCOXX									
Module Description		With the increasing significance of wireless connectivity, the security and privacy aspect of the cyber network is becoming increasingly vital. This module will provide an introduction to the concept of cybersecurity, cyber attack and its countermeasure. One of real-time cyber threat detection and mitigation based on the actual case will be covered.									
Keywords		CybersecurityCountermeasurePrivacy									
Topics / Teaching Plan		Teaching Plan									
		Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)		Soft Skill	
1		Introduction to Cyber Attacks		LectureGroup discussion		Lectures (by Course Coordinator) Video on cyber attacks, URL of video: 1. https://www.youtube.com/watch?v=btZhrmK2zYA 2. https://www.youtube.com/watch?v=odPdwWNBK4 Movie: The Imitation Game		3		Interpersonal skills	
2		Cyber Attack Countermeasures		Case studyGroup work		Invited lectures (by Industry Players) Case study on cyber attacks countermeasures URL of video: 1. https://www.youtube.com/watch?v=iFgve5MUUnE 2. https://www.youtube.com/watch?v=7KCMK-LY-WM		6			
3		Real-time Cyber Threat Detection and Mitigation		LectureProject assignment		Lectures (by Course Coordinator) URL of video: 1. https://www.youtube.com/watch?v=Dk-ZgQ-bfy4 2. https://www.youtube.com/watch?v=zqvDu00aY8k		3			
Meta Skills		To be a wireless network engineer									
Module Outcomes		Students will be able to explain the concept of cyber security, attacks, countermeasures including detection and mitigation									
Target Group (students, workers...)		Master studentsSME personnels									
Target Group Level		Not applicable									
Assesement Method		Project report, Project presentation, Assessment rubric for teamwork									
Teaching Material											
Equipment		None									
Multimedia		Lecture notes									
Content URL		Video and case study report									
Class requirements (equipment that participants should bring)		Computer									
Prerequisites (previous modules that student should attend)		Introduction to IR4.0									
Total duration (Hrs)		12									

Table 24: Domain 3 – Syllabus Module 6: “Introduction to Cybersecurity”

3.4 Domain 4 Skills 4.0 Learning Programs: Artificial Intelligence

13 Modules are detailed for the Learning framework for the fourth domain, “Artificial Intelligence”. It is composed by the three main Skill Sets:

- **SkS-D4-1: Machine Learning (7 modules)**
- **SkS-D4-1: Optimization (5 modules)**
- **SkS-D4-1: AI Applications (5 modules)**


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
Shyfte 4.0	Artificial Intelligence						
Shyfte Domain Curriculum (sub domain)							
Skill Set	Machine Learning	Optimization	Artificial Intelligence Application				
Skill Level	Beginners						
Module Title	Introduction to Industrial Revolution 4.0						
Module Acronym	IIR 4.0						
Module Description	comprehensive coverage on stages of industrial revolutions, drivers and enablers of IR 4.0 as well as various opportunities, challenges brought by IR 4.0, and how to prepare to reap the benefits in organizations and individual perspective.						
Keywords	drivers	enablers	industry 4.0	revolutions			
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill		Delivery Method (gamification, case study, simulation...)	Teaching Material	Duration (Hrs)	Soft Skill	
	1 Evolvement of industrial revolutions		Lecture (face-to-face teaching method), Case study teaching (real case study analysis - group work through active learning method, e.g. fishbowl, jigsaw etc.)	Lecture notes, sets of real case study	1	. Team working . Problem solving . Analytical thinking . Decision making	
	2 drivers, enablers, compelling forces and challenges for IR 4.0				1		
	3 Related disciplines, system and technologies for enabling IR 4.0				1		
	4 Road to Industrial Revolution 4.0				1		
	5 Business issues in IR 4.0				1		
Meta Skills	students/trainee who aware on Industry revolution 4.0						
Module Outcomes	Students/trainee should be able to describe the various stages of industrial revolutions.		Students/trainee should be able to identify the drivers and enablers of Industry 4.0	Students/trainee should be able to Analyze the opportunities, challenges brought about by Industry 4.0 and how			
Target Group (students, workers...)	Bachelor student	Master students	SME personnels				
Target Group Level	2nd year B.Eng onward	1st year M.IE onward	all level				
Assesement Method	Project Group Assignment, Quizzes						
Teaching Material							
Equipment	sets of real case study	Lecture notes					
Multimedia							
Content URL							
Class requirements (equipment that participants should bring)	pen and papers						
Prerequisites (previous modules that student should attend)							
Total duration (Hrs)	5						

Table 25: Domain 4 – Syllabus Module 1: “Introduction to IR 4.0”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
Shyfte Domain Curriculum (sub domain)	Artificial Intelligence							
Skill Set	Machine Learning	Optimization	Artificial Intelligence Application					
Skill Level	Beginners							
Module Title	Fundamental of Artificial Intelligence							
Module Acronym	FAI							
Module Description	Introduction to basic definition and concept of artificial intelligence (AI). Comprehensive coverage on the related standardization of AI (ethical and trustworthiness), the types of artificial intelligence (narrow, general or super AI) and the benefits, challenges, risk as well as the future of AI.							
Keywords	Human intelligence	narrow AI	super AI	general AI	ethical	trustworthiness		
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
1	Artificial and Human Intelligence: An Introduction, history and current trends		Lecture (face-to-face teaching method), Case study teaching (real case study analysis - group work through active learning method, e.g. fishbowl, jigsaw etc.)		Lecture notes, sets of real case study		1	. Team working . Problem solving . Analytical thinking . Decision making
2	What is artificial intelligence (AI)? Narrow AI, General AI or Super AI.						1	
3	Artificial Intelligence: Benefits, Challenges and Risks						1	
4	Standardization of AI (ethical and trustworthiness)						1	
5	The Future of Artificial Intelligence – Human and Machine Together.						1	
Meta Skills	students/personnel who aware on Artificial intelligence							
Module Outcomes	Students/trainee should be able to explain the basic definition and concept of Artificial		Students/trainee should be able to identify types of Artificial Intelligence		Students/trainee should be able to Demonstrate understanding of the benefits, challenges and risks of Artificial Intelligence.			
Target Group (students, workers...)	Bachelor student	Master students	SME personnels					
Target Group Level	1st year B.Eng onward	1st year M.IE onward	all level					
Assesement Method	Project Group Assignment, Quizzes							
Teaching Material								
Equipment	sets of real case study	Lecture notes						
Multimedia								
Content URL								
Class requirements (equipment that participants should bring)	pen and papers							
Prerequisites (previous modules that student should attend)								
Total duration (Hrs)	5							

Table 26: Domain 4 – Syllabus Module 2: “Fundamental of AI”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
Shyfte 4.0	Artificial Intelligence						
Shyfte Domain Curriculum (sub domain)							
Skill Set	Machine Learning	Optimization	AI Application				
Skill Level	Skills Level Beginner						
Module Title	Structure for Problem Solving						
Module Acronym	SPS						
Module Description	Overview on the importance of structuring the problem solving through understanding problem definition and solution design from AI perspective.						
Keywords	Knowledge representation		State space graph	Intelligent agent			
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill	Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill	
1	Importance of structure of problem solving in AI	Lecture (face-to-face teaching method), Case study teaching (real case study analysis - group work through active learning method, e.g. fishbowl, jigsaw etc.), Real project (small scale) demonstration and mini project.		Lecture notes, sets of real case study, real project (small scale) for demonstration and mini project.	1	.Communication .Team working skills .Problem solving	
2	Understanding of knowledge representation and AI agent				1		
3	Defining graph theory and search strategies				2		
4	Designing and proposing structure of state space for AI solution				3		
5							
Meta Skills	to be an engineer who have a basic knowledge in developing AI solution						
Module Outcomes	Students/trainee able to explain the structure of problem solving, knowledge representation and artificial intelligence agent.		Students/trainee able to develop appropriate structure for artificial intelligence solution.				
Target Group (students, workers...)	Bachelor student	Master students	SME Personnel				
Target Group Level	1st year B.Eng onward	1st year M.Eng onward	all level				
Assesement Method	Quiz, Project presentation						
Teaching Material							
Equipment	Computer						
Multimedia							
Content URL							
Class requirements (equipment that participants should bring)							
Prerequisites (previous modules that student should attend)							
Total duration (Hrs)	7						

Table 27: Domain 4 – Syllabus Module 3: “Structure of Problem Solving”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
ShySHYFTE 4.0	Artificial Intelligence							
Shyfte Domain Curriculum (sub domain)								
Skill Set	Machine Learning	Optimization						
Skill Level	Skills Level Beginner							
Module Title	Supervised and Unsupervised Learning							
Module Acronym	SLUL							
Module Description	Transforming data into important features by understanding from machine learning views through machine learning process, learning types and machine learning techniques. Evaluation metrics to measure performance of machine learning methods on datasets helps students to gain insight AI approach to solve real world problems.							
Keywords	Supervised Learning	Unsupervised Learning	Machine Learning					
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
1	Defining types and methods how machine learns		Lecture (face-to-face teaching method), Case study teaching (real case study analysis - group work through active learning method, e.g. fishbowl, jigsaw etc.), Real project (small scale) demonstration and mini project.		Lecture notes, sets of real case study, real project (small scale) for demonstration, software platform for mini project (.ML tools .Datasets).		1	.Communication .Team working skills .Problem solving .Analytical thinking
2	Understanding of machine learning process						1	
3	Understanding supervised learning and unsupervised learning and evaluation metrics						2	
4	Designing and proposing machine learning method for problem solving						3	
5								
Meta Skills	to be an engineer who have a basic knowledge in machine learning method.							
Module Outcomes	Students/trainee able to explain the structure and process of machine learning.		Students/trainee able to develop appropriate machine learning method for artificial intelligence solution.					
Target Group (students, workers...)	Bachelor student	Master students	SME Personnel					
Target Group Level	1st year B.Eng onward	1st year M.Eng onward	technical staff					
Assesement Method	Quiz, Project presentation							
Teaching Material								
Equipment	Computer	software (.ML tools)						
Multimedia	video							
Content URL								
Class requirements (equipment that participants should bring)								
Prerequisites (previous modules that student should attend)								
Total duration (Hrs)	7							

Table 28: Domain 4 – Syllabus Module 4: “Supervised and Unsupervised Learning”


		SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus					
SHYFTE 4.0		Artificial Intelligence					
Shyfte Domain Curriculum (sub domain)							
Skill Set	Machine Learning	Optimization					
Skill Level	Skills Level Intermediate						
Module Title	Reinforcement Learning						
Module Acronym	RL						
Module Description	Introduction to the basic concept of reinforcement learning and types of reinforcement modeling behavior. Comprehensive coverage on formulating appropriate solutions and design intelligent reinforcement learning to solve problem in real world applications.						
Keywords	Reinforcement Learning	Machine Learning					
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill	Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill	
1	Defining concept and basic fundamental of Reinforcement Learning (RL)	Lecture (face-to-face teaching method), Case study teaching (real case study analysis - group work through active learning method, e.g. fishbowl, jigsaw etc.), Real project (small scale) demonstration and mini project.		Lecture notes, sets of real case study, real project (small scale) for demonstration and OpenAI Gym platform.	1	.Communication .Team working skills .Problem solving .Critical thinking. Analytical thinking	
2	Understanding real world applications and challenges in RL				1		
3	Understanding RL vs supervised learning and unsupervised learning				1		
4	Designing and modeling RL for problem solving				4		
5							
Meta Skills	to be an engineer who has a knowledge ad skills in developing/designing an intelligent reinforcement learning						
Module Outcomes	Students will be able to explain the basic concept of reinforcement learning and types of reinforcement modeling behavior		Student will be able to develop appropriate solutions and design intelligent reinforcement learning to solve problem in real world applications.				
Target Group (students, workers...)	Bachelor student	Master students	SME Personnel				
Target Group Level	2nd year B.Eng onward	1st year M.Eng onward	technical staff				
Assesement Method	Quiz, Project presentation						
Teaching Material							
Equipment	OpenAI Gym Toolkit						
Multimedia							
Content URL							
Class requirements (equipment that participants should bring)	Laptop						
Prerequisites (previous modules that student should attend)							
Total duration (Hrs)	7						

Table 29: Domain 4 – Syllabus Module 5: “Reinforcement Learning”


SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
	Artificial Intelligence						
Shyfte Domain Curriculum (sub domain)							
Skill Set	Machine Learning						
Skill Level	Intermediate						
Module Title	Neural Network Computing						
Module Acronym	NNC						
Module Description	Introduction to Neural Networks and Artificial Neural Networks fundamentals as well as intermediate level implementation. Comprehensive coverage on knowledge and skills to develop, design and analyse industrial problem using Neural Network (NN) and Artificial Neural Network (ANN) through real case study and a hands-on programming session.						
Keywords	Neural Network	Computing	Artificial Neural Networks				
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill	Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill	
1	Introduction to fundamentals of artificial intelligence, neural network and vision process.	Lecture (face-to-face teaching method), Case study teaching (real case study analysis - group work through active learning method, e.g. fishbowl, jigsaw etc.), Real data simulation and hands-on.		Lecture notes, Videos, datasets (MNIST) for simulations and hands-on session, Tensorflow (cloud platform)	1	. Team working . Problem solving . Ability to work with data . Presentation . Infographic communication	
2	Supervised and unsupervised Neural Network				1		
3	Simulation on data analysis using Neural Networks (supervised and unsupervised)				5		
4							
5							
Meta Skills	to be an engineer who has a knowledge and skills in developing Artificial Neural Network to solve related problem						
Module Outcomes	Students will be able to explain the basic concept of Neural Network and Artificial Neural Network.		Students will be able to apply Neural Network and Artificial Neural Network to solve real problem				
Target Group (students, workers...)	Bachelor student	Master students	SME Personnel				
Target Group Level	2nd year B.Eng onward	1st year M.Eng onward	technical staff				
Assesement Method	Assignment, Project presentation, Assessment rubric for teamwork						
Teaching Material							
Equipment	Tensorflow cloud platform	Flow process mapping software	Data set MNIST (Tensorflow)				
Multimedia	Video						
Content URL							
Class requirements (equipment that participants should bring)	Computer	Internet					
Prerequisites (previous modules that student should attend)	Basic programming	Engineering mathematics					
Total duration (Hrs)	7						

Table 30: Domain 4 – Syllabus Module 6: “Neural Network Computing”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
SHYFTE 4.0	Artificial Intelligence						
Shyfte Domain Curriculum (sub domain)							
Skill Set	Machine Learning						
Skill Level	Intermediate						
Module Title	Convolution Neural Network						
Module Acronym	CNN						
Module Description	Introduction to Convolution Neural Networks (CNN) techniques as well as intermediate level of CNN implementation. Comprehensive coverage on knowledge and skills to develop, design and analyse industrial problem using Convolution Neural Network (CNN) technique through real case study and a hands-on programming session. Specifically, Python programming language will be used in this module.						
Keywords	Convolution Neural Netw	Computing	Artificial Neural Network	python	image classification		
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill	Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill	
1	Introduction to Machine Learning and the Importance of data in manufacturing system	Lecture (face-to-face teaching method), Case study teaching (real case study analysis - group work through active learning method, e.g. fishbowl, jigsaw etc.), Real data simulation and hands-on.		Lecture notes, Videos, datasets for simulations and hands-on session, Python platform	1	. Team working . Problem solving . Ability to work with data . Presentation . Infographic communication	
2	Introduction to Python programming language for data collecting in production process				1		
3	Neural Networks vs Convolution Neural Networks in designing the data collecting system.				2,5		
4	Simulation on data analysis using Convolution neural networks.				2,5		
5							
Meta Skills	to be an engineer who has a knowledge and skills in solving related industrial problem using Convolution Neural Network technique.						
Module Outcomes	Students/trainee will be able to explain the basic concept of Convolution Neural Network.		Students/trainee will be able to apply Convolution Neural technique to solve real problem				
Target Group (students, workers...)	Bachelor student	Master students	SME Personnel				
Target Group Level	2nd year B.Eng onward	1st year M.Eng onward	technical staff				
Assesement Method	Assignment, Project presentation, Assessment rubric for teamwork						
Teaching Material							
Equipment	Phyton software program	Laptop					
Multimedia	Video						
Content URL							
Class requirements (equipment that participants should bring)	Computer	Internet					
Prerequisites (previous modules that student should attend)	Basic programming	Engineering mathematics					
Total duration (Hrs)	7						

Table 31: Domain 4 – Syllabus Module 7: “Convolution Neural Network ”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
Shyfte 4.0	Artificial Intelligence							
Shyfte Domain Curriculum (sub domain)								
Skill Set	Artificial Intelligence Application							
Skill Level	expert							
Module Title	Advance Machine Learning for BigData							
Module Acronym	AdvMLBD							
Module Description	Introduction to basic concept and application of advance machine learning. Comprehensive coverage on manipulating massive datasets on Graphic Processing Unit (GPU), performing data analysis at massive scale and performing multiple analysis task on several massive datasets.							
Keywords	Machine Learning	Big Data	massive data	GPU				
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
1	Introduction to advance machine learning and related application of advance machine learning to big data.		Lecture (face-to-face teaching method), Case study teaching (real case study analysis - group work through active learning method, e.g. fishbowl, jigsaw etc.), Real project (small scale) demonstration and some hands-on.		Lecture notes, sets of real case study, real project (small scale) for demonstration.		1	. Team working . Problem solving . Analytical thinking . Decision making
2	Ingest and manipulate massive datasets directly on GPU.						2	
3	Perform data analysis at massive scale utilizing a wide variety of GPU-accelerated machine learning algorithm.						2	
4	performing mutple analysis tasks on several massive datasets.						2	
Meta Skills	young data scientist							
Module Outcomes	Students/trainee should be able to explain thebasic concept and application of advance machine learning.		Students/trainee should be able to perform a wide variety of end-to-end data science tasks using multiple massive datasets.					
Target Group (students, workers...)	Bachelor student	Master students	SME personnels					
Target Group Level	3rd year B.Eng onward	1st year M.Eng onward	Senior technical staff and Manager					
Assesement Method	Project Group Assignment, Quizzes							
Teaching Material								
Equipment	sets of real case study	Lecture notes	jetson nano development kit					
Multimedia	Video							
Content URL								
Class requirements (equipment that participants should bring)	pen and papers	laptops						
Prerequisites (previous modules that student should attend)	Basic progarmming							
Total duration (Hrs)	7							

Table 32: Domain 4 – Syllabus Module 8: “Advance Machine Learning for BigData”

	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
SHYFTE 4.0 in	Artificial Intelligence							
SHYFTE 4.0 Curriculum (sub domain)								
Skill Set	Optimization							
Skill Level	Intermediate							
Module Title	Search Algorithm							
Module Acronym	SA							
Module Description	This module offers emphasizes on theoretical and practical aspects of search strategies, and various search algorithms from exhaustive search to heuristic search algorithms. The module features practical implementations through case studies and simulation, undertaken both individually and in groups.							
Keywords	Search Algorithm	Heuristic Search	Exhaustive Search					
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
1	Search strategies		Lecture	Gamification, simulation and group problem solving	Data set, laptop with MATLAB software	2	Team working Problem solving Ability to work with data Presentation skill Programming skill	
2	Exhaustive search and heuristic search		Lecture			1		
3	Breadth-first search		Case study			1		
4	Depth-first search		Case study			1		
5	Heuristic evaluation and best first search		Case study			2		
Meta Skills	Artificial Intelligence							
Module Outcomes	Understand the roles of search algorithm		Formulate appropriate search strategy for complex problems.		Apply search techniques for complex problems.			
Target Group (students, workers...)	Bachelor student	Master students	SME personnels					
Target Group Level	3rd year engineering / computer science	1st year	Technical staff					
Assessment Method	Group project, group presentation and rubric for teamwork.							
Teaching Material								
Equipment	Laptop							
Multimedia	MATLAB software	Data set						
Content URL								
Class requirements (equipment that participants should bring)	Laptop with installed MATLAB							
Prerequisites (previous modules that student should attend)	Structure for problem solving							
Total duration (Hrs)	7							

Table 33: Domain 4 – Syllabus Module 9: “Search Algorithm”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
Shyfte Domain Curriculum (sub domain)	Artificial Intelligence							
Skill Set	Optimization							
Skill Level	Expert							
Module Title	Metaheuristic Optimization							
Module Acronym	MhO							
Module Description	This module describes the basic concept of metaheuristic optimization and identifies the types of metaheuristic search strategy in solving domain's problem. Trainees will be taught on how to formulate appropriate solutions and design intelligent computer-based systems to solve complex problem in different domains.							
Keywords	Optimization	Metaheuristic	Intelligent					
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
1	Optimization model		Lecture	Simulation and group presentation	Data set, laptop with MATLAB software	1	. Team working . Problem solving . Ability to work with data . Presentation skill . Programming skill	
2	Metaheuristic concept – representation, objective function, constraint handling, parameter tuning, performance analysis		Lecture			2		
3	Introduction to optimization and Evolutionary Algorithm		Lecture			1		
4	Simulated annealing		Case study			1		
5	Genetic algorithm		Case study			1		
6	Particle Swarm Optimization		Case study			1		
Meta Skills	Creative and innovative in designing intelligent system							
Module Outcomes	Identify the metaheuristic search strategy for different problems.		Formulate appropriate solutions for complex problems.		Design intelligent-based systems for complex problems based on metaheuristic algorithm.			
Target Group (students, workers...)	Bachelor student	Master students	SME personnels					
Target Group Level	3rd year engineering / computer science	1st year	Technical staff					
Assesment Method	Assignment, Project presentation, Assessment rubric for teamwork							
Teaching Material								
Equipment	Laptop							
Multimedia	Matlab software	Data set						
Content URL								
Class requirements (equipment that participants should bring)	Laptop with installed MATLAB							
Prerequisites (previous modules that student should attend)	Search Algorithm							
Total duration (Hrs)	7							

Table 34: Domain 4 – Syllabus Module 10: “Metaheuristique Optimization”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus						
SHYFTE 4.0	Artificial Intelligence						
Shyfte Domain Curriculum (sub domain)							
Skill Set	Artificial Intelligence Application						
Skill Level	Beginners						
Module Title	Introduction to Artificial Intelligence Application						
Module Acronym	IAIA						
Module Description	comprehensive coverage on Artificial Intelligence capabilities and limitations as well as workflow in building AI application or project (engineering and non engineering based).						
Keywords	AI capabilities	AI limitations	artificial intelligence	AI application			
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill	Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill	
	1 Introduction to Artificial Intelligence (AI)	Lecture (face-to-face teaching method), Case study teaching (real case study analysis - group work through active learning method, e.g. fishbowl, jigsaw etc.), Real project (small scale) demonstration.		Lecture notes, sets of real case study, real project for demonstration	1	. Team working . Problem solving . Analytical thinking . Decision making	
	2 Building AI Projects/Applications : Computer Vision Application: Self-Driving Car, Speech Recognition Application: Smart Speaker, Natural Language Processing: Sentiment Analysis, SLAM: Robot Motion Planning				4,5		
	3 Realistic view of Artificial Intelligence.				0,5		
Meta Skills	Students/personnel who aware on Artificial Intelligence applications						
Module Outcomes	Students/trainee should be able to explain basic definition of artificial intelligence and its capabilities		Students/trainee should be able to Describe the workflow in building an AI project/application		Students/trainee should be able to Describe different AI applications built based on video, image and text data.		
Target Group (students, workers...)	Bachelor student	Master students	SME personnels				
Target Group Level	2nd year B.Eng onward	1st year M.IE onward	all level				
Assesement Method	Project Group Assignment, Quizzes						
Teaching Material							
Equipment	sets of real case study	Lecture notes	jetson nano and PC	open source AI software (e.g TensorFlow or			
Multimedia	Video related to AI application						
Content URL							
Class requirements (equipment that participants should bring)	pen and papers	laptop					
Prerequisites (previous modules that student should attend)							
Total duration (Hrs)	5						

Table 35: Domain 4 – Syllabus Module 11: “Introduction to AI Application”


SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
	Artificial Intelligence						
Shyfte Domain Curriculum (sub domain)							
Skill Set	AI Application						
Skill Level	Intermediate						
Module Title	Artificial Intelligence for Computer Vision						
Module Acronym	AICV						
Module Description	Introduction to the fundamentals of computer vision and exposure to various applications of computer visions in industry. Comprehensive coverage on embedded implementation of AI algorithm for computer vision and the edge AI application using jetson nano board.						
Keywords	AI applicaion	computer vision	image processing	Edge AI			
Topics / Teaching Plan	Topics		Teaching Plan				
	Hard Skill	Delivery Method (gamification, case study, simulation...)		Teaching Material	Duration (Hrs)	Soft Skill	
1	Introduction to the fundamentals of computer vision and various applications of computer visions in industry.	Lecture (face-to-face teaching method). Case study teaching (real case study analysis - group work through active learning method, e.g. fishbowl, jigsaw etc.), Real project (small scale) demonstration and some hands-on.		Lecture notes, Data set, Linux software, OpenCV and CUDA toolkit, jetson nano board	1	. Team working . Problem solving . Ability to work with data . Programming skill	
2	Introduction to embedded systems and edge AI application using Jetson board (Procedure, structure and related operating system and programming language)				3		
3	Computer vision application demo and hands-on : image processing (OpenCV and CUDA on the Jetson, Working with GPIO, and acquiring camera input, deep learning method on jetson board)				3		
4							
5							
6							
Meta Skills	computer vision engineer						
Module Outcomes	Students/trainee should be able to explain the fundamentals of computer visions and identify the related applications		Students/trainee should be able to develop a real-time AI applications for edge AI using programming and software tools.		Students/trainee should be able to demonstrate understanding on the methodology of implementing real-time AI systems for real-world applications.		
Target Group (students, workers...)	Bachelor student	Master students	SME personnels				
Target Group Level	3rd year engineering / computer science	1st year	Technical staff and manager				
Assesment Method	Project Group Assignment, Quizzes						
Teaching Material							
Equipment	sets of real case study	Lecture notes	Nvidia Jetson or Jetson Nano board	Desktop PC/laptop	OpenCV and CUDA toolkit		
Multimedia							
Content URL							
Class requirements (equipment that participants should bring)	Laptop						
Prerequisites (previous modules that student should attend)	Basic progarmming						
Total duration (Hrs)	7						

Table 36: Domain 4 – Syllabus Module 12: “ AI for Computer Vision”


	SHYFTE 4.0 - T1.4 - T.5 Learning Material Syllabus							
Shyfte 4.0	Artificial Intelligence							
Shyfte Domain Curriculum (sub domain)								
Skill Set	Artificial Intelligence Application							
Skill Level	Expert							
Module Title	Artificial Intelligence for Industry							
Module Acronym	All							
Module Description	Introduction to basic definition and concept of artificial intelligence (AI) for industry as well as exposure to the AI-based industrial improvement (categories and types of applications).							
Keywords	automation	AI industry	cyber manufacturing					
Topics / Teaching Plan	Topics		Teaching Plan					
	Hard Skill		Delivery Method (gamification, case study, simulation...)		Teaching Material		Duration (Hrs)	Soft Skill
1	Introduction to Artificial Intelligence for industry		Lecture (face-to-face teaching method), Case study teaching (real case study analysis - group work through active learning method, e.g. fishbowl, jigsaw etc.), Real project (small scale) demonstration.		Lecture notes, sets of real case study, real project (small scale) for demonstration		1	. Team working . Problem solving . Analytical thinking . Decision making
2	Artificial Intelligence for Industry : product applications for user value creation.						1	
3	Artificial Intelligence for Industry : Process Applications for productivity improvement						1	
4	Artificial Intelligence for Industry: Insight Applications for Knowledge Discovery						2	
5	Artificial Intelligence-based industrial improvement (case study)						2	
Meta Skills								
Module Outcomes	Students/trainee should be able to explain the basic definition and concept of Artificial Intelligence and Artificial intelligence for industry.		Students/trainee should be able to identify categories of Artificial Intelligence for industry		Students/trainee should be able to describe the different Artificial Intelligence applications for industry.			
Target Group (students, workers...)	Bachelor student	Master students	SME personnels					
Target Group Level	2nd year B.Eng onward	1st year M.IE onward	Senior technical staff and manager					
Assesement Method	Project Group Assignment, Quizzes							
Teaching Material								
Equipment	sets of real case study	Lecture notes	demonstration kit					
Multimedia	Video							
Content URL								
Class requirements (equipment that participants should bring)	pen and papers	laptops						
Prerequisites (previous modules that student should attend)								
Total duration (Hrs)	7							

Table 37: Domain 4 – Syllabus Module 13: “ AI for Industry”

4. Shyfte Pilots Deployment Strategy

This section describes the teaching and learning strategies for deploying the four pilots. The development of each pilots (Tasks T2.1 to T2.4) will follow the following sub-activities:

- Learning Materials development: theoretical part, industrial use case, equipment used, infrastructure, material preparation... *(see syllabus in section 3 of this deliverable)*
- Validation by the group of expert: Internal (1 or more expert per university partner) + External (advisory board & companies)
- Training of the trainer's sessions
- Learning Materials assessment & update
- Student's maturity level assesment
- Training of the student's sessions
- Learning Materials assesment & update

4.1 Domain 1: Industrial Engineering and Management deployment strategy

The description of the Domain Pilot 1 (Industrial Engineering) includes the development of 6 modules (see table 38). Module developers and contributors have been identified, and trainers have been also identified.

Pilot in Domain 1: Industrial engineering and management	Skill Set	Module titles	Level (B, I, Expert)	Module Contributors/Developpers	Module Trainers
1	All	Introduction to Industry 4.0	B	Korakot Yaibuathet (CMU) Kotcharat Srisuk (Bernina Thailand Co.ltd.)	Korakot Yaibuathet
2	Agile Manufacturing System, Quality System 4.0	Cloud ERP	B	Wapee Manopiniwes Kotcharat Srisuk (Bernina Thailand Co.ltd.)	Wapee Manopiniwetch
3	Smart Production Management, Agile Manufacturing System	Integrated Simulation and Optimization	Expert	Sakgasem Ramingwong, Apichat Sopadang Natdanai Homkong (Kirimaru Co.ltd)	Apichat Sopadan, Sakgasem Ramingwong
4	Agile Manufacturing System, Quality System 4.0	Data Collecting System	B	Salinee Santiteerakul Narongsak Nanthagasigom (Vernia Thailand Co.ltd.)	Salinee Santiteerakul
5	Agile Manufacturing System, Quality System 4.0	Automatic Data Collecting System	I	Salinee Santiteerakul Narongsak Nanthagasigom (Vernia Thailand Co.ltd.)	Salinee Santiteerakul
6	Intelligence Quantitative Analysis	Decision Making with Big Data	I	Sakgasit Ramingwong Natdanai Homkong (Kirimaru Co.ltd)	Sakgasit Ramingwong

Table 38: Pilot 1 – Learning strategy: Module contributors & trainers (1/1)

The Training of the Trainer (ToT) sessions and the Training of the Students (ToS) have been also organized and scheduled for some of them (see Table 39):

Training Sessions	Start Date	End Date	Number of trainees	Venue	Module Title	Module Delivery (Learning method)	Module Assessment
Training of Trainers (ToT)	20-avr-21	20-avr-21	5	Department of Industrial Engineering, CMU	Introduction to Industry 4.0	Case study, Project assignment, Team working group	Assignment, Project presentation
	21-avr-21	22-avr-21	5	Department of Industrial Engineering, CMU	Cloud ERP	Case study, simulation game, projec assignment	Assignment, Project presentation, Assessment rubric for teamwork
	23-avr-21	23-avr-21	5	Department of Industrial Engineering, CMU	Integrated Simulation and Optimization	case study, project assignment	Assignment, Project presentation, Assessment rubric for teamwork
	24-avr-21	24-avr-21	5	Department of Industrial Engineering, CMU	Data Collecting System	case study, project assignment	Assignment, Project presentation, Assessment rubric for teamwork
	25-avr-21	25-avr-21	5	Department of Industrial Engineering, CMU	Automatic Data Collecting System	practical assignment, project assignment	Assignment, Project presentation, Assessment rubric for teamwork
	27-avr-21	27-avr-21	5	Department of Industrial Engineering, CMU	Decision Making with Big Data	case study, group assignment, project assignment	Assignment, Project presentation
Training of Students (ToS)	29 June 2021	30-juin-21	20	Department of Industrial Engineering, CMU	Introduction to Industry 4.0	Case study, Project assignment, Team working group	Assignment, Project presentation
	01-juil-21	08-juil-21	10	Department of Industrial Engineering, CMU	Cloud ERP	Case study, simulation game, projec assignment	Assignment, Project presentation, Assessment rubric for teamwork
	28-juin-21	03-juil-21	10	Department of Industrial Engineering, CMU	Integrated Simulation and Optimization	case study, project assignment	Assignment, Project presentation, Assessment rubric for teamwork
	03-juil-21	10-juil-21	10	Department of Industrial Engineering, CMU	Data Collecting System	case study, project assignment	Assignment, Project presentation, Assessment rubric for teamwork
	11-juil-21	16-juil-21	10	Department of Industrial Engineering, CMU	Automatic Data Collecting System	practical assignment, project assignment	Assignment, Project presentation, Assessment rubric for teamwork
	03-juil-21	10-juil-21	10	Department of Industrial Engineering, CMU	Decision Making with Big Data	case study, group assignment, project assignment	Assignment, Project presentation

Table 39: Pilot 1 – Learning strategy: ToT and ToS Schedule

The description of the Domain Pilot 1 (Business Management) includes the development of 6 modules (see table 40). Module developers and contributors have been identified, and trainers have been also identified.

Pilot in Domain 1: Industrial engineering and management	Skill Set	Module titles	Level (B, I, Expert)	Module Contributors	Module Trainers
1	Human Resource Management	Human Resource Management for Industry 4.0	B	Panisara Thitatorn /Veerinyaorn Luangboriboon	Panisara Thitatorn /Veerinyaorn Luangboriboon
2	Planning/Leading/ Organizing/Controlling	Digital Age Organization	B	Pittawat Ueasangkomsate	Pittawat Ueasangkomsate
3	New Media Literacy	Role of Data for Future Organization	B	Waranpong Boonsiritomachai	Waranpong Boonsiritomachai
4	Communication	Communication for Industry 4.0	I	Panisara Thitatorn /Thita Phatwarawisit	Panisara Thitatorn /Thita Phatwarawisit
5	Decision-making skills / Data analytics skills	Business Intelligence	I	Waranpong Boonsiritomachai	Waranpong Boonsiritomachai
6	Creativity/Teamwork / Decision Making / Complex Problem Solving	Business Strategic Approach	E	Pittawat Ueasangkomsate / Ajjaree Limpamont	Pittawat Ueasangkomsate / Ajjaree Limpamont

Table 40: Pilot 1 – Learning strategy: Module contributors & trainers (2/2)

The Training of the Trainer (ToT) sessions and the Training of the Students (ToS) have been also organized and scheduled for some of them (see Table 41):

Training Sessions	Start Date	End Date	Number of Trainees	Venue	Module Title	Module Delivery	Module Assessment
Training of Trainers (ToT) (17-24 February 2021)	2/17/2021	2/18/2021	5	Department of Management, KU	Human Resource Management for Industry 4.0	Lecture / Case Study	Quiz / Exam
	2/18/2021	2/18/2021	5	Department of Management, KU	Digital Age Organization	Lecture / Case Study / Workshop	Assingment / Presentation
	2/19/2021	2/19/2021	5	Department of Management, KU	Role of Data for Future Organization	Lecture and Demonstration Class discussion	Case study analysis
	2/22/2021	2/22/2021	5	Department of Management, KU	Communication for Industry 4.0	Lecture / Case Study Workshop	Quiz / Exam / Reflection
	2/23/2021	2/23/2021	5	Department of Management, KU	Business Intelligence	Lecture and Demonstration Class discussion	Case study analysis
	2/24/2021	2/25/2021	5	Department of Management, KU	Business Strategic Approach	Lecture / Case Study / Workshop	Assingment / Presentation
Training of Students (ToS) (1-10 July 2021)	7/1/2021	7/1/2021	10	Department of Management, KU	Human Resource Management for Industry 4.0	Lecture / Case Study	Quiz / Exam
	7/2/2021	7/2/2021	10	Department of Management, KU	Digital Age Organization	Lecture / Case Study / Workshop	Assingment / Presentation
	7/5/2021	7/5/2021	20	Department of Management, KU	Role of Data for Future Organization	Lecture and Demonstration Class discussion	Case study analysis
	7/6/2021	7/6/2021	10	Department of Management, KU	Communication for Industry 4.0	Lecture / Case Study Workshop	Quiz / Exam / Reflection
	7/7/2021	7/7/2021	10	Department of Management, KU	Business Intelligence	Lecture and Demonstration Class discussion	Case study analysis
	7/8/2021	7/8/2021	20	Department of Management, KU	Business Strategic Approach	Lecture / Case Study / Workshop	Assingment / Presentation

Table 41: Pilot 2 – Learning strategy: ToT and ToS Schedule

4.2 Domain 2: Software Engineering and Big data analysis deployment strategy

The description of the Domain Pilot 1 (Industrial Engineering) includes the development of 6 modules (see table 42). Module developers and contributors have been identified, and trainers have been also identified.

Pilot in Domain 2: Software Engineering and big data analysis	Skill Set	Module titles	Level (B, I, Expert)	Module Contributros	Module Trainers
1	All	Principle and Application of BigData Technology	B	YU XI	YU XI
	Understand the framework of Hadoop	Principle and Application of BigData Technology	B	YU XI	YU XI
	Ability of HDFS programming	Principle and Application of BigData Technology	B	YU XI	YU XI
	Ability of HBase programming	Principle and Application of BigData Technology	B	YU XI	YU XI
	Ability of MapReduce Programming	Principle and Application of BigData Technology	B	YU XI	YU XI
2	Skills of solving Supervised learning Problems	Comprehensive Training of Artificial Intelligence	I	Haiqing Zhang	Haiqing Zhang
	Skills of solving Unsupervised learning Problems	Comprehensive Training of Artificial Intelligence	I	Haiqing Zhang	Haiqing Zhang
	Skills of solving Semi-supervised learning Problems	Comprehensive Training of Artificial Intelligence	I	Haiqing Zhang	Haiqing Zhang
	Able to conduct BigData reduction	Comprehensive Training of Artificial Intelligence	I	Haiqing Zhang	Haiqing Zhang
	Able to solve Recommendation issues	Comprehensive Training of Artificial Intelligence	I	Haiqing Zhang	Haiqing Zhang
3	Define critical thinking oriented Big data.	Critical Thinking Oriented BigData	I	Yueyue Li	Yueyue Li
	Identify and classify a preliminary set of critical thinking skills under the conception of Big data.	Critical Thinking Oriented BigData	I	Yueyue Li	Yueyue Li
	Examine and verify the data quality from the perspective of BigData analysis.	Critical Thinking Oriented BigData	I	Yueyue Li	Yueyue Li
	Apply critical thinking skills and analyze the affecting factors of data quality based on decision making cases.	Critical Thinking Oriented BigData	I	Yueyue Li	Yueyue Li
4	Background knowledge of smart decision making	Smart Decision Making with BigData	E	Da Shi	Da Shi
	Data and data processing	Smart Decision Making with BigData	E	Da Shi	Da Shi
	Data modeling and analysis	Smart Decision Making with BigData	E	Da Shi	Da Shi
	Visual analysis	Smart Decision Making with BigData	E	Da Shi	Da Shi
	Case analysis	Smart Decision Making with BigData	E	Da Shi	Da Shi
5	Mastering the process of data process	Data Mining	E	Yuefei Wang	Yuefei Wang
	Mining deep relationships between objects	Data Mining	E	Yuefei Wang	Yuefei Wang
	Constructing the data classifier	Data Mining	E	Yuefei Wang	Yuefei Wang
	Constructing the clustering model	Data Mining	E	Yuefei Wang	Yuefei Wang
	Analyzing associations between objects or collections	Data Mining	E	Yuefei Wang	Yuefei Wang
	Evaluating the quality of the methodologies	Data Mining	E	Yuefei Wang	Yuefei Wang

Table 42: Pilot 2 – Learning strategy: Module contributors & trainers

The Training of the Trainer (ToT) sessions and the Training of the Students (ToS) have been also organized and scheduled for some of them (see Table 43):

Training Sessions	Start Date	End Date	Number of trainees	Venue	Module Title	Module Delivery	Module Assessment
Training of Trainers (ToT)	12/10/2020	14/10/2020	5	Chengdu University of Information Technology	Comprehensive Training of Artificial Intelligence		Assignment, Project presentation, Assessment rubric for teamwork
	15/10/2020	17/10/2020	5	Chengdu University	Principle and Application of BigData Technology		Assignment, Project presentation, Assessment rubric for teamwork
	17/10/2020	19/10/2020	5	Chengdu University	Smart Decision Making with BigData		Assignment, Project presentation, Assessment rubric for teamwork
	19/10/2020	21/10/2020	5	Chengdu University	Critical Thinking Oriented BigData		Assignment, Project presentation, Assessment rubric for teamwork
			10	Chengdu University of Information Technology	Data Mining		Assignment, Project presentation, Assessment rubric for teamwork
Training of Students (ToS)	22/10/2020	24/10/2020	30	Chengdu University of Information Technology	Comprehensive Training of Artificial Intelligence		Assignment, Project presentation, Assessment rubric for teamwork
	25/10/2020	27/10/2020	30	Chengdu University	Principle and Application of BigData Technology		Assignment, Project presentation, Assessment rubric for teamwork
	27/10/2020	29/10/2020	30	Chengdu University	Smart Decision Making with BigData		Assignment, Project presentation, Assessment rubric for teamwork
	29/10/2020	31/10/2020	30	Chengdu University	Critical Thinking Oriented BigData		Assignment, Project presentation, Assessment rubric for teamwork
			40	Chengdu University of Information Technology	Data Mining		

Table 43: Pilot 3 – Learning strategy: ToT and ToS Schedule

4.3 Domain 3: Wireless Networks Analytics deployment strategy

The description of the Domain Pilot 1 (Industrial Engineering) includes the development of 6 modules (see table 44). Module developers and contributors have been identified, and trainers have been also identified.

Pilot in Domain 3: Wireless Network and Analytics	Skill Set	Module titles	Level (B, I, Expert)	Module Contributors/Developers	Module Trainers
1	Wireless Security	Introduction to Cybersecurity	B	Fazirulhisyam Hashim (UPM)	Fazirulhisyam Hashim
2	IoT System	Data Acquisition and Analysis	I	Syamsiah Mashohor (UPM)	Mohd Fadlee A Rasid
3	IoT System	Data Governance and Management	E	Syamsiah Mashohor (UPM)	Khairulmizam Shamsudin
4	Energy Management	Introduction to Energy Management	B	Nor Kamariah Noordin (UPM)	Nor Kamariah Noordin
5	Energy Management	Renewable Energy for Wireless Networks	I	Aduwati Sali (UPM)	Aduwati Sali
6	Energy Management	Green Energy Wireless Network	E	Borhanuddin Mohd Ali (UPM)	Borhanuddin Mohd Ali

Table 44: Pilot 3 – Learning strategy: Module contributors & trainers

The Training of the Trainer (ToT) sessions and the Training of the Students (ToS) have been also organized and scheduled for some of them (see Table 45):

Training Sessions	Start Date	End Date	Number of trainees	Venue	Module Title	Module Delivery (Learning method)	Module Assessment
Training of Trainers (ToT)	December 2020 Day 1	December 2020 Day 2	20	Department of Computer and Communication System Engineering, UPM	Introduction to Cybersecurity	Lecture, Case study, Group discussion, Group work, Project assignment	Project report, Project presentation, Assessment rubric for teamwork
	December 2020 Day 3	December 2020 Day 4	20	Department of Computer and Communication System Engineering, UPM	Data Acquisition and Analysis	Lecture, Group discussion, IoT hands-on project, Group work, Case study	Project report, Project presentation, Assessment rubric for teamwork
	December 2020 Day 5	December 2020 Day 6	20	Department of Computer and Communication System Engineering, UPM	Data Governance and Management	Lecture, Role play, Problem-based learning, Group work	Project report, Project presentation, Assessment rubric for teamwork
	December 2020 Day 7	December 2020 Day 8	20	Department of Computer and Communication System Engineering, UPM	Introduction to Energy Management	Lecture, Group discussion, Case study, Project assignment	Project report, Project presentation, Assessment rubric for teamwork
	December 2020 Day 9	December 2020 Day 9	20	Department of Computer and Communication System Engineering, UPM	Renewable Energy for Wireless Networks	Lecture, Group discussion, Case study, Group work, Project assignment, Academic Visit	Project report, Project presentation, Project video
	December 2020 Day 10	December 2020 Day 10	20	Department of Computer and Communication System Engineering, UPM	Green Energy Wireless Network	Lecture, Group discussion, Problem-based learning, Group work and gamification, Blended learning	Project report, Project presentation, Assessment rubric for teamwork
Training of Students (ToS)	July-September 2021	July-September 2021	50	Department of Computer and Communication System Engineering, UPM	Introduction to Cybersecurity	Lecture, Case study, Group discussion, Group work, Project assignment	Project report, Project presentation, Assessment rubric for teamwork
	July-September 2021	July-September 2021	50	Department of Computer and Communication System Engineering, UPM	Data Acquisition and Analysis	Lecture, Group discussion, IoT hands-on project, Group work, Case study	Project report, Project presentation, Assessment rubric for teamwork
	July-September 2021	July-September 2021	50	Department of Computer and Communication System Engineering, UPM	Data Governance and Management	Lecture, Role play, Problem-based learning, Group work	Project report, Project presentation, Assessment rubric for teamwork
	July-September 2021	July-September 2021	50	Department of Computer and Communication System Engineering, UPM	Introduction to Energy Management	Lecture, Group discussion, Case study, Project assignment	Project report, Project presentation, Assessment rubric for teamwork
	July-September 2021	July-September 2021	50	Department of Computer and Communication System Engineering, UPM	Renewable Energy for Wireless Networks	Lecture, Group discussion, Case study, Group work, Project assignment	Project report, Project presentation, Assessment rubric for teamwork
	July-September 2021	July-September 2021	50	Department of Computer and Communication System Engineering, UPM	Green Energy Wireless Network	Lecture, Group discussion, Problem-based learning, Group work and gamification, Blended learning	Project report, Project presentation, Assessment rubric for teamwork

Table 45: Pilot 3 – Learning strategy: ToT and ToS Schedule

4.4 Domain 4: Artificial Intelligence deployment strategy

The description of the Domain Pilot 4 (Artificial Intelligence) includes the development of 13 modules (see table 46). Module developers and contributors have been identified, and trainers have been also identified.

Pilot in Domain 4: Artificial Intelligence	Skill Set	Module titles	Level (B, I, Expert)	Module Contributor/Developer	Module Trainers
1	ML, Optimization, AI Application	Introduction to IR4.0	B	Dr. Norjulia Mohamad Nordin	Assoc. Prof. Sharifah Kamilah Assoc. Prof. Dr. Naziha A. Azli
2	ML, Optimization, AI Application	Fundamental of AI	B	Dr. Norjulia Mohamad Nordin	Dr. Norjulia Mohamad Nordin
3	ML, Optimization, AI Application	Structure for Problem Solving	B	Dr. Aida Ali	Dr. Aida Ali
4	ML, Optimization	Supervised and Unsupervised Learning	B	Dr Aida Ali	Dr Aida Ali
5	AI Application	Introduction to AI Application	B	Assoc. Prof. Hazlina Selamat	Assoc. Prof. Hazlina Selamat
6	ML, Optimization	Reinforcement Learning	I	Dr Aida Ali	Dr Aida Ali
7	ML	Neural Network Computing	I	Dr Kumeresan A. Danapalasingam	Dr Kumeresan A. Danapalasingam
8	Optimization	Search Algorithm	I	Assoc. Prof. Dr Nurul Mu'azzah Abdul Latiff	Assoc. Prof. Dr Nurul Mu'azzah Abdul Latiff
9	AI Application	AI for Computer Vision	I	Dr. Usman Ullah	Dr. Usman Ullah
10	ML	Convolution Neural Network	I	Dr Uswah Khairuddin	Dr Uswah Khairuddin
11	ML	Advance Machine Learning for Big Data	E	Dr Ibrahim Shapiai	Dr Ibrahim Shapiai
12	Optimization	Metaheuristic Optimization	E	Assoc. Prof. Dr Nurul Mu'azzah Abdul Latiff	Assoc. Prof. Dr Nurul Mu'azzah Abdul Latiff
13	AI Application	AI for Industry	E	Assoc. Prof. Yeong Che Fai	Assoc. Prof. Yeong Che Fai

Table 46: Pilot 4 – Learning strategy: Module contributors & trainers

The Training of the Trainer (ToT) sessions and the Training of the Students (ToS) have been also organized and scheduled for some of them (see Table 47):

Training Sessions	Start Date	End Date	Number of trainees	Venue	Module Title	Module Delivery	Module Assessment
Training of Trainers (ToT)	15-déc-20	15-déc-20	30	UTM Kuala Lumpur	Introduction to IR4.0	Lecture presentation, Case study, Group Work.	Project Group Assignment, Quizzes
	15-déc-20	15-déc-20	30	UTM Kuala Lumpur	Fundamental of AI	Lecture presentation, Case study, Group Work.	Project Group Assignment, Quizzes
	15-déc-20	15-déc-20	30	UTM Kuala Lumpur	Structure for Problem Solving	Lecture presentation, Case study, Project Group Work.	Project Presentation, Quiz
	15-déc-20	15-déc-20	30	UTM Kuala Lumpur	Introduction to AI Application	Lecture presentation, Case study, Project Group Work.	Project Group Assignment, Quizzes
	16-déc-20	16-déc-20	30	UTM Kuala Lumpur	AI for Computer Vision	Lecture presentation, Case study, Project Group Work and hands-on activities.	Project Group Assignment, Quizzes
	16-déc-20	16-déc-20	30	UTM Kuala Lumpur	AI for Industry	Lecture presentation, Case study, Group Work.	Project Group Assignment, Quizzes
Training of Students (ToS)	July-September 2021	Day 1	30	UTM Johor Bahru	Introduction to IR4.0	Lecture presentation, Case study, Group Work.	Project Group Assignment, Quizzes
	July-September 2021				Fundamental of AI	Lecture presentation, Case study, Group Work.	Project Group Assignment, Quizzes
	July-September 2021	Day 2	30	UTM Johor Bahru	Structure for Problem Solving	Lecture presentation, Case study, Project Group Work.	Project Presentation, Quiz
	July-September 2021				Supervised and Unsupervised Learning	Lecture presentation, Case study, Project Group Work.	Quiz, Project Presentation
	July-September 2021	Day 3	30	UTM Johor Bahru	Introduction to AI Application	Lecture presentation, Case study, Project Group Work.	Project Group Assignment, Quizzes
	July-September 2021				Reinforcement Learning	Lecture presentation, Case study, Project Group Work.	Quiz, Project Presentation
	July-September 2021	Day 4	30	UTM Johor Bahru	Neural Network Computing	Lecture presentation, Case study, Project Group Work.	Assignment, Project Presentation and Teamworking Skills
	July-September 2021	Day 5	30	UTM Johor Bahru	Search Algorithm	Gamification, simulation and group problem solving	Group Project Assignment, Presentation and Teamworking Skills
	July-September 2021	Day 6	30	UTM Johor Bahru	AI for Computer Vision	Lecture presentation, Case study, Project Group Work and hands-on activities.	Project Group Assignment, Quizzes
	July-September 2021	Day 7	30	UTM Johor Bahru	Convolution Neural Network	Lecture presentation, Case study, Project Group Work.	Assignment, Project Presentation and Teamworking Skills
	July-September 2021	Day 8	30	UTM Johor Bahru	Advance Machine Learning for Big Data	Lecture presentation, Case study, Project Group Work and hands-on activities.	Project Group Assignment, Quizzes
	July-September 2021	Day 9	30	UTM Johor Bahru	Metaheuristic Optimization	Lecture presentation, Case study, Simulation, Group Presentation.	Assignment, Project Presentation and Teamworking Skills
	July-September 2021	Day 10	30	UTM Johor Bahru	AI for Industry	Lecture presentation, Case study, Group Work.	Project Group Assignment, Quizzes

Table 47: Pilot 4 – Learning strategy: ToT and ToS Schedule

5. Conclusion

The Shyfte learning strategy will be deployed for each of the 4 areas. The four pilots will be developed and validated at each stage by internal and external evaluators.

A phase of certification of trainers will be implemented (see WP3).

The development process will be done in a continuous improvement perspective, each module will be reviewed after each training session according to the feedback from the learners (trainers and the students).

The modules developed will be the basis for the services offered in the Shyfte Learning Centres.



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