

# Building Skills 4.0 through University and Enterprise Collaboration

## SHYFTE 4.0

### WP2: Implementation of Shyfte framework for training and learning

#### D2.3: Pilot in domain3 Wireless networks analytics vs:2.0

**Deliverable Lead and Editor:** Aduwati SALI, UPM

**Contributing Partners:** Universiti Putra Malaysia, All

**Date:** 2022-09

**Dissemination:** Confidential

**Status:** <Draft | Consortium Approved | EU Approved>

The objectives of this deliverable are to describe:

- the learning materials
- the Training of trainers (ToT)
- the evaluation of the quality of the learning material and training
- the Training of students (ToS)
- the mitigation actions due to Covid 19.

Project Ref: 598649-EPP-1-  
2018-1-FR-EPPKA2-CBHE-JP

Grant Agreement:  
2018 - 3316 / 001 - 001

## Document Status

Deliverable Lead	A. Sali, UPM
Internal Reviewer 1	S. Santiteerakul, CMU
Internal Reviewer 2	Y. Ouzrout, ULL
Type	Deliverable
Work Package	WP2: Implementation of Shyfte framework for training and learning
ID	D2.3: Pilot in domain3 Wireless networks analytics
Due Date	2022-09
Delivery Date	2022-09
Status	<Draft - Consortium Approved - EU Approved>

## Status

This deliverable is subject to final acceptance by the EACEA.

## Further Information

<http://www.shyfte.eu/>

## Disclaimer

The views represented in this document only reflect the views of the authors and not the views of the European Union. The European Union is not liable for any use that may be made of the information contained in this document.

Furthermore, the information is provided “as is” and no guarantee or warranty is given that the information is fit for any particular purpose. The user of the information uses it at its sole risk and liability.

## Project Partners:



## Table of Contents

<b>1. Executive Summary</b>	<b>6</b>
<b>2. Domain 3: Wireless Network Analytics</b>	<b>8</b>
<b>3. Learning Materials Description</b>	<b>10</b>
3.1 Introduction to IR 4.0	10
3.2 Introduction to Cybersecurity	11
3.3 Introduction to Energy Management	14
3.4 Data Acquisition and Analysis	15
3.5 Renewable Energy for Wireless Network	18
3.6 Data Governance and Management	20
3.7 Green Energy Wireless Networks	22
<b>4. Use of Shyfte Equipment</b>	<b>25</b>
<b>5. Learning Materials Review and Improvement</b>	<b>28</b>
5.1 Introduction to IR 4.0	28
5.2 Introduction to Cybersecurity	28
5.3 Introduction to Energy Management	29
5.4 Data Acquisition and Analysis	31
5.5 Renewable Energy for Wireless Network	31
5.6 Data Governance and Management	32
5.7 Green Energy Wireless Networks	33
<b>6. Training of the Trainers Sessions</b>	<b>35</b>
6.1 ToT Part 1	35
6.1.1 Part 1 Description and Analysis	36
6.1.2 Part 1 Feedback	39
6.2 ToT Part 2	40
6.2.1 Part 2 Description and Analysis	41
6.2.2 Part 2 Feedback	43
<b>7. Training of the Students (ToS) Sessions</b>	<b>45</b>
7.1 ToS Session Details	45
7.2 ToS Analysis	49
<b>8. Resources for Learning Materials</b>	<b>51</b>
<b>9. Deviations and Mitigation Actions</b>	<b>54</b>

<b>10. Sustainability of Shyfte Learning Centre</b>	<b>55</b>
<b>11. Conclusions</b>	<b>56</b>
<b>Annex 1</b>	<b>57</b>
<b>Annex 2</b>	<b>61</b>
<b>Annex 3</b>	<b>62</b>
<b>Annex 4</b>	<b>68</b>

## 1. Executive Summary

This document describes the implementation of the pilot project in Malaysia to significantly improve the quality of “Wireless Network Analytics” courses through the use of the new skills required by the companies for the industry of the future. Based on the skills 4.0 framework and the teaching and learning materials defined in the WP1, the objectives of this deliverable are to describe:

- the learning materials
- the training of trainers
- the evaluation of the quality of the learning material and training
- the training of students
- deviations and mitigation actions

The Learning Materials are delivered during the Training of Trainers (ToTs) and Training of Students (ToS). Six (6) modules have been delivered, there are Introduction to IR 4.0, Introduction to Cybersecurity, Introduction to Energy Management, Data Acquisition and Analysis, Renewable Energy for Wireless Network, Data Governance and Management and Green Energy Wireless Network. Each module has been reviewed by one (1) Internal coming from local Institution of Higher Learning (IHL) and one (1) external from local industry.

For the ToTs, the Trainers have been identified based on their expertise and research area. The trainers have conducted the ToTs to 56 potential trainers. The selection of potential trainers is based on their interests, since most of them are already working in the areas of IR 4.0. During the ToT, at least one (1) researcher from UTM, KU and CMU attended the sessions. The partners from China could not participate due to the COVID situation in their country. In TOT, 55% of attendees responded to the questionnaires. From the feedback received from the attendees, a few modules have been improved, especially to include more hands-on and application-based activities and materials for the ToS delivery.

For ToS, there are 69 students attended the sessions. 50 of them responded to the questionnaires (72%) and most of them were satisfied and agreed with the materials. However, (one) 1 module which is Renewable Energy for Wireless Networks, the students wished to see more practical-based content. This is part of our continuous quality improvement plan to respond to the need of the students. During the ToTs, a few participants were from the industry, namely 2 from Malaysian Communications and Multimedia Commission (MCMC), 1 from MIMOS, and 2 from Vectolabs. Upon completion of the ToTs and ToS, attendees were provided with Certificates of Appreciation.

The summary of the proposed key performance indicators (KPI) as compared to the achieved KPI is shown in the Table 1.1:

Table 1.1 : The proposed and achieved KPI.

No	Proposed KPI	Achieved KPI
1.	At least 6 modules	7 modules developed
2.	Modules reviewed by internal and external reviewer	Yes
3.	Trained 5 -10 trainers per country	56 trainers (51 academics, 5 industry)

4.	1 staff trained per partner	1 staff trained from CMU, UTM and KU
5.	5 questionnaires per TOT	31 overall responses for TOT
6.	1 improvement plan from the questionnaires	1 overall plan
7.	100 -120 students trained per country	69 students trained (UPM)
8.	5-10 trained from companies	5 trained from companies
9.	70% of trainer (TOT) responded the questionnaires	55% (31 out of 56 trainers responded)
10.	70% of students (TOS) responded to the questionnaires	72% (50 out of 69 students responded)

Although the ToTs and ToS were scheduled to be in July 2020, the sessions were delayed due to the COVID situation. The equipment could not arrive on time especially the electronics devices because of shortage in supplies. Furthermore, Financial Department of our institutions were closed and the needs for hardcopy documentation for procurements exacerbated the situation. During the pandemic, all teaching and learning activities especially lectures and laboratory sessions were put on hold. Hence, the ToTs were conducted online instead and divided into two (2) sessions. The first session is theoretical in nature, whilst the second session involves more hands-on and the use of equipment purchased from SHYFTE equipment cost.



## 2. Domain 3: Wireless Network Analytics

In D1.2 and D1.3, a survey was conducted to 40 small and medium-sized enterprises (SMEs) in Malaysia asking them about the required elements of the Fourth Industrial Revolution (IR 4.0). Some of the SMEs that responded to the survey are Vectolab Technologies Sdn. Bhd., TS Global Networks Sdn. Bhd., SR Aviation Sdn. Bhd., Fujitsu Component (M) Sdn. Bhd., etc. The survey also asked the importance of relevant topics of IR 4.0 such as IoT, wireless sensor networks, big data, artificial intelligence, among others. From the survey, it is observed that the SMEs require IoT and big data analytics skill sets for upskilling their existing knowledge. Hence, Domain 3 addresses these topics in the development of our module.

The learning framework for the third domain “Wireless Network Analytics” include five skill sets (SkS) which are defined in Figure 2.1.

### 2.1 Domain 3: Skill Sets

The “Wireless Network Analytics” domain is composed of five 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

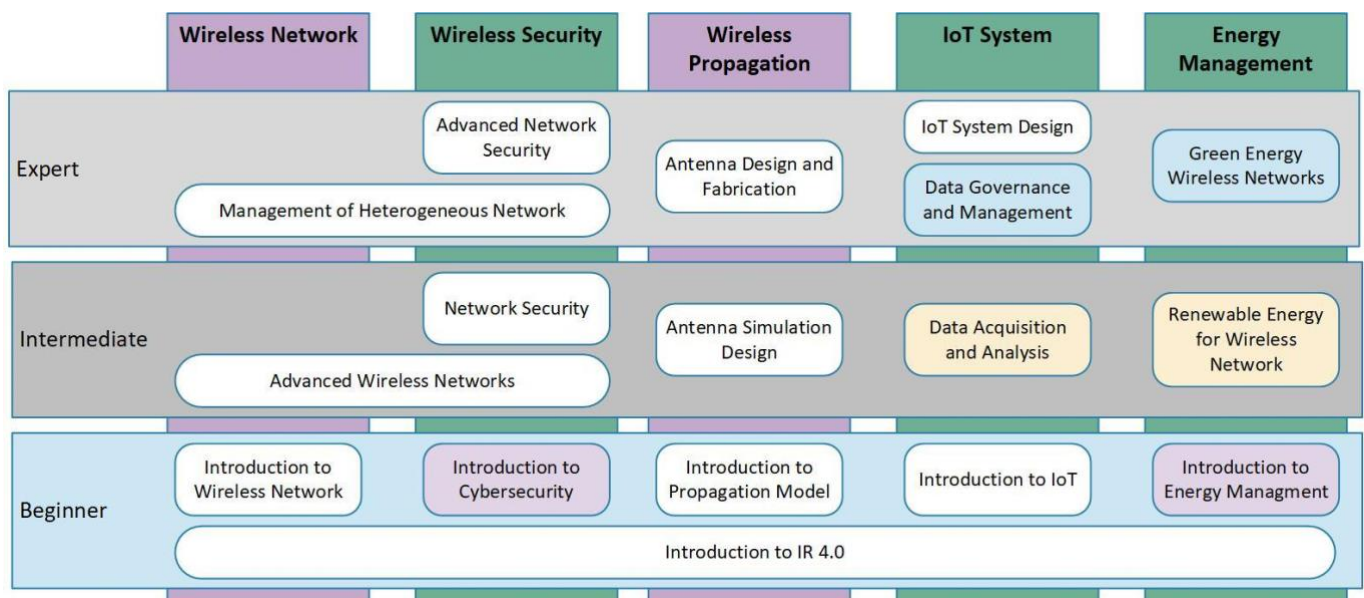


Figure 2.1: Learning Framework – Domain 3: Wireless Network Analytics.



## 2.2 Domain 3: Learning Materials Overview

From the framework, a total number of 17 modules are included in the third domain learning framework. Out of the 17 modules, 7 modules are newly developed modules to fit the knowledge gap and requirement of Skills4.0 between the HEIs and industries in Asia. The new modules are as follows:

- Introduction to IR 4.0
- Introduction to Cybersecurity
- Introduction to Energy Management
- Data Acquisition and Analysis
- Renewable Energy for Wireless Network
- Data Governance and Management
- Green Energy Wireless Network

For the seven newly developed modules, “Introduction to IR 4.0” is included in all four domains and developed by partners on domain one, whilst the rest are developed by Universiti Putra Malaysia. The remaining 11 modules are adapted from the existing curriculum of Universiti Putra Malaysia to fulfil the skills requirement identified in WP1. Learning materials of newly developed modules are detailed in the next section.

### 3. Learning Materials Description

This section provides detailed information about the learning materials developed including the topics, teaching plans (delivery method and soft skills), prerequisites and learning outcomes.

#### 3.1 Introduction to IR 4.0

MODULE TITLE		Introduction to Industrial Revolution 4.0	
TOTAL LEARNING HOURS	:	18 hours	
PRE-REQUISITE	:	None	
LEARNING OUTCOMES	:	Participants are able to :	
		1. Explain the concept of Industry 4.0. 2. Realize how to implement this concept to targeted industry.	
SYNOPSIS	:	Introduction to Industry 4.0 concept application and case studies	
MODULE CONTENTS			
			<b>Learning Hours</b>
TOPICS	:	1. Introduction to IR 4.0	2
		- Background of Industry 4.0 - Industry 4.0 Environment	
		2. The implementation challenges of Industry 4.0	2
		3. Introduction to Smart factories	2
		4. Digital Supply Chain	2
		5. The Role of Big Data Analytic in Industry 4.0	2
		6. Industrial IoT - Application and case studies 1	1.5
		7. Maturity assessment tool for Industry 4.0	2
		8. Cyber Physical System and next generation of sensors	3
		9. Industrial IoT - Application and case studies 2	2
		<b>Total</b>	<b>12</b>
DELIVERY	:	Lecture	
METHOD		Case study	
		Group work	
SOFT SKILLS	:	Team working	
		Problem solving	
		Ability to work with data	

<b>RESOURCES</b>		<b>Presentation Slide</b>	<a href="https://disp-ds.univ-lyon2.fr/owncloud/f/1118695">https://disp-ds.univ-lyon2.fr/owncloud/f/1118695</a>
<b>REFERENCES</b>	:	<p>Dominik T. Matt, Vladimír Modrák, Helmut Zsifkovits (2020), Industry 4.0 for SMEs: Challenges, Opportunities and Requirements, Palgrave Macmillan Cham</p> <p>Dominik T. Matt, Vladimír Modrák, Helmut Zsifkovits (2020), Implementing Industry 4.0 in SMEs: Concepts, Examples and Applications, Palgrave Macmillan Cham</p> <p>Santiteerakul S, Sopadang A, Yaibuathet Tipayawong K, Tamvimol K. The Role of Smart Technology in Sustainable Agriculture: A Case Study of Wangree Plant Factory. Sustainability. 2020; 12(11):4640. <a href="https://doi.org/10.3390/su12114640">https://doi.org/10.3390/su12114640</a></p>	

### 3.2 Introduction to Cybersecurity

<b>MODULE TITLE</b>	<b>Introduction to Cybersecurity</b>		
<b>TOTAL LEARNING HOURS</b>	:	12 hours	
<b>PRE-REQUISITE</b>	:	Introduction to IR 4.0	
<b>LEARNING OUTCOMES</b>	:	<p>Participants are able to :</p> <ol style="list-style-type: none"> <li>1. Understand the issues and challenges in cybersecurity</li> <li>2. Analyse cybersecurity related problems</li> <li>3. Identify the solution to cybersecurity related problems</li> </ol>	
<b>SYNOPSIS</b>	:	<p>This course covers the fundamental concept of cybersecurity. Participants will learn about importance of cybersecurity, its main issues and challenges, related law and regulations, and basic cryptography. This course also presents the defensive measures that can be taken by organization or individual to prevent attacks, and provides an overview of the malicious software types used in computer networks.</p>	
<b>MODULE CONTENTS</b>			
			<u>Learning Hours</u>
<b>TOPICS</b>	:	1. Cybersecurity Fundamentals	1
		<ul style="list-style-type: none"> <li>- Definition and importance of cybersecurity</li> <li>- Security goals: the CIA triad</li> <li>- Vulnerabilities and threats</li> </ul>	

			<ul style="list-style-type: none"> <li>- Cyber space: issues and challenges</li> <li>- Cybersecurity law and regulation</li> </ul>	
		2.	Cryptography for Beginners	2
			<ul style="list-style-type: none"> <li>- Encryption and decryption</li> <li>- Classical cryptography: substitution vs transposition</li> <li>- Cryptographic algorithm: symmetric vs asymmetric</li> <li>- Hashing and checksum</li> <li>- Public Key Infrastructure (PKI)</li> </ul>	
		3.	Cybersecurity Threat: Malware	2
			<ul style="list-style-type: none"> <li>- Worms</li> <li>- Viruses</li> <li>- Spyware</li> <li>- Trojans</li> <li>- Case study</li> </ul>	
		4.	Cybersecurity Threat: Security Breaches	1
			<ul style="list-style-type: none"> <li>- Phishing</li> <li>- Identity theft</li> <li>- Harassment</li> <li>- Cyberstalking</li> <li>- Case study</li> </ul>	
		5.	Cybersecurity Threat: Cyber Attacks	2
			<ul style="list-style-type: none"> <li>- Passive vs active attacks</li> <li>- Penetration testing</li> <li>- Password attacks</li> <li>- Denial of Service (DoS) attacks</li> <li>- Distributed Denial of Service (DDoS) attacks</li> <li>- Case study</li> </ul>	
		6.	Critical Cyber Threats	1
			<ul style="list-style-type: none"> <li>- Cyber terrorism</li> <li>- Cyber warfare</li> <li>- Cyber espionage</li> </ul>	
		7.	Countermeasures and Defense	3
			<ul style="list-style-type: none"> <li>- Cybersecurity best practices</li> <li>- Firewalls</li> <li>- Virtual Private Networks (VPN)</li> <li>- Anti-virus and anti-spyware</li> <li>- Intrusion detection</li> <li>- Mobile protection and social network security</li> <li>- Digital forensics</li> <li>- Legal recourse</li> <li>- Useful tools for cybersecurity</li> </ul>	
			<b>Total</b>	<b>12</b>
<b>DELIVERY</b>	:	Lecture		

<b>METHOD</b>		Case study	
		Group work	
<b>SOFT SKILLS</b>	:	Infographic communication	
		Teamwork	
		Presentation	
<b>REFERENCES</b>	:	<ol style="list-style-type: none"> <li>1. Aumasson, J.P. (2017). Serious Cryptography: A Practical Introduction to Modern Encryption. San Francisco: No Starch Press.</li> <li>2. Easttom, C.C. (2018). Network Defense and Countermeasures: Principles and Practices: Principles and Practices. (6th Edition). London: Pearson.</li> <li>3. Gilman, E. &amp; Barth, D. (2018). Zero Trust Networks: Building Secure Systems in Untrusted Networks. California: O'Reilly Media.</li> <li>4. Kizza, J.M. (2017). Guide to Computer Network Security (Computer Communications and Networks). New York: Springer.</li> <li>5. Stallings, W. (2016). Cryptography and Network Security: Principles and Practice. (7th Edition). London: Pearson.</li> </ol>	

The resources for the module can be found here:

Item	Link
Slides	<a href="https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Introduction_to_Cybersecurity-SHYFTE-FHH.pptx">https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Introduction_to_Cybersecurity-SHYFTE-FHH.pptx</a>
Recorded zoom sessions	None
Video / link for references	<ol style="list-style-type: none"> <li>1. <a href="https://www.youtube.com/watch?v=btZhrmK2sYA">https://www.youtube.com/watch?v=btZhrmK2sYA</a></li> <li>2. <a href="https://www.youtube.com/watch?v=odPdvvWNBK4">https://www.youtube.com/watch?v=odPdvvWNBK4</a></li> <li>3. <a href="https://www.youtube.com/watch?v=iFGve5MUUnE">https://www.youtube.com/watch?v=iFGve5MUUnE</a></li> <li>4. <a href="https://www.youtube.com/watch?v=7KCMK-LY-WM">https://www.youtube.com/watch?v=7KCMK-LY-WM</a></li> <li>5. <a href="https://www.youtube.com/watch?v=Dk-ZqQ-bfy4">https://www.youtube.com/watch?v=Dk-ZqQ-bfy4</a></li> <li>6. <a href="https://www.youtube.com/watch?v=zqvDu0OaY8k">https://www.youtube.com/watch?v=zqvDu0OaY8k</a></li> </ol>

### 3.3 Introduction to Energy Management

MODULE TITLE		Introduction to Energy Management	
TOTAL LEARNING HOURS	:	6 hours	
PRE-REQUISITE	:	Introduction to IR 4.0	
LEARNING OUTCOMES	:	Participants are able to :	
		1. Understand the concept and components of energy management and Energy Management System Standards (EnMS) for wireless network. 2. Manage the energy efficiency and lifecycle in IoT system 3. Design energy management framework for wireless network system.	
SYNOPSIS	:	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.	
MODULE CONTENTS			
			<u>Learning Hours</u>
TOPICS	:	1. Energy management systems and energy efficiency	2
		<ul style="list-style-type: none"> <li>- Overview and concept</li> <li>- Energy management techniques</li> </ul>	
		2. Energy management system standard	2
		<ul style="list-style-type: none"> <li>- EnMS for wireless communication and IoT</li> <li>- EnMS project lifecycle</li> </ul>	
		3. Application-specific energy management and energy efficiency	2
		<ul style="list-style-type: none"> <li>- Heterogeneous network</li> <li>- Cellular network</li> <li>- Ad-hoc network</li> <li>- Cognitive radio network</li> <li>- Emerging wireless network</li> </ul>	
		<b>Total</b>	<b>6</b>
DELIVERY METHOD	:	Lecture	
		Case study	
		Group work	
		Project assignment	

<b>SOFT SKILLS</b>	:	Infographic communication	
		Teamwork	
		Presentation	
<b>REFERENCES</b>	:	<ol style="list-style-type: none"> <li>1. Shakir, M. Z., Imran, M. A., Qaraqe, K. A., Alouini, M. S., &amp; Vasilakos, A. V. (Eds.). (2016). Energy management in wireless cellular and ad-hoc networks. Springer International Publishing.</li> <li>2. Zhang, D., Chen, Z., Zhou, H., &amp; Shen, X. S. (2017). Resource management for energy and spectrum harvesting sensor networks. Springer.</li> <li>3. Jamalipour, A., &amp; Bi, Y. (2019). Wireless powered communication networks: From security challenges to IoT applications. Springer International Publishing.</li> <li>4. Huang, C., Zhou, S., Xu, J., Niu, Z., Zhang, R., &amp; Cui, S. (2019). Energy Harvesting Wireless Communications. John Wiley &amp; Sons, Incorporated.</li> </ol>	

The resources for the module can be found here:

Item	Link
Slides	<a href="https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Intro_to_Energy_Mgmt.pptx">https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Intro_to_Energy_Mgmt.pptx</a>
Recorded zoom sessions	<a href="https://drive.google.com/file/d/1pgdmtZ3r_OLMoBjvzQtfer3-Nj1Olud/view?usp=sharing">https://drive.google.com/file/d/1pgdmtZ3r_OLMoBjvzQtfer3-Nj1Olud/view?usp=sharing</a>
Video / link for references	None

### 3.4 Data Acquisition and Analysis

MODULE TITLE	Data Acquisition and Analysis	
<b>TOTAL LEARNING HOURS</b>	:	12 hours
<b>PRE-REQUISITE</b>	:	Introduction to IoT
<b>LEARNING OUTCOMES</b>	:	Students are able to :



		1. Participants will be able to build a basic IoT data acquisition and perform data analysis 2. Participants will be able to understand the opportunities and challenges of IoT system	
<b>SYNOPSIS</b>	:	This course will cover the IoT framework for data acquisition and analysis to solve the problem. Participants will be learning about IoT architecture, smart objects, IoT communication protocol, connecting smart objects to the network, and data and knowledge management. Advanced concepts such as distributed data analysis and LoRa configuration and hands-on will be covered toward the end of the course.	
<b>MODULE CONTENTS</b>			
			<u>Learning Hours</u>
<b>TOPICS</b>	:	1. IoT Architecture	1
		<ul style="list-style-type: none"> <li>- Definition IoT</li> <li>- Massive IoT: IoT applications in Different Domains</li> <li>- IoT Challenge</li> <li>- Emerging IoT Standards</li> <li>- Layer 1: Things, Sensors and Actuators</li> <li>- Layer 2: Communication Network Layer</li> <li>- Layer 3: Application Layer</li> </ul>	
		2. Smart Objects	1
		<ul style="list-style-type: none"> <li>- Trend in Smart Objects</li> <li>- Smart Object Architectures</li> <li>- Reliability of Smart Object Architectures</li> <li>- Scalability of Smart Object Architectures</li> </ul>	
		3. IoT Communication Protocol	1
		<ul style="list-style-type: none"> <li>- Wireless Communication Protocol: Bluetooth, WiFi, Zigbee, 6LowPAN</li> <li>- Networking Protocols: TCP/IP, Ethernet</li> <li>- IoT Application Protocol: RESTful HTTP, Web Socket, MQTT, CoAP</li> </ul>	
		4. Connecting Smart Objects to the Network	1
		<ul style="list-style-type: none"> <li>- Machine to machine communications (m2m)</li> <li>- Network reliability and security</li> </ul>	
		5. IoT Data and Knowledge Management	1
		<ul style="list-style-type: none"> <li>- Stream processing in IoT</li> <li>- Data normalization</li> </ul>	
		6. Distributed Data Analysis	1
		<ul style="list-style-type: none"> <li>- Basic data analytics in IoT</li> <li>- Cloud services model</li> </ul>	

			- Big data tools to process IoT data	
		7.	LoRA Configuration and Hands-on	6
			<ul style="list-style-type: none"> <li>- Hardware and software setup</li> <li>- Signal strength measurement</li> <li>- Data transmission and data analysis</li> </ul>	
			<b>Total</b>	<b>12</b>
<b>DELIVERY</b>	:	Lecture		
<b>METHOD</b>		Case study		
		Group work & discussion		
		IoT hands-on project		
<b>SOFT SKILLS</b>	:	Problem solving		
		Critical thinking		
		Teamwork		
		Infographic communication		
<b>REFERENCES</b>	:	1. Minteer, A. (2017). <i>Analytics for the Internet of Things (IoT): Intelligent analytics for your intelligent devices</i> . Packt Publishing Ltd.  2. Greengard, S. (2015). <i>The Internet of Things</i> . The MIT Press.  3. Cirani, S., Ferrari, G., Picone, M., & Veltri, L. (2018). <i>Internet of Things: Architectures, Protocols and Standards</i> . John Wiley & Sons.  4. Lea, P. (2018). <i>Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security</i> . Packt Publishing Ltd.  5. Schwab, K. (2017). <i>The fourth industrial revolution</i> . Currency.		

The resources for the module can be found here:

Item	Link
Slides	<a href="https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Data_acquisition_and_analysis.pptx">https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Data_acquisition_and_analysis.pptx</a>
Recorded zoom sessions	1. <a href="https://youtu.be/b1195aqDI1o">https://youtu.be/b1195aqDI1o</a> 2. <a href="https://youtu.be/PKJ-6oEGUqQ">https://youtu.be/PKJ-6oEGUqQ</a>
Video / link for references	1. <a href="https://www.youtube.com/watch?time_continue=224&amp;v=w6ygDCTSQuq&amp;feature=emb_logo">https://www.youtube.com/watch?time_continue=224&amp;v=w6ygDCTSQuq&amp;feature=emb_logo</a>

	2. <a href="https://www.youtube.com/watch?v=UrwbeOllc68">https://www.youtube.com/watch?v=UrwbeOllc68</a> 3. <a href="https://www.youtube.com/watch?v=x-KBN5cPGww">https://www.youtube.com/watch?v=x-KBN5cPGww</a> 4. <a href="https://www.youtube.com/watch?v=Pwc0cX43sec">https://www.youtube.com/watch?v=Pwc0cX43sec</a> 5. <a href="https://www.youtube.com/watch?v=K2vLNtvJcQE">https://www.youtube.com/watch?v=K2vLNtvJcQE</a> 6. <a href="https://www.youtube.com/watch?v=-ijLW67YIzY">https://www.youtube.com/watch?v=-ijLW67YIzY</a>
--	--

### 3.5 Renewable Energy for Wireless Network

MODULE TITLE		Renewable Energy for Wireless Network	
TOTAL LEARNING HOURS	:	6 hours	
PRE-REQUISITE	:	Introduction to Energy Management	
LEARNING OUTCOMES	:	Participants are able to :	
		1. Understand the concept and components of renewable energy for wireless network. 2. Learn the latest techniques or technology for renewable and sustainable wireless network system. 3. Design renewable energy framework for wireless network system.	
SYNOPSIS	:	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.	
MODULE CONTENTS			
			<u>Learning Hours</u>
TOPICS	:	1. Introduction to renewable energy in wireless communication	1
		- Overview - Types of renewable energy	
		2. Energy harvesting in wireless communication	1
		- Method of energy harvesting - RF energy harvesting - RF power source	
		3. Concept of wireless power transfer	1
		- Overview - Near-field techniques - Far-field techniques	

		4.	Simultaneous wireless information and power transfer (SWIPT)	2
			<ul style="list-style-type: none"> <li>- Separate receiver</li> <li>- Time switching receiver</li> <li>- Power splitting receiver</li> <li>- Antenna switching receiver</li> <li>- Interference exploitation in SWIPT</li> <li>- Emerging Scenario</li> </ul>	
		5.	Power allocation for multi-node energy harvesting channel	1
			<ul style="list-style-type: none"> <li>- Multi-access channels</li> <li>- Relay model and network</li> <li>- Optimal sum power allocation</li> </ul>	
			<b>Total</b>	<b>6</b>
<b>DELIVERY METHOD</b>	:		Lecture	
			Case study	
			Group work	
			Project assignment	
<b>SOFT SKILLS</b>	:		Infographic communication	
			Teamwork	
			Presentation	
<b>REFERENCES</b>	:		<ol style="list-style-type: none"> <li>1. Shakir, M. Z., Imran, M. A., Qaraqe, K. A., Alouini, M. S., &amp; Vasilakos, A. V. (Eds.). (2016). Energy management in wireless cellular and ad-hoc networks. Springer International Publishing.</li> <li>2. Zhang, D., Chen, Z., Zhou, H., &amp; Shen, X. S. (2017). Resource management for energy and spectrum harvesting sensor networks. Springer.</li> <li>3. Jamalipour, A., &amp; Bi, Y. (2019). Wireless powered communication networks: From security challenges to IoT applications. Springer International Publishing.</li> <li>4. Huang, C., Zhou, S., Xu, J., Niu, Z., Zhang, R., &amp; Cui, S. (2019). Energy Harvesting Wireless Communications. John Wiley &amp; Sons, Incorporated.</li> </ol>	

The resources for the module can be found here:

Item	Link
Slides	<a href="https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPa">https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPa</a>

	ckages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Doma n3-Renewable_Energy_for_Wireless_Net.pptx
Recorded zoom sessions	<a href="https://drive.google.com/file/d/1gGsntNggl-H-zl9mZbm2PBWNqwcgo_Mc/view?usp=sharing">https://drive.google.com/file/d/1gGsntNggl-H-zl9mZbm2PBWNqwcgo_Mc/view?usp=sharing</a>
Video / link for references	<ol style="list-style-type: none"> <li>1. <a href="https://www.youtube.com/watch?v=SdZODbIT010">https://www.youtube.com/watch?v=SdZODbIT010</a></li> <li>2. <a href="https://hal.archives-ouvertes.fr/hal-01283728/document">https://hal.archives-ouvertes.fr/hal-01283728/document</a></li> </ol>

### 3.6 Data Governance and Management

MODULE TITLE		Data Governance and Management	
TOTAL LEARNING HOURS	:	12 hours	
PRE-REQUISITE	:	Data Acquisition and Analysis	
LEARNING OUTCOMES	:	Participants are able to :	
		<ol style="list-style-type: none"> <li>1. Understand the issues and challenges in data governance and management in IoT system</li> <li>2. Manage data and security issues in IoT system</li> <li>3. Design data governance and management framework for IoT system.</li> </ol>	
SYNOPSIS	:	This course will cover the concept of data governance and management for IoT system. Participants will learn about the concept of data governance, its challenges in IoT system, data management to implement the data governance policies, security requirements, and the best practices. Advanced concepts such as value-based data governance and intelligent data governance will be covered toward the end of the course.	
MODULE CONTENTS			
			<u>Learning Hours</u>
TOPICS	:	1. Data Governance and Management Concepts, Principles and Components	1
		<ul style="list-style-type: none"> <li>- Definition of data governance and management</li> <li>- Comparison of data governance against data management</li> <li>- Components of data governance</li> <li>- Type of data governance and management (Horizontal, Vertical, others)</li> </ul>	

		2.	Data Governance Challenges in IoT	1
			<ul style="list-style-type: none"> <li>- Data structure in IoT</li> <li>- Setting data policies, standard and process</li> <li>- Enforcing and monitoring data governance</li> </ul>	
		3.	Data Management Needs and Challenges	1
			<ul style="list-style-type: none"> <li>- Lifecycle of a dataset</li> <li>- Data documentation/Metadata</li> <li>- File organization and file formats</li> <li>- Data quality issues</li> </ul>	
		4.	Data Protection and Security Requirements	1
			<ul style="list-style-type: none"> <li>- Data integrity and availability</li> <li>- Access and version control</li> <li>- Security evaluation</li> <li>- Privacy and risk management</li> </ul>	
		5.	Data Governance Best Practices	1
			<ul style="list-style-type: none"> <li>- Value-based data governance</li> <li>- Transforming from data governance to business insights</li> <li>- Recent IoT data governance frameworks</li> </ul>	
		6.	Data Governance Benefits and Opportunities	1
			<ul style="list-style-type: none"> <li>- Documentation</li> <li>- Archiving</li> <li>- Data as business Asset</li> </ul>	
		7.	Case Study on Data Governance and Management	6
			<ul style="list-style-type: none"> <li>- Data analysis on IoT based system</li> <li>- Design data governance and management framework</li> </ul>	
			<b>Total</b>	<b>12</b>
<b>DELIVERY</b>	:	Lecture		
<b>METHOD</b>		Case study		
		Group work		
		Role play		
<b>SOFT SKILLS</b>	:	Problem solving		
		Critical thinking		
		Teamwork		
		Infographic communication		
<b>REFERENCES</b>	:	1. Hitachi Vantara. (2018). <i>Intelligent Data Governance</i> . John Wiley & Sons, Inc.  2. MIT Libraries Data Management. (2016). <i>Data Management</i> . MIT Open Courseware.		

	<ol style="list-style-type: none"> <li>3. Hanes, D., Salgueiro, G., Grossetete, P., Barton, R., &amp; Henry, J. (2017). IoT fundamentals: Networking technologies, protocols, and use cases for the internet of things. Cisco Press.</li> <li>4. Sunil Soares (2015). The Chief Data Officer Handbook for Data Governance Paperback. MC Press.</li> <li>5. Helmut Schindlwick (2017). IT Governance: How to Reduce Costs and Improve Data Quality through the Implementation of IT Governance (First Edition). CreateSpace Independent Publishing Platform.</li> </ol>
--	--

The resources for the module can be found here:

Item	Link
Slides	<a href="https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Data_governance_and_management.pptx">https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Data_governance_and_management.pptx</a>
Recorded zoom sessions	<a href="https://drive.google.com/file/d/1HNtKdOtCECQbHN3brOsLdivpQ9FYOhxn/view?usp=sharing">https://drive.google.com/file/d/1HNtKdOtCECQbHN3brOsLdivpQ9FYOhxn/view?usp=sharing</a>
Video / link for references	<ol style="list-style-type: none"> <li>1. <a href="https://www.tableau.com/learn/articles/data-governance-best-practices">https://www.tableau.com/learn/articles/data-governance-best-practices</a></li> <li>2. <a href="https://www.iotone.com/casestudies">https://www.iotone.com/casestudies</a></li> </ol>

### 3.7 Green Energy Wireless Networks

MODULE TITLE	Green Energy Wireless Networks	
TOTAL LEARNING HOURS	:	18 hours
PRE-REQUISITE	:	Renewable Energy for Wireless Network
LEARNING OUTCOMES	:	Participants are able to :
		<ol style="list-style-type: none"> <li>1. explain the concept of energy management in general.</li> <li>2. model energy usage based on data provided for sustainable business model.</li> <li>3. apply appropriate techniques for energy optimisation based on the model identified.</li> </ol>



<b>SYNOPSIS</b>	:	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.		
<b>MODULE CONTENTS</b>				
				<u>Learning Hours</u>
<b>LECTURE</b>	:	1.	Sustainability in telecommunication network	3
			<ul style="list-style-type: none"> <li>- Environmental Impact of Telecommunication</li> <li>- Rebound Effect</li> <li>- Life-Cycle Assessment</li> <li>- Concept of Green Telecommunication</li> <li>- Green Network Opportunities and Challenges</li> </ul>	
		2.	Sustainable business telecommunication business model	5
			<ul style="list-style-type: none"> <li>- Eco-Sustainable System and Network Architectures for Green Networks</li> <li>- Data Centers in Green Communication</li> <li>- Telecommunication and Habitats</li> <li>- Telecommunication recycling</li> <li>- Capacity planning and optimization</li> </ul>	
		3.	Wireless Energy Usage and Modelling	5
			<ul style="list-style-type: none"> <li>- Benchmarking of Energy Consumption</li> <li>- Power Consumption Modelling</li> <li>- Energy Efficiency in Telecommunication Network</li> <li>- Energy Consumption of Data Centers</li> </ul>	
		4.	Wireless Energy Optimisation Techniques	5
			<ul style="list-style-type: none"> <li>- Optimizing Hardware</li> <li>- Shutdown Approach</li> <li>- Slowdown Approach</li> <li>- Coordination Approach</li> <li>- BTS Energy Saving Strategies</li> <li>- Renewable Energy Sources</li> </ul>	
			<b>Total</b>	<b>18</b>
<b>DELIVERY</b>	:	Lecture		

<b>METHOD</b>		Case study	
		Group work	
		Role play	
<b>SOFT SKILLS</b>	:	Problem solving	
		Critical thinking	
		Teamwork	
		Infographic communication	
<b>REFERENCES</b>	:	<ol style="list-style-type: none"> <li>1. Shakir, M. Z., Imran, M. A., Qaraqe, K. A., Alouini, M. S., &amp; Vasilakos, A. V. (Eds.). (2016). Energy management in wireless cellular and ad-hoc networks. Springer International Publishing.</li> <li>2. Huang, C., Zhou, S., Xu, J., Niu, Z., Zhang, R., &amp; Cui, S. (2019). Energy Harvesting Wireless Communications. John Wiley &amp; Sons, Incorporated.</li> <li>3. Alsharif, M. H., Kim, J., &amp; Kim, J. H. (2017). Green and sustainable cellular base stations: An overview and future research directions. Energies, 10(5), 587.</li> <li>4. Habib, S. J., &amp; Marimuthu, P. N. (2012, October). Capacity Planning for Enterprise Green Communications. In International Conference on Green Communications and Networking (pp. 72-80). Springer, Berlin, Heidelberg.</li> </ol>	

The resources for the module can be found here:

Item	Link
Slides	<a href="https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Green_Energy_Wireless_Network.pptx">https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Green_Energy_Wireless_Network.pptx</a>
Recorded zoom sessions	<a href="https://drive.google.com/file/d/1HNtKdOtCECQbHN3brOsLdivpQ9FYOhxn/view?usp=sharing">https://drive.google.com/file/d/1HNtKdOtCECQbHN3brOsLdivpQ9FYOhxn/view?usp=sharing</a>

## 4. Use of Shyfte Equipment

From the survey we conducted among SMEs in the areas of wireless networks, it was found that the IoT and data analytics are very much in demand due to the nature of manufacturing and production in the local environment. Hence, Domain 3 considered procuring IoT and data analytics equipment. It was identified that LoRA access technology is feasible and cost-efficient for IoT system development. Matlab software, on the other hand, has been robust in simulations of data analytics and visualisation.

The equipment was then purchased using the procedures outlined by UPM Bendahari Office. These are the procedures involved:

1. Identification of three (3) quotations from relevant companies
2. Bendahari Office and ICT Department sit for a meeting for approval
3. One (1) quotation will be chosen, and Purchase Order (PO) are issued for the company to complete the service
4. Equipment and service is delivered by the selected company
5. Upon completion, Local Order (LO) is issued by the company for payment by UPM Bendahari Office.
6. The researcher issues a Release Order (RO) to complete the procurement process.

The equipment purchased under the project has been used in Data Acquisition and Analysis, and Renewable Energy for Wireless Networks. The summary on how the equipment is being used in the modules are presented in Table 4.1 below. The figure 4.1 and Figure 4.2 illustrates the equipments that have been used for the module's implementation.

Table 4.1 : List of module and equipment.

Module Title	Equipment	Implementation
Data Acquisition and Analysis	LoRA modules (Receiver) Indoor LoRA Gateway Outdoor LoRA Gateway	<p>The LoRA setup is being demonstrated, to show how it is used in IoT system development.</p> <p>From the LoRA modules, sensors are connected to relay data such as temperature, gas and air quality, from the site to the cloud.</p> <p>The sensory data is displayed on a simple dashboard for the users to view the data.</p>
Renewable Energy for Wireless Networks	Matlab software Personal Computers	In this module, Matlab is used to simulate Simultaneous Wireless Information and Power Transfer

		<p>(SWIPT) in a wireless networks scenario.</p> <p>Two (2) techniques on how to implement SWIPT in a wireless network scenario are shown, which are Optimal Relay Selection (ORS) and 2-stage Relay Selection (2RRS). From the algorithms, the performance parameters such as throughput and system efficiency are plotted.</p>
--	--	---



(a) LoRA module (receiver).

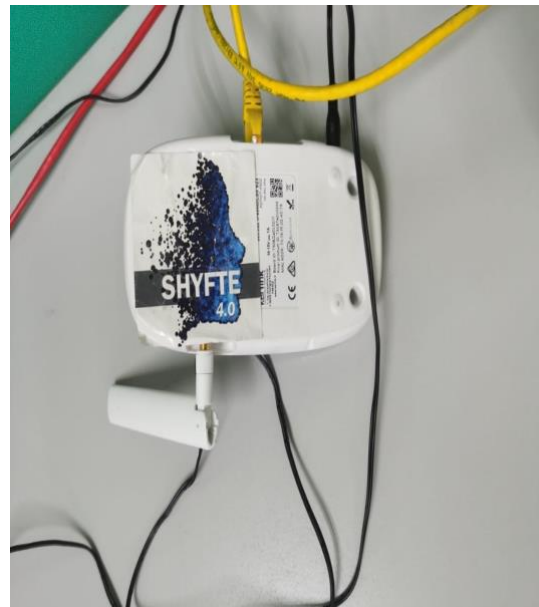


(b) Environmental monitoring using LoRA module.





(c) Lora indoor gateway (top-view).



(d) Lora indoor gateway (bottom-view).

Figure 4.1 : Shyfte equipment with sticker.



Figure 4.2 : LoRA outdoor gateway.

## 5. Learning Materials Review and Improvement

To ensure the quality of developed learning materials, all the newly developed modules have been reviewed and improved based on the feedback of internal and external reviewers. This section will highlight the overview of both the internal and external reviews. Details of the reviews have been filled in the reviewer form.

### 5.1 Introduction to IR 4.0

Internal Reviewer's Name	Assoc. Prof. Dr. Wichai Chattinnawat
Position	Associate Professor
Organization (University/Company)	Chiang Mai University
Date Review Completed	18 <sup>th</sup> June 2021
Instructional Design Elements Score	43/48 (average 3.58)
Content Score	19/20 (average 3.80)
Suggestions	If the video links are accessible to the public, you should include the link in the material so that trainees can rewatch it.

### 5.2 Introduction to Cybersecurity

Internal Reviewer's Name	Assoc. Prof. Dr. Sharifah Mumtazah Syed Ahmad
Position	Associate Professor
Organization (University/Company)	Universiti Putra Malaysia
Date Review Completed	23 <sup>rd</sup> Feb 2021
Instructional Design Elements Score	45/60
Content Score	19/25
Suggestions	No further comments.

External Reviewer's Name	Salman Abdul Wahab
Position	Manager
Organization (University/Company)	CyberSecurity Malaysia

<b>Date Review Completed</b>	<b>26<sup>th</sup> Feb 2021</b>
<b>Instructional Design Elements Score</b>	<b>45/60</b>
<b>Content Score</b>	<b>18/25</b>
<b>Suggestions</b>	<p>To rearrange the Cryptography topic under Countermeasures.</p> <p>The reason why not to highlight cryptography as 1 main topic, we don't want the participants think that cyber security is only about cryptography.</p> <p>To expose the trainee with the Cyber Security Domains. This will explain the areas in cyber security.</p> <p>Can make a reference to 8 CISSP Domains :</p> <ol style="list-style-type: none"> <li>1. Software Development security</li> <li>2. Security Operations</li> <li>3. Security Assessment and testing</li> <li>4. Identity and Access Management</li> <li>5. Communication and Network Security</li> <li>6. Security Architecture and Engineering</li> <li>7. Asset Security</li> <li>8. Security and Risk Management</li> </ol> <p>This can be included in Cybersecurity Fundamentals with brief explanation on each of the domains.</p> <p>Overall, the outline looks good. All the best to the team.</p>

### 5.3 Introduction to Energy Management

<b>Internal Reviewer's Name</b>	<b>Assoc. Prof. Dr. Zurina Mohd. Hanapi</b>
<b>Position</b>	<b>Associate Professor</b>
<b>Organization (University/Company)</b>	<b>Universiti Putra Malaysia</b>
<b>Date Review Completed</b>	<b>7<sup>th</sup> Dec 2020</b>
<b>Instructional Design Elements Score</b>	<b>43/50</b>
<b>Content Score</b>	<b>17/25</b>



<b>Suggestions</b>	<ol style="list-style-type: none"> <li>1. LO been scoped for wireless network and IoT. It would be better to highlight from the title and synopsis (especially). Or just make it general at the LO.</li> <li>2. Why only on these 3 layers (PHY, Data link, Network)? Different applications on different OS might utilize different energy, as well as TCP or UDP or SCTP. So better make general, perhaps.</li> <li>3. Based on the LO, where is EnMS IoT?</li> <li>4. Where to relate with IoT?</li> </ol>
--------------------	---

<b>External Reviewer's Name</b>	<b>Prof. Dr. Sharifah Kamilah Syed Yusof</b>
<b>Position</b>	<b>Associate Professor</b>
<b>Organization (University/Company)</b>	<b>Universiti Teknologi Malaysia</b>
<b>Date Review Completed</b>	<b>10<sup>th</sup> March 2021</b>
<b>Instructional Design Elements Score</b>	<b>46/60</b>
<b>Content Score</b>	<b>20/25</b>
<b>Suggestions</b>	<ol style="list-style-type: none"> <li>1. The module is timely relevant to the wireless communication area.</li> <li>2. The number of outcomes is adequate, and the statements are clear.</li> <li>3. EnMS is highlighted well in both the synopsis and lecture content. My suggestion is to include the term 'standard or EnMS' in one of the outcomes. Regarding the IoT system, shouldn't it be part of the lecture content? Or it's part of the case study/evaluation?</li> <li>4. The content can be delivered within the allocated time.</li> <li>5. The assessment is suitable and adequate. It is presumed that energy management framework design is involved in the evaluation process.</li> </ol>

## 5.4 Data Acquisition and Analysis

Internal Reviewer's Name	Siti Mariam Shafie @ Musa
Position	Lecturer
Organization (University/Company)	Universiti Putra Malaysia
Date Review Completed	19 <sup>th</sup> Oct 2020
Instructional Design Elements Score	47/60
Content Score	20/25
Suggestions	Minor revision needed on the wordings for learning outcomes.

External Reviewer's Name	Shamry Mubdi
Position	CEO
Organization (University/Company)	LoRaNet Technologies
Date Review Completed	30 <sup>th</sup> Oct 2020
Instructional Design Elements Score	48/60
Content Score	20/25
Suggestions	No comments.

## 5.5 Renewable Energy for Wireless Network

Internal Reviewer's Name	Prof. Madya Dr. Nasri Sulaiman
Position	Associate Professor
Organization (University/Company)	Universiti Putra Malaysia
Date Review Completed	9 <sup>th</sup> March 2021
Instructional Design Elements Score	43/60
Content Score	17/25
Suggestions	1. Describe the concept and components of renewable energy for wireless network.

	2. Apply the latest techniques or technology for renewable and sustainable wireless network system.
--	---

<b>External Reviewer's Name</b>	<b>Prof. Madya Dr. Bruce Leow</b>
<b>Position</b>	<b>Associate Professor</b>
<b>Organization (University/Company)</b>	<b>Universiti Teknologi Malaysia</b>
<b>Date Review Completed</b>	<b>2<sup>nd</sup> Jan 2021</b>
<b>Instructional Design Elements Score</b>	<b>46/60</b>
<b>Content Score</b>	<b>19/25</b>
<b>Suggestions</b>	<p>The proposed course looks good to me. I have only several suggestions:</p> <ol style="list-style-type: none"> <li>2. Suggestions: To consider introducing the concept of green communication along with the content in the proposed course.</li> <li>2. Suggestions: To consider introducing the concept of cycling wireless energy in Topic 4.</li> </ol>

## 5.6 Data Governance and Management

<b>Internal Reviewer's Name</b>	<b>Prof. Dr. Syed Abdul Rahman Al-Haddad Syed Mohamed</b>
<b>Position</b>	<b>Professor</b>
<b>Organization (University/Company)</b>	<b>Universiti Putra Malaysia</b>
<b>Date Review Completed</b>	<b>24<sup>th</sup> Nov 2020</b>
<b>Instructional Design Elements Score</b>	<b>42/60</b>
<b>Content Score</b>	<b>17/25</b>
<b>Suggestions</b>	<ol style="list-style-type: none"> <li>1. In general this course focuses on "IoT Data Governance and Management". Therefore the course title is suggested to add "IoT"</li> <li>2. Overall the course content is good which has elements of data preparation/policies, data cycles, security, and data quality</li> <li>3. No 1 add sub-content " Type of governance/management" either vertical,</li> </ol>

	horizontal, etc. CEO, COO, CIO, IT Manager, IT Support. SMALL/BIG Company 4. No.4 add privacy and sub-content "Risk management".
--	---

<b>External Reviewer's Name</b>	<b>Dr. Ahmad Nasruddin 'Atiqullah Fakrullah</b>
<b>Position</b>	<b>Senior Director</b>
<b>Organization (University/Company)</b>	<b>Malaysian Communications and Multimedia Commission</b>
<b>Date Review Completed</b>	<b>27<sup>th</sup> Nov 2020</b>
<b>Instructional Design Elements Score</b>	<b>47/60</b>
<b>Content Score</b>	<b>19/25</b>
<b>Suggestions</b>	Maybe, if it is not covered, for you to consider adding topic about the law and ethics with regards to data management etc into the module.

## 5.7 Green Energy Wireless Networks

<b>Internal Reviewer's Name</b>	<b>Prof. Dr. Mohd. Fadlee Abdul Rasid</b>
<b>Position</b>	<b>Professor</b>
<b>Organization (University/Company)</b>	<b>Universiti Putra Malaysia</b>
<b>Date Review Completed</b>	<b>12<sup>th</sup> March 2021</b>
<b>Instructional Design Elements Score</b>	<b>46/60</b>
<b>Content Score</b>	<b>19/25</b>
<b>Suggestions</b>	<ul style="list-style-type: none"> <li>2 The use of RE sources and energy harvesting maybe considered for Green Networks.</li> <li>2 Suggest updating references with more recent ones.</li> </ul>

<b>External Reviewer's Name</b>	<b>Assoc. Prof. Dr. Nurul Adilah Abdul Latiff</b>
<b>Position</b>	<b>Senior Lecturer</b>
<b>Organization (University/Company)</b>	<b>Universiti Malaysia Terengganu</b>

<b>Date Review Completed</b>	<b>9<sup>th</sup> March 2021</b>
<b>Instructional Design Elements Score</b>	<b>46/60</b>
<b>Content Score</b>	<b>18/25</b>
<b>Suggestions</b>	<ul style="list-style-type: none"> <li>3. Probably can add a subtopic on communication act by MCMC in the syllabus. This is important specially to connect with SME business.</li> <li>3. The lecture chapters look good and appropriate for students.</li> <li>3. Reference no 4, probably can find the latest &lt;5years publication for latest technologies.</li> <li>3. Should add 1 more textbooks on Optimisation in Reference.</li> </ul>

All the comments from the internal and external reviewers have been addressed and included in our learning materials. For example, in Introduction to Cybersecurity, the contents of cryptography have been reduced and the 8 domains related to Certified Information Systems Security Professional (CISSP) is included. Other comments have been updated in the syllabus for all other modules and implemented during the training of trainers (ToT) and students (ToS).

## 6. Training of the Trainers Sessions

Upon the completion of learning materials development and revision, Training of the Trainers (ToT) sessions are conducted.

We have disseminated the calling for ToT to relevant agencies and professional bodies which are already involved in IR 4.0 related area. The dissemination is made through emails and social media platforms to attract groups from Institute of Electrical and Electronics Engineers (IEEE), Department of Computer and Communication Systems Engineering, Department of Electrical and Electronics Engineering, Faculty of Computer Science and Information Technology, etc.

For Domain 3: Wireless Network Analytics, the ToT are conducted in 2 parts with each parts covering different modules. The decision of organising two parts ToT is due to the consideration of adapting the delivery methods based on the COVID-19 situation. First part of the ToT for Domain 3 is organised virtually given the travel restriction imposed by the partner countries. Second part of the ToT for Domain 3 which was planned to be held physically, is also organised virtually due to the prolonged travel restriction in Malaysia.

Overall, the ToTs have been attended by 56 participants where 2 participants are from Malaysian Communications and Multimedia Commission (MCMC), 1 from MIMOS Berhad, 2 from Vectolabs, some from other institutions such as Universiti Malaysia Terengganu (UMT) and Multimedia University (MMU). Upon completion of the ToTs, attendees were provided with Certificate of Appreciation. An example of the certificate is shown in Annex 5.

### 6.1 ToT Part 1

First part of ToT for Domain 3 is held virtually from 28<sup>th</sup> July until 2<sup>nd</sup> August 2021. Given that this part of ToT was held virtually during the pandemic, modules selected for the training are those which require less hands-on. The poster for the ToT sessions is shown in Figure 6.1.

Modules covered in first part of the ToTs are as follows:

1. Introduction to Cybersecurity
2. Introduction to Energy Management
3. Data Acquisition and Analysis (Theory)
4. Data Governance and Management



Figure 6.1: Domain 3 ToT Part 1 poster.

### 6.1.1 Part 1 Description and Analysis

Part 1 of the ToT for Domain 3 was held over four days in the afternoon to allow for the participations of EU partners. Based on the record, Domain 3 ToT Part 1 was attended by 95 trainers, including trainers from partner universities, such as CMU, KU and UTM. Detailed number of attendees for each modules are listed in Table 6.1, while the percentage of attendees are shown in Figure 6.2. The opening session is delivered by Prof Yacine Ouzrout, shown in Figure 6.3. Figure 6.4 until Figure 6.7 show the ToT sessions that have been conducted online.

Table 6.1 : ToT modules and number of participants.

ToT Module	Number of Participants
<i>Introduction to Cybersecurity</i>	34
<i>Introduction to Energy Management</i>	22
<i>Data Acquisition and Analysis</i>	22
<i>Data Governance and Management</i>	17
<b>Total</b>	<b>95</b>



The list of attendance of Training of Trainers is shown in Annex 1. All attendees of ToT are provided with Certificate of Appreciation and a sample is shown in Annex 2.

Which session you are attending?

95 responses

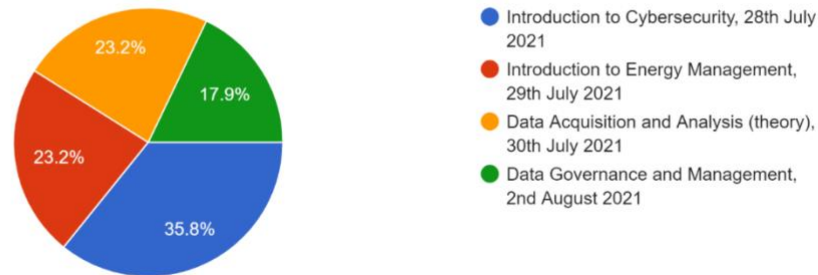


Figure 6.2: Percentage of attendance for each module.



Figure 6.3: Opening of Domain 3 ToT Part 1 by Prof. Yacine Ouzrout on 28<sup>th</sup> July 2021.

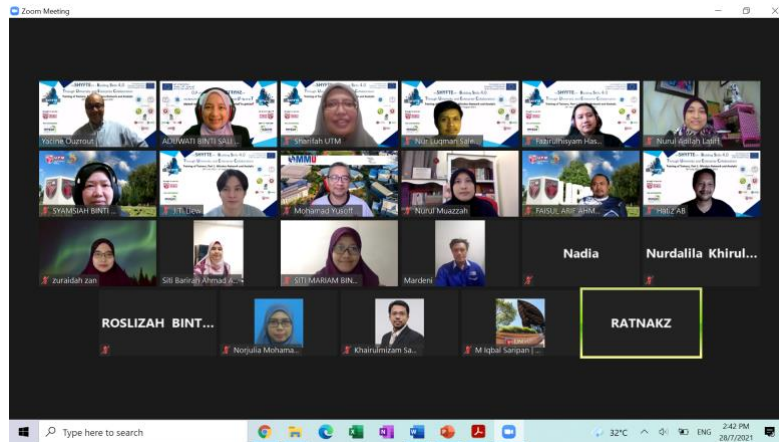


Figure 6.4: Picture of trainer and trainee on 28<sup>th</sup> July 2021.

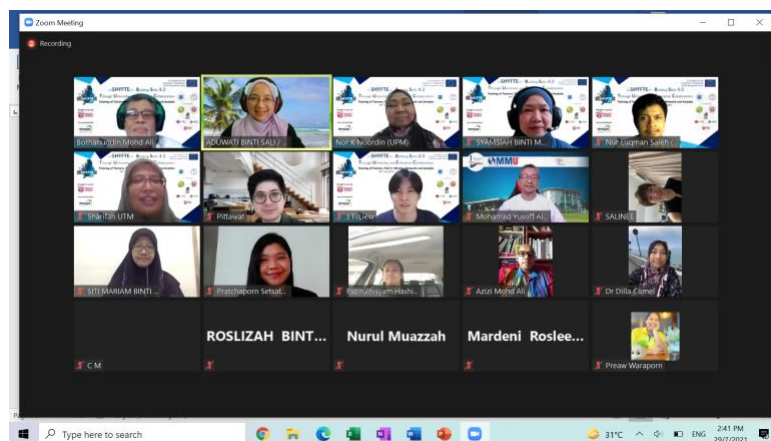


Figure 6.5: Picture of trainer and trainee on 29th July 2021.

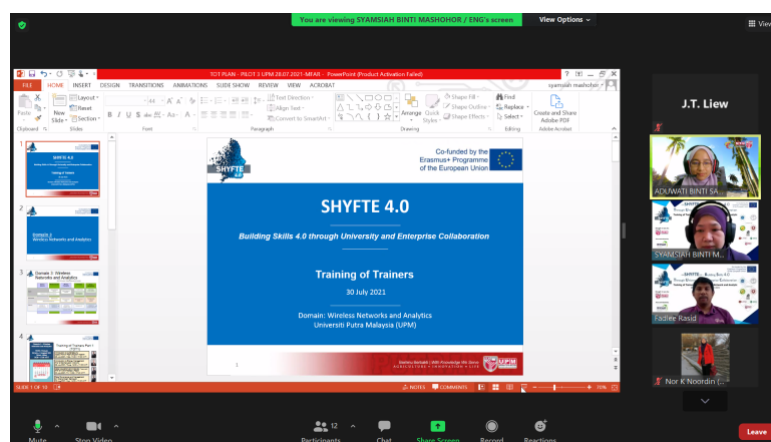


Figure 6.6: Picture of ToT session on 30th July 2021.

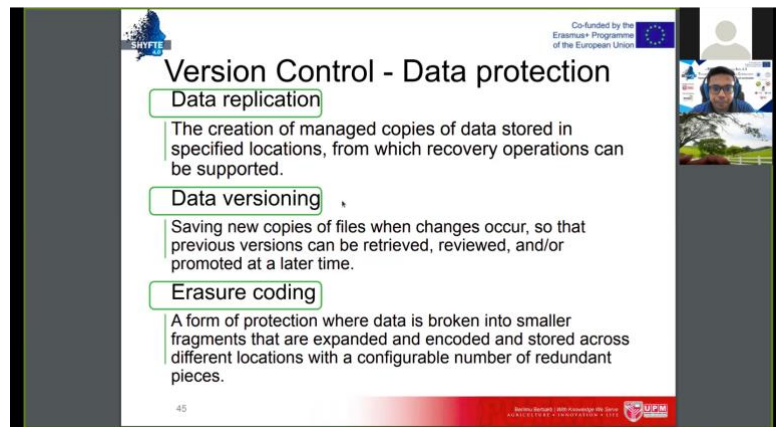


Figure 6.7: Picture of ToT session on 2nd August 2022.

### 6.1.2 Part 1 Feedback

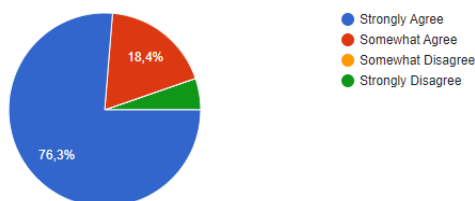
Satisfaction questionnaires was provided to all attendees to collect their feedback on quality of the ToT. From the collected responses shown in Table 6.2, the attendees are generally satisfied with the ToT sessions (shown in Figure 6.8). The inclusion of practical use cases also enhances the appreciation of the attendees on the knowledge shared. Nonetheless, it is suggested that the length of the modules can be increased to allow for more thorough knowledge sharing. However, from the many attendees, only 31% responded to the questionnaires.

Table 6.2 : List of module and participants.

ToT Module	Number of Participants
<b>Introduction to Cybersecurity</b>	<b>11</b>
<b>Introduction to Energy Management</b>	<b>3</b>
<b>Data Acquisition and Analysis</b>	<b>5</b>
<b>Data Governance and Management</b>	<b>10</b>
<b>Total</b>	<b>29</b>

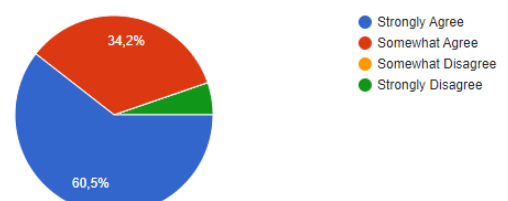
Did the trainer(s) provide suitable learning material to teach the specific topic?

38 response



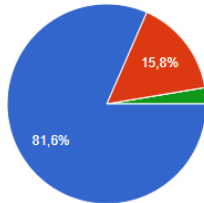
Did the learning method of trainer(s) stimulate interest in the specific topic?

38 response



The degree of explanation of the trainer(s) is adequate for this topic?

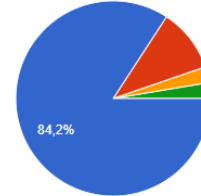
38 risposte



Strongly Agree  
Somewhat Agree  
Somewhat Disagree  
Strongly Disagree

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

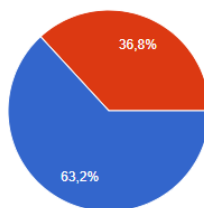
38 risposte



Strongly Agree  
Somewhat Agree  
Somewhat Disagree  
Strongly Disagree

Did you understand the content of the module?

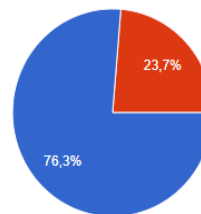
38 risposte



Strongly Agree  
Somewhat Agree  
Somewhat Disagree  
Strongly Disagree

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

38 risposte



Strongly Agree  
Somewhat Agree  
Somewhat Disagree  
Strongly Disagree

Figure 6.8 : The feedback's from the participants of ToT (Part 1).

## 6.2 ToT Part 2

Second part of ToT for domain 3 is held virtually on 11 January, 12 & 13 April 2022. Second part involves more hands-on with the usage of purchased equipment and software. The poster for ToT Part 2 is shown in Figure 6.9.

Modules covered in second part are as follows:

5. Data Acquisition and Analysis (Hands-on)
6. Renewable Energy for Wireless Network
7. Green Energy Wireless Network

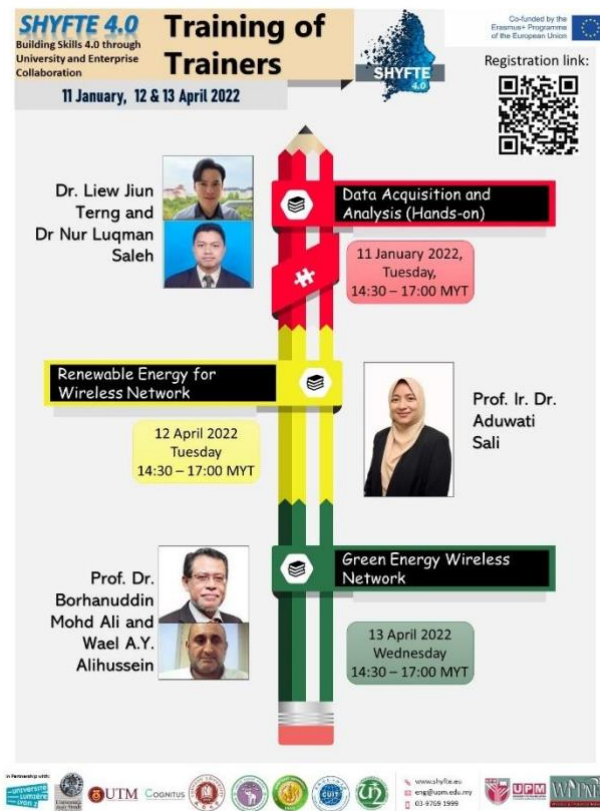


Figure 6.9: Domain 3 ToT Part 2 poster.

## 6.2.1 Part 2 Description and Analysis

Domain 3 ToT Part 2 was originally planned to be held physically with live demonstration of the equipment handling. However, due to the travel restriction, the ToT Part 2 was forced to held virtually with demonstration of the equipment handling through video recording. Furthermore, the modules also show the simulation process using purchased software: MATLAB. ToT Part 2 was attended by 146 attendees and the details are shown in Table 6.3 and the percentage of attendance is shown in Figure 6.10. The pictures of the online sessions are shown in Figure 6.11 until Figure 6.13.

Table 6.3 : List of ToT module and number of participants.

ToT Module	Number of Participants
<b>Data Acquisition and Analysis (Hands-on)</b>	<b>17</b>
<b>Renewable Energy for Wireless Network</b>	<b>107</b>
<b>Green Energy Wireless Network</b>	<b>22</b>
<b>Total</b>	<b>146</b>

107 students attended the ToT Part 2 – Renewable Energy for Wireless Networks session, 12th April 2022. It was opened for the public via zoom. We demonstrated how to use Matlab to optimize energy consumption in wireless networks. We advertised through our networks as well as our students.



The list of trainers attends the TOT is shown in Annex 3.

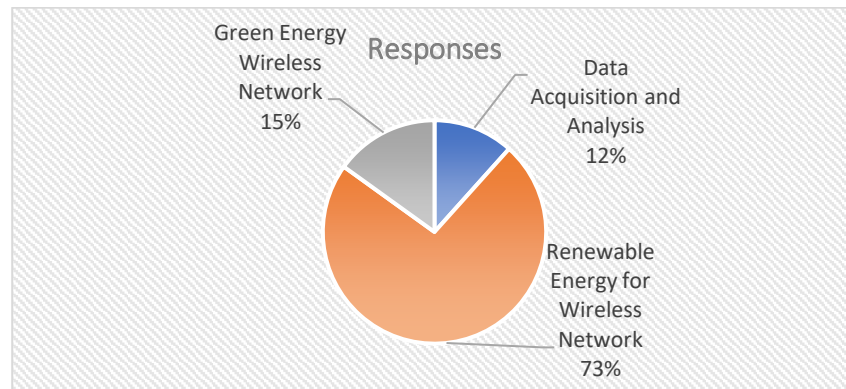


Figure 6.10: Percentage of attendance for each module.



Figure 6.11: Picture of trainer and trainee on 11th January 2022.

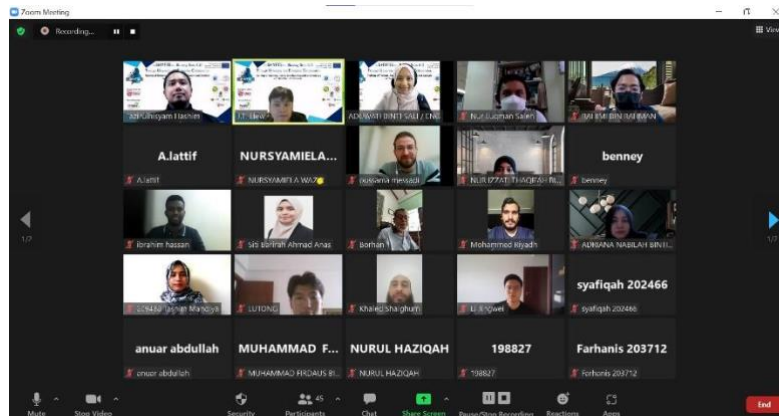


Figure 6.12: Picture of trainer and trainee on 12th April 2022.

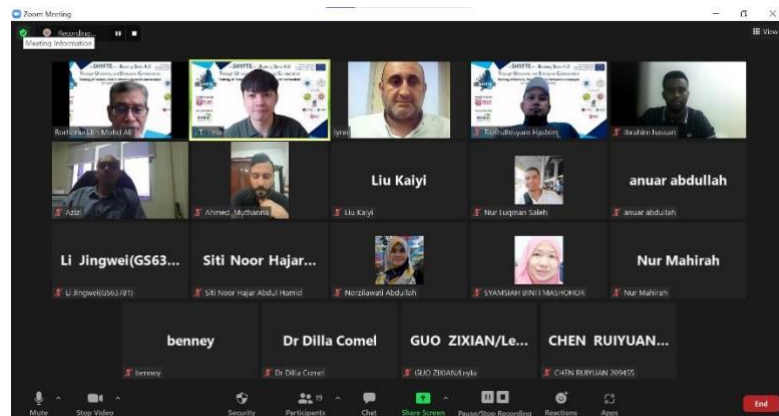


Figure 6.13: Picture of trainer and trainee on 13th April 2022.

## 6.2.2 Part 2 Feedback

Similar to ToT Part 1, satisfaction questionnaire has been distributed to all attendee for feedback collection. Based on the 34 responses collected as listed in Table 6.4, the audience are much more satisfied with the ToT sessions with every respondent have positive responses. The only major recommendation is that the attendee hopes the host can communicate more clearly about the software needed prior to training. Like Part 1 of ToT, small percentage of attendees (23%) responded to the questionnaires.

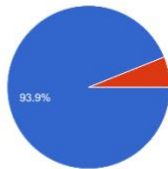
Table 6.4 : The list of module and number of respondents.

ToT Module	Number of Respondents
<b>Data Acquisition and Analysis (Hands-on)</b>	<b>6</b>
<b>Renewable Energy for Wireless Network</b>	<b>22</b>
<b>Green Energy Wireless Network</b>	<b>6</b>
<b>Total</b>	<b>34</b>



Did the trainer(s) provide suitable learning material to teach the specific topic? \*

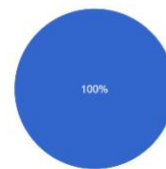
33 responses



Strongly Agree  
Somewhat Agree  
Somewhat Disagree  
Strongly Disagree

Did the learning method of trainer(s) stimulate interest in the specific topic? \*

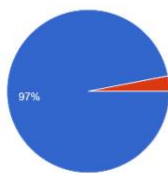
33 responses



Strongly Agree  
Somewhat Agree  
Somewhat Disagree  
Strongly Disagree

The degree of explanation of the trainer(s) is adequate for this topic? \*

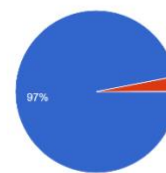
33 responses



Strongly Agree  
Somewhat Agree  
Somewhat Disagree  
Strongly Disagree

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

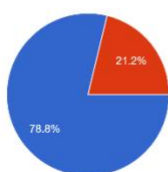
33 responses



Strongly Agree  
Somewhat Agree  
Somewhat Disagree  
Strongly Disagree

Did you understand the content of the module? \*

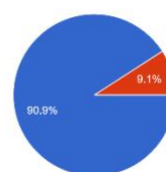
33 responses



Strongly Agree  
Somewhat Agree  
Somewhat Disagree  
Strongly Disagree

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

33 responses



Strongly Agree  
Somewhat Agree  
Somewhat Disagree  
Strongly Disagree

Figure 6.14 : The feedback's from the participants of ToT (Part 2).

Based on the feedbacks during ToT (shown in Figure 6.14), some participants could not relate to the topics in the Renewable Energy for Wireless Network module. They are new topics which are still at research level. This shortcoming has been addressed in ToS training such that we reduce the technical aspect of the renewable energy and include application related to this topic.

## 7. Training of the Students (ToS) Sessions

The Shyfte 4.0 Training of Students (ToS) for Pilot 3 Wireless Networks and Analytics have been conducted from 13 to 17 June 2022. The participants are Final Year and MSc students from Bachelor of Engineering in Computer and Communication Systems Engineering and Master Science in Communication Engineering.

### 7.1 ToS Session Details

The ToS was held from 13 – 17 June 2022 and the details are shown in Table 7.1.

Table 7.1 : The schedule of ToS.

Week 12	Day	Time	Venue	Module	Trainer	Trainee	Nof. Students
13-Jun	Mon	11:00 - 13:00	BK10	Intro to Cybersecurity	Assoc. Prof Dr Fazirulhisyam Hashim	Final year of bachelor students	23
		14:00 - 17:00	DK8	Data Governance and Management	Dr Khairulmizam Samsudin		15
14-Jun	Tue	11:00 - 13:00	DK8	Renewable Energy for Wireless Network	Prof. Dr Aduwati Sali and Dr Oussama	Final year of bachelor students	43
15-Jun	Wed	09:00 - 12:00	Online	Intro to Energy Management	Prof. Ir. Ts Nor Kamariah Noordin	Final year of bachelor students	43
16-Jun	Thu	09:00 - 12:00	Online	Data Acquisition and Analysis	MFAR	Final year of bachelor students	43
		14:00 - 17:00	WiPNET Meeting Room / Training Room / Wireless Lab	Data Acquisition and Analysis (Hands-on)	Dr Liew Jiun Terng, Dr Nur Luqman Salleh and Mr Azizi Mohd Ali	Final year of bachelor students	43
17-Jun	Fri	09:00 - 12:00	Online	Green Energy Wireless Networks	Prof Borhanuddin Mohd Ali and Dr Wael	Master Students	7

The posters for ToS session are shown in Figure 7.1.



Co-funded by the  
Erasmus+ Programme  
of the European Union



## Training of Students (ToS)

<b>Domain 3 – Wireless Networks and Analytics</b>  <b>TOS (Hybrid)</b> <b>13 June- 17 June 2022</b> <b>(Mon- Fri)</b>	<b>Introduction to Cybersecurity</b> Assoc Prof Dr Fazirulhisyam Hashim 13 June 2022, 11:00– 13:00 MYT	
	<b>Data Governance and Management</b> Dr Khairulmizam Samsudin 13 June 2022, 14:00 – 16:00 MYT	
	<b>Renewable Energy for Wireless network</b> Prof Ir Dr Aduwati Sali 14 June 2022, 11:00-13:00 MYT	
	<b>Introduction to Energy Management</b> Prof Ir Ts Dr Nor Kamariah Noordin 15 June 2022, 09:00– 12:00 MYT	



Co-funded by the  
Erasmus+ Programme  
of the European Union



## Training of Students (ToS)

<b>Data Acquisition and Analysis (Hands-on)</b> Dr Liew Jiun Terng / Dr Nur Luqman Saleh / En Azizi Mohd Ali 16 June 2022, 14:00– 17:00 MYT	  
<b>Green Energy Wireless Network</b> Prof Dr Borhanuddin Mohd Ali 17 June 2022, 09:00– 12:00 MYT	

**Domain 3 – Wireless  
Networks and Analytics**  
  
**TOS (Hybrid)**  
**13 June- 17 June 2022**  
**(Mon- Fri)**



Co-funded by the  
Erasmus+ Programme  
of the European Union



Figure 7.1 : Posters for ToS.

Some photos from the ToS are shown in Figure 7.2 until Figure 7.6.

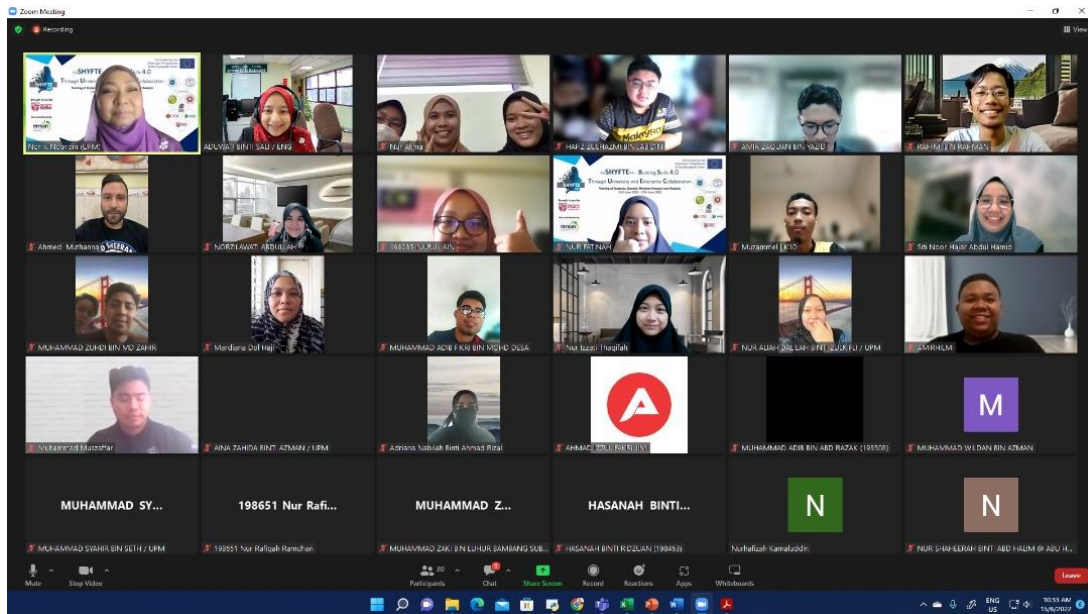


Figure 7.2 : Picture of trainer and participants for Introduction to Energy Management (ToS).



Figure 7.3 : Picture of trainer and participants for Introduction to Cybersecurity (ToS).





Figure 7.4 : Picture of trainer and participants for Renewable Energy for Wireless Networks (ToS).

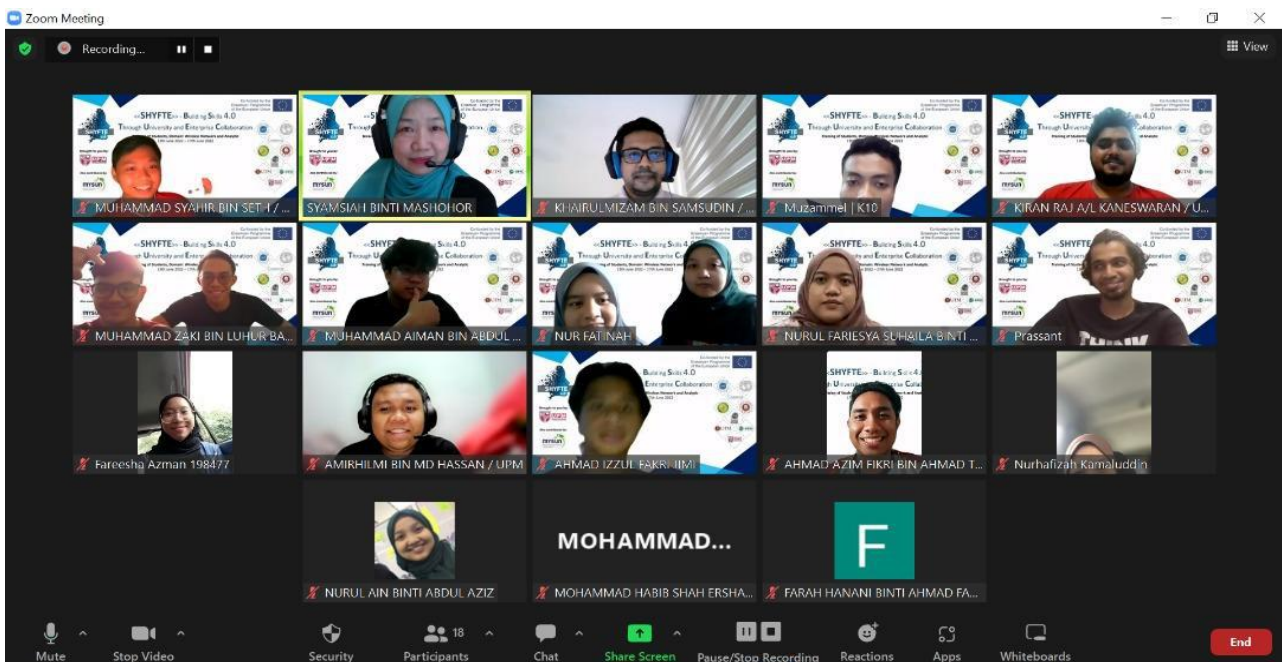


Figure 7.5 : Picture of trainer and participants for Data Governance and Management (ToS).



Figure 7.6 : Picture of trainer Data Acquisition and Analysis (Hands-on) (ToS).

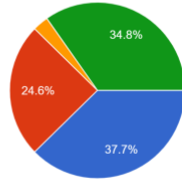
The ToS has received excellent participations from the students. The modules are related to wireless networks and IoT systems, and the participants appreciate the modules especially the hands-on session on LoRA modules. Each module is explained in the context of Pilot 3 : Wireless Networks and Analytics, as shown in Figure 2.1.

A total of 69 students attended the session and the attendance is recorded via an online form <https://forms.gle/VKZjPLNwSzXVkuCu5>. The list of attendance of ToS is shown in Annex 4.

## 7.2 ToS Analysis

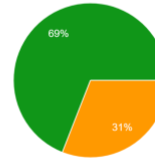
The feedback received from students was very encouraging such that more than 90 percent respondents were interested with the content of the modules. As for individual topics attended, the survey asked 17 questions ranging from items about students' knowledge, modules materials, module workload, evaluation, etc. A total of 69 students attended the six modules with the distribution shown in Figure 7.7 and the percentage of response for ToS is summarised in Table 7.2.

Which session you are attending?  
69 responses



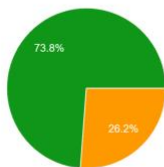
- Introduction to Cybersecurity, 13 June 2022
- Data Governance and Management, 13 June 2022
- Renewable Energy for Wireless Networks, 14 June 2022
- Introduction to Energy Management, 15 June 2022
- Data Acquisition and Analysis, 16 June 2022
- Green Energy Wireless Network, 17 June 2022

Q1. Was the preliminary knowledge owned sufficient to understand the topics?  
42 responses



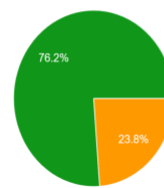
- Definitely not
- No more than yes
- Yes more than no
- Definitely yes

Q.2. Is the teaching workload proportional to the work assigned?  
42 responses



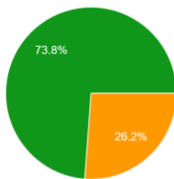
- Definitely not
- No more than yes
- Yes more than no
- Definitely yes

Q.3. Is the teaching material (indicated and available) suitable for the study of the topic?  
42 responses



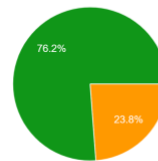
- Definitely not
- No more than yes
- Yes more than no
- Definitely yes

Q.4. Have the evaluation methods been clearly defined?  
42 responses



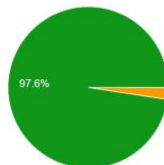
- Definitely not
- No more than yes
- Yes more than no
- Definitely yes

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



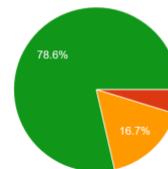
- Definitely not
- No more than yes
- Yes more than no
- Definitely yes

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



- Definitely not
- No more than yes
- Yes more than no
- Definitely yes

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



- Definitely not
- No more than yes
- Yes more than no
- Definitely yes

Figure 7.7 : Summary of Students' Feedback.

Table 7.2 : The percentage of response for ToS session.

No.	Questions	Percentage of Responses
1.	Introduction to Cybersecurity	37%
2.	Data Governance and Management	24%
3.	Renewable Energy for Wireless	5%
4.	Introduction to Energy Management	34%
5.	Data Acquisition and Analysis	-
6.	Green Energy Wireless Network	-



## 8. Resources for Learning Materials

The resources are divided into two types which are public and private materials. The recorded lectures are uploaded to Youtube platform and set as public, while the private materials are uploaded to the Owncloud. The details of the resources are listed in Table 8.1.

Table 8.1 : The list of training module and resource link.

No	Training Module	Resource Link
1	Introduction to IR 4.0	Private : 1. <a href="https://disp-ds.univ-lyon2.fr/owncloud/f/1118695">https://disp-ds.univ-lyon2.fr/owncloud/f/1118695</a>
2	Introduction to Cybersecurity	Public : 1. <a href="https://www.youtube.com/watch?v=btZhrmK2sYA">https://www.youtube.com/watch?v=btZhrmK2sYA</a> 2. <a href="https://www.youtube.com/watch?v=odPdvvWNBK4">https://www.youtube.com/watch?v=odPdvvWNBK4</a> 3. <a href="https://www.youtube.com/watch?v=iFGve5MUUnE">https://www.youtube.com/watch?v=iFGve5MUUnE</a> 4. <a href="https://www.youtube.com/watch?v=7KCMK-LY-WM">https://www.youtube.com/watch?v=7KCMK-LY-WM</a> 5. <a href="https://www.youtube.com/watch?v=Dk-ZqQ-bfy4">https://www.youtube.com/watch?v=Dk-ZqQ-bfy4</a> 6. <a href="https://www.youtube.com/watch?v=zqvDu0OaY8k">https://www.youtube.com/watch?v=zqvDu0OaY8k</a>  Private : 1. <a href="https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/Work%20Packages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Introduction_to_Cybersecurity-SHYFTE-FHH.pptx">https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/Work Packages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Introduction_to_Cybersecurity-SHYFTE-FHH.pptx</a>
3	Introduction to Energy Management	Public : 1. Recorded lecture - <a href="https://drive.google.com/file/d/1pgdmtZ3r_OLMoBjvzQtfem3-Nj1Oluud/view?usp=sharing">https://drive.google.com/file/d/1pgdmtZ3r_OLMoBjvzQtfem3-Nj1Oluud/view?usp=sharing</a>  Private : 1. <a href="https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Intro_to_Energy_Mgmt.pptx">https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/Work Packages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Intro_to_Energy_Mgmt.pptx</a>
4	Data Acquisition and Analysis	Public : 1. <a href="https://www.youtube.com/watch?time_continue=224&amp;v=w6ygDCTSQu&amp;feature=emb_logo">https://www.youtube.com/watch?time_continue=224&amp;v=w6ygDCTSQu&amp;feature=emb_logo</a> 2. <a href="https://www.youtube.com/watch?v=UrwbeOllc68">https://www.youtube.com/watch?v=UrwbeOllc68</a> 3. <a href="https://www.youtube.com/watch?v=x-KBN5cPGww">https://www.youtube.com/watch?v=x-KBN5cPGww</a>

		<ol style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=Pwc0cX43sec">https://www.youtube.com/watch?v=Pwc0cX43sec</a></li> <li><a href="https://www.youtube.com/watch?v=K2vLNtvJcQE">https://www.youtube.com/watch?v=K2vLNtvJcQE</a></li> <li><a href="https://www.youtube.com/watch?v=-ijLW67YIzY">https://www.youtube.com/watch?v=-ijLW67YIzY</a></li> <li>Recorded lecture - <a href="https://youtu.be/b1195aqDI1o">https://youtu.be/b1195aqDI1o</a></li> <li>Recorded lecture - <a href="https://youtu.be/PKJ-6oEGUqQ">https://youtu.be/PKJ-6oEGUqQ</a></li> </ol> <p>Private :</p> <ol style="list-style-type: none"> <li><a href="https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Data_acquisition_and_analysis.pptx">https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Data_acquisition_and_analysis.pptx</a></li> </ol>
5	Renewable Energy for Wireless Network	<p>Public :</p> <ol style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=SdZODbIT010">https://www.youtube.com/watch?v=SdZODbIT010</a></li> <li><a href="https://hal.archives-ouvertes.fr/hal-01283728/document">https://hal.archives-ouvertes.fr/hal-01283728/document</a></li> <li>Recorded lecture - <a href="https://drive.google.com/file/d/1gGsntNggl-H-zl9mZbm2PBWNqwcgo_Mc/view?usp=sharing">https://drive.google.com/file/d/1gGsntNggl-H-zl9mZbm2PBWNqwcgo_Mc/view?usp=sharing</a></li> </ol> <p>Private :</p> <ol style="list-style-type: none"> <li><a href="https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Renewable_Energy_for_Wireless_Net.pptx">https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Renewable_Energy_for_Wireless_Net.pptx</a></li> </ol>
6	Data Governance and Management	<p>Public :</p> <ol style="list-style-type: none"> <li><a href="https://www.tableau.com/learn/articles/data-governance-best-practices">https://www.tableau.com/learn/articles/data-governance-best-practices</a></li> <li><a href="https://www.iotone.com/casestudies">https://www.iotone.com/casestudies</a></li> <li>Recorded lecture - <a href="https://drive.google.com/file/d/1HNtKdOtCECQbHN3brOsLdivpQ9FYOhxn/view?usp=sharing">https://drive.google.com/file/d/1HNtKdOtCECQbHN3brOsLdivpQ9FYOhxn/view?usp=sharing</a></li> </ol> <p>Private :</p> <ol style="list-style-type: none"> <li><a href="https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Data_governance_and_management.pptx">https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Data_governance_and_management.pptx</a></li> </ol>
7	Green Energy Wireless Network	<p>Public :</p> <ol style="list-style-type: none"> <li>Recorded lecture - <a href="https://drive.google.com/file/d/1HNtKdOtCECQbHN3brOsLdivpQ9FYOhxn/view?usp=sharing">https://drive.google.com/file/d/1HNtKdOtCECQbHN3brOsLdivpQ9FYOhxn/view?usp=sharing</a></li> </ol>

		<p>Private :</p> <ol style="list-style-type: none"><li>1. <a href="https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Green_Energy_Wireless_Network.pptx">https://disp-ds.univ-lyon2.fr/owncloud/remote.php/webdav/SHYFTE%20(3)/WorkPackages/WP2_DEVELOPMENT/T2.3_LearningMaterials/Domain3-Green_Energy_Wireless_Network.pptx</a></li></ol>
--	--	---

## 9. Deviations and Mitigation Actions

Deviation and some mitigation have taken place during the implementation and completion of the project. This is due to COVID -19 such that many activities were not implemented according to plan. A delay in procurement affected the conduct of training. It is further worsened by the movement control order which do not allow anyone to work on campus.

The project mitigated to conduct the training online instead of face to face due to pandemic and lock down. Many potential trainers were able to attend the training of trainers since it is online. Although many attended the training, it is very difficult to get their feedback to the questionnaires. As a result the percentage of responses is very low. The project also faced similar situation in getting responses from students. We managed to get students to attend during the very last week of their semester before they left for holidays. UPM only managed to collect 30% responses of the questionnaires. UPM will continue to improve the modules for future training based on the feedback received.

UPM also has to conduct ToS without the assistance of EU partners who were supposed to assist for the 20 days training. However, the comments received from internal and external reviewers, as well as feedback from ToT, helped UPM to improve the conduct of training for ToS.

## 10. Sustainability of Shyfte Learning Centre

Many training modules have been developed and a lot of dissemination programmes have been done to ensure the exposure of the SHYFTE 4.0 to both students and enterprises. The Learning Centre for this domain is created to ensure the sustainability of the SHYFTE 4.0. The website for this Learning Centre is created to reach out to public interested to upskill and reskill their Skill of IR 4.0.

The developed modules will be used in the undergraduates (UG) and postgraduates (PG) curriculum as listed in the Table 10.1.

Table 10.1 : The list of module and the equivalent undergraduate or postgraduate course.

Module Title of Domain 3 of SHYFTE Domain 3 : Wireless Network Analytics	Equivalent Undergraduate/ Postgraduate Course
1. Introduction to Cybersecurity	Computer Security
2. Data Acquisition and Analysis	Internet of Things
3. Data Governance and Management	Internet of Things
4. Introduction to Energy Management	Wireless Network
5. Renewable Energy for Wireless Network	Wireless Network
6. Green Energy Wireless Network	Wireless Network

This Learning Centre allows participants to customise the training based on their profile. They could also pick and choose the modules they are interested in as part of their life long learning should they choose not to customise their training. This Learning Centre will be maintained and managed by UPM via Wireless and Photonics Networks Research Centre (WiPNET) once the project ends.

We developed a simple business plan to ensure the sustainability of the Learning Centre such that participants will need to pay a minimum cost once the project ends. The existence of the Learning Centre is make know via social media and individual networkings.

## 11. Conclusions

This project, SHYFTE, has completed after a 10 month extension. We have successfully completed the project by developing 7 new modules that would enhance the skillset of participants in the area of wireless networks analytics. We have conducted the training of trainers (ToT) to identify potential trainers to ensure sustainability of the training.

We have also conducted training of students (ToS) and many students have shown interest to further enhance their skill. Both trainings utilized the equipment purchased under the project and will be used for future trainings.

The sustainability of the project is enhanced with the development of a Learning Centre which provide a platform for potential participants to enroll into this training. During the course of the project a few deviations and mitigations have taken place to ensure the completion of the project. UPM opted for online trainings for some of the modules, and hands-on were given once movement control order (MCO) was lifted.

## Annex 1

### List of Attendance of Training of Trainers – Part 1

Attendance for ToT Part 1- Data Acquisition and Analysis (theory) on 30th July 2021.

No	Email Address	Name	Organization	Country
1	agmohammed@fptb.edu.ng	Mohammed Aliyu Gadam	Federal Polytechnic Bauchi	Nigeria
2	aduwati@upm.edu.my	ADUWATI SALI	Universiti Putra Malaysia	Malaysia
3	yusoff@mmu.edu.my	Mohamad Yusoff bin Alias	Multimedia University (MMU)	Malaysia
4	pratchaporn.s@rbru.ac.th	Pratchaporn Setsathien	Rambhai Barni Rajabhat University	Thailand
5	siravat.t@cmu.ac.th	Siravat Teerasoponpong	Chiang Mai University (CAMT)	Thailand
6	khairulmizam@upm.edu.my	Khairulmizam bin samsudin	Universiti Putra Malaysia	Malaysia
7	sar@upm.edu.my	Syed Abdul Rahman Al-HAddad	Universiti Putra Malaysia	Malaysia
8	nknordin@upm.edu.my	NOR KAMARIAH BINTI NOORDIN	Universiti Putra Malaysia	Malaysia
9	syamsiah@upm.edu.my	Syamsiah Mashohor	Universiti Putra Malaysia	Malaysia
10	salinee.s@cmu.ac.th	Salinee Santiteerakul	Chiang Mai University	Thailand
11	ma_azizi@upm.edu.my	AZIZI BIN MOHD ALI	Universiti Putra Malaysia	Malaysia
12	nurluqmansaleh@upm.edu.my	NUR LUQMN SALEH	Universiti Putra Malaysia	Malaysia
13	mhab@upm.edu.my	Muhammad Hafiz Abu Bakar	Universiti Putra Malaysia	Malaysia
14	mariam@upm.edu.my	Siti Mariam Shafie	Universiti Putra Malaysia	Malaysia
15	liewjt@upm.edu.my	Liew Jiun Terng	Universiti Putra Malaysia	Malaysia
16	roslizah@upm.edu.my	Roslizah binti Ali	Universiti Putra Malaysia	Malaysia
17	syamsuri@upm.edu.my	Syamsuri Yaakob	Universiti Putra Malaysia	Malaysia
18	faisul@upm.edu.my	Faisul Arif Ahmad@ Mohd Yusoff	Universiti Putra Malaysia	Malaysia
19	piyaon.sr@ssru.ac.th	Piyaon Sriwan	Suan Sunandha Rajabhat University	Thailand
20	supaporn.kamt@crru.ac.th	Supaporn Kamtaeja	Chiang Rai Rajabhat University	Thailand
21	nurdalila306@uitm.edu.my	NUR DALILA	Universiti Teknologi Mara	Malaysia
22	piyaon.sr@ssru.ac.th	Piyaon Sriwan	Suan Sunandha Rajabhat University	Malaysia

Attendance for ToT Part 1- Data Governance and Management, 2nd August 2021.

No	Email Address	Name	Organization	Country
1	agmohammed@fptb.edu.ng	Mohammed Aliyu Gadam	Federal Polytechnic Bauchi	Nigeria
2	khairulmizam@upm.edu.my	Khairulmizam bin samsudin	Universiti Putra Malaysia	Malaysia
3	syamsiah@upm.edu.my	Syamsiah Mashohor	Universiti Putra Malaysia	Malaysia



4	pratchaporn.s@rbru.ac.th	Pratchaporn Setsathien	Rambhai Barni Rajabhat University,	Thailand
5	nurluqmansaleh@upm.edu.my	NUR LUQMAN SALEH	Universiti Putra Malaysia	Malaysia
6	yusoff@mmu.edu.my	Mohamad Yusoff bin Alias	Multimedia University (MMU)	Malaysia
7	liewjt@upm.edu.my	Liew Jiun Terng	Universiti Putra Malaysia	Malaysia
8	nknordin@upm.edu.my	NOR KAMARIAH BINTI NOORDIN	Universiti Putra Malaysia	Malaysia
9	supaporn.kamt@rru.ac.th	Supaporn Kamtaeja	Chiang Rai Rajabhat University	Thailand
10	piyaon.sr@ssru.ac.th	Piyaon Sriwan (ปิยะอร ศรีวรรณ)	Suan Sunandha Rajabhat University	Thailand
11	fudzah@upm.edu.my	Makhfudzah Mokhtar	Universiti Putra Malaysia	Malaysia
12	zuraidahz@upm.edu.my	Zuraidah Zan	Universiti Putra Malaysia	Malaysia
13	naziha@utm.my	Naziha Ahmad Azli	Universiti Teknologi Malaysia	Malaysia
14	supaporn.kamt@rru.ac.th	Supaporn Kamtaeja	Chiang Rai Rajabhat University	Thailand
15	salinee.s@cmu.ac.th	Salinee Santiteerakul	Chiang Mai University	Thailand
16	norjulia@utm.my	Norjulia binti Mohamad Nordin	Universiti Teknologi Malaysia	Malaysia
17	nurulmuazzah@utm.my	Nurul Muazzah Abdul Latiff	Universiti Teknologi Malaysia	Malaysia

Attendance for ToT Part 1- Introduction to Cybersecurity, 28th July 2021.

No	Email Address	Name	Organization	Country
1	agmohammed@fptb.edu.ng	Mohammed Aliyu Gadam	Federal Polytechnic Bauchi	Nigeria
2	nurul_adilah@umt.edu.my	Nurul Adilah Abdul Latiff	Universiti Malaysia Terengganu	Malaysia
3	nadiatulhuda@utm.my	Nadiatulhuda Zulkifli	Universiti Teknologi Malaysia	Malaysia
4	khairulmizam@upm.edu.my	Khairulmizam bin samsudin	Universiti Putra Malaysia	Malaysia
5	mhab@upm.edu.my	Muhammad Hafiz Abu Bakar	Universiti Putra Malaysia	Malaysia
6	aduwati@upm.edu.my	ADUWATI SALI	Universiti Putra Malaysia	Malaysia
7	syamsiah@upm.edu.my	Syamsiah Mashohor	Universiti Putra Malaysia	Malaysia
8	faisul@upm.edu.my	Faisul Arif Ahmad@ Mohd Yusoff	Universiti Putra Malaysia	Malaysia
9	kamilah@utm.my	SHARIFAH KAMILAH BINTI SYED YUSOF	Universiti Teknologi Malaysia	Malaysia
10	liewjt@upm.edu.my	Liew Jiun Terng	Universiti Putra Malaysia	Malaysia
11	fazirul@upm.edu.my	Fazirulhisyam Hashim	Universiti Putra Malaysia	Malaysia
12	roslizah@upm.edu.my	Roslizah binti Ali	Universiti Putra Malaysia	Malaysia
13	yusoff@mmu.edu.my	Mohamad Yusoff bin Alias	Multimedia University (MMU)	Malaysia
14	iqbal@upm.edu.my	M IQBAL BIN SARIPAN	Universiti Putra Malaysia	Malaysia

15	pratchaporn.s@rbru.ac.th	Pratchaporn Setsathien	Rambhai Barni Rajabhat University	Thailand
16	norjulia@utm.my	Norjulia binti Mohamad Nordin	Universiti Teknologi Malaysia	Malaysia
17	martusorn.kh@ssru.ac.th	MARTUSORN KHAENGKHAN	Suan Sunandha Rajabhat University	Thailand
18	zuraidahz@upm.edu.my	Zuraidah Zan	Universiti Putra Malaysia	Malaysia
19	nurluqmansaleh@upm.edu.my	NUR LUQMAN SALEH	Universiti Putra Malaysia	Malaysia
20	syamsuri@upm.edu.my	Syamsuri Yaakob	Universiti Putra Malaysia	Malaysia
21	mariam@upm.edu.my	Siti Mariam Shafie	Universiti Putra Malaysia	Malaysia
22	ratna@upm.edu.my	RATNA KALOS ZAKIAH SAHBUDIN	Universiti Putra Malaysia	Malaysia
23	supaporn.kamt@rru.ac.th	Supaporn Kamtaeja	Chiang Rai Rajabhat University	Thailand
24	iqbal@upm.edu.my	M IQBAL BIN SARIPAN	Universiti Putra Malaysia	Malaysia
25	barirah@upm.edu.my	Siti Barirah Ahmad Anas	Universiti Putra Malaysia	Malaysia
26	nurulmuazzah@utm.my	Nurul Muazzah Abdul Latiff	Universiti Teknologi Malaysia	Malaysia
27	sittichai.pi@ssru.ac.th	Sittichai pintuma	Suan Sunandha Rajabhat University	Thailand
28	hanif@upm.edu.my	Mohd Hanif Yaacob	Universiti Putra Malaysia	Malaysia
29	mardeni.roslee@mmu.edu.my	Mardeni Bin Roslee	Multimedia University	Malaysia
30	nurdalila.krool@gmail.com	NUR DALILA KHIRUL ASHAR	Universiti Teknologi Mara	Malaysia
31	salinee.s@cmu.ac.th	Salinee Santiteerakul	Chiang Mai University	Thailand
32	kamalmy@utm.my	Kamaludin Mohamad Yusof	Universiti Teknologi Malaysia	Malaysia
33	nurul_adilah@umt.edu.my	Nurul Adilah Abdul Latiff	Universiti Malaysia Terengganu	Malaysia
34	piyaon.sr@ssru.ac.th	Piyaon Sriwan	Suan Sunandha Rajabhat University	Thailand







Attendance for ToT Part 1- Introduction to Energy Management, 29th July 2021.

No	Email Address	Name	Organization	Country
1	agmohammed@fptb.edu.ng	Mohammed Aliyu Gadam	Federal Polytechnic Bauchi	Nigeria
2	pitawat.u@ku.th	Pittawat Ueasangkomsate	Kasetsart University	Thailand
3	salinee.s@cmu.ac.th	Salinee Santiteerakul	Chiang Mai University	Thailand
4	kamilah@utm.my	SHARIFAH KAMILAH SYED YUSOF	Universiti Teknologi Malaysia	Malaysia
5	ma_azizi@upm.edu.my	Azizi Mohd Ali	Universiti Putra Malaysia	Malaysia
6	pratchaporn.s@rbru.ac.th	Pratchaporn Setsathien	Rambhai Barni Rajabhat University	Thailand
7	aduwati@upm.edu.my	ADUWATI SALI	Universiti Putra Malaysia	Malaysia
8	nknordin@upm.edu.my	NOR KAMARIAH BINTI NOORDIN	Universiti Putra Malaysia	Malaysia

9	mariam@upm.edu.my	Siti Mariam Shafie	Universiti Putra Malaysia	Malaysia
10	liewjt@upm.edu.my	Liew Jiun Terng	Universiti Putra Malaysia	Malaysia
11	supaporn.kamt@crru.ac.th	Supaporn Kamtaeja	Chiang Rai Rajabhat University	Thailand
12	syamsiah@upm.edu.my	Syamsiah Mashohor	Universiti Putra Malaysia	Malaysia
13	norjulia@utm.my	NORJULIA BINTI MOHAMAD NORDIN	Universiti Teknologi Malaysia	Malaysia
14	nurul_adilah@umt.edu.my	Nurul Adilah Abdul Latiff	Universiti Malaysia Terengganu	Malaysia
15	mardeni.roslee@mmu.edu.my	Mardeni Bin Roslee	Multimedia University	Malaysia
16	nurulmuazzah@utm.my	Nurul Muazzah Abdul Latiff	Universiti Teknologi Malaysia	Malaysia
17	roslizah@upm.edu.my	Roslizah binti Ali	Universiti Putra Malaysia	Malaysia
18	mariff@utm.my	MUHAMMAD ARIFF BIN BAHARUDIN	Universiti Teknologi Malaysia	Malaysia
19	alyani@upm.edu.my	Alyani Ismail	Universiti Putra Malaysia	Malaysia
20	piyaon.sr@ssru.ac.th	Piyaon Sriwan	Suan Sunandha Rajabhat University	Thailand
21	sar@upm.edu.my	Syed Abdul Rahman Al-Haddad	Universiti Putra Malaysia	Malaysia
22	yusoff@mmu.edu.my	Mohamad Yusoff bin Alias	Multimedia University (MMU)	Malaysia

## Annex 2

A sample of Certificate of Appreciation provided to the participant of ToT or ToS.

	<p>Co-funded by the Erasmus+ Programme of the European Union</p>			
<h1>Certificate of Appreciation</h1>				
<p>This certificate is proudly awarded to <b>Prof. Dr. Mohamad Yusoff bin Alias</b></p>				
<p>In recognition for participation as a trainee in the Erasmus+ SHYFTE 4.0 project with the module:</p>				
<p><b>Data Governance and Management, 2nd August 2021</b></p>				
<p>Held at the UNIVERSITI PUTRA MALAYSIA, 43400 SERDANG, SELANGOR, MALAYSIA</p>				
<p><b>Building Skills4.0 THrough University and Enterprise</b></p>				
<p><b>Collaboration (SHYFTE)</b></p>				
<p>Reference Number:-EPP-1-2018-1-FR-EPPKA2-CBHE-JP</p>				
	<p>02/08/2021</p>		<p>03/08/2021</p>	
<p>Prof. Dr. Nor Kamariah Noordin Project Leader/Country Coordinator Universiti Putra Malaysia</p>	<p>Date</p>	<p>Prof. Dr. Yacine Ouzzurt SHYFTE Project Coordinator University of Lyon</p>	<p>Date</p>	

## Annex 3

### List of Attendance of Training of Trainers – Part 2

Attendance for ToT Part 2 – Data Acquisition and Analysis (Hands-on), 11th January 2022.

No	Email Address	Name	Organization	Country
1	liewjt@upm.edu.my	Liew Jiun Terng	Universiti Putra Malaysia	Malaysia
2	aduwati@upm.edu.my	ADUWATI SALI	UPM	Malaysia
3	ma_azizi@upm.edu.my	AZIZI BIN MOHD ALI	UNIVERSITI PUTRA MALAYSIA	Malaysia
4	syamsiah@upm.edu.my	Syamsiah Mashohor	UPM	Malaysia
5	nurluqmansaleh@upm.edu.my	NUR LUQMAN SALEH	UPM	Malaysia
6	fazirul@upm.edu.my	Fazirulhisyam Hashim	UPM	Malaysia
7	gs59236@student.upm.edu.my	Mohammed Riyadh Abdulrahman Al-Imari	UPM	Malaysia
8	gs59044@student.upm.edu.my	AMMAR ALI FADHIL AL-BAYATI	UPM	Malaysia
9	Benney56@qq.com	LU LI	Universiti Putra Malaysia	Malaysia
10	gs58581@gmail.com	Zarina binti Ibrahim	UPM	Malaysia
11	GS58420@student.upm.edu.my	Nurul Syuhada Binti Md Yazid	UPM	Malaysia
12	gs59827@student.upm.edu.my	Nurul Aini Tarmuji	Upm	Malaysia
13	gs61712@student.upm.edu.my	Hussein Ali jasim Mohammed	UPM	Malaysia
14	kowthar.ameen@gmail.com	KAWTHER AMEEN MOHAMMED AL-HASHIMI	Upm	Malaysia
15	gs58563@student.upm.edu.my	Azizul Bin Ab Halim	UPM	Malaysia
16	eng.vailt85@gmail.com	Vailet Hikmat Faraj Al khattat	UPM	Malaysia
17	benney56@qq.com	LU LI	Universiti Putra Malaysia	Malaysia

Attendance for ToT Part 2 – Renewable Energy for Wireless Networks, 12th April 2022.

No	Email	Name	Organization	Country
1	198842@student.upm.edu.my	Nur Izzati Thaqifah binti Samsol Bahari	UPM	Malaysia
2	aduwati@upm.edu.my	ADUWATI SALI	UPM	Malaysia
3	barirah@upm.edu.my	Siti Barirah Ahmad Anas	UPM	Malaysia
4	198106@student.upm.edu.my	ADRIANA NABILAH BINTI AHMAD RIZAL	UNIVERSITI PUTRA MALAYSIA	Malaysia
5	gs61881@student.upm.edu.my	Norzilawati Binti Abdullah	University Putra Malaysia (UPM)	Malaysia
6	203712@student.upm.edu.my	NUR FARHANIS AZWA BINTI MUHAMAD FAKRUZI	UPM	Malaysia

7	199612@student.upm.edu.my	ANUAR BIN ABDULLAH	UPM	Malaysia
8	203713@student.upm.edu.my	NURUL NASHYUHA BINTI ABD KARIM	UPM	Malaysia
9	196142@student.upm.edu.my	Nurul Fariesya Suhaila binti Md Sazihan	Universiti Putra Malaysia	Malaysia
10	196161@student.upm.edu.my	Nursyamiela Wazir	UPM	Malaysia
11	209488@student.upm.edu.my	TASNIM MAHDIYA	Universiti Putra Malaysia	Malaysia
12	haziqah1999@gmail.com	Nurul Haziqah	UPM	Malaysia
13	197208@student.upm.edu.my	Aiman Farhan Bin Jamalullail	Upm	Malaysia
14	196410@student.upm.edu.my	MUHAMMAD ZUHDI BIN MD ZAHIR	UPM	Malaysia
15	198827@student.upm.edu.my	NUR AKMA BINTI MD ZAINOL	UNIVERSITI PUTRA MALAYSIA	Malaysia
16	gs59236@student.upm.edu.my	Mohammed Riyadh Abdulrahman Al-Imari	Upm	Malaysia
17	aafikri99@gmail.com	Ahmad Azim Fikri Bin Ahmad Tarmizi	UPM	Malaysia
18	gs61319@student.upm.edu.my	Liu Kaiyi	Universiti Putra Malaysia	Malaysia
19	jalal170375@gmail.com	jalal faraaaj salem almadani	UPM	Malaysia
20	gs6240@student.upm.edu	LUTONG	Universiti Putra Malaysia	Malaysia
21	198798@student.upm.edu.my	Siti Aqilah Binti Azman	Universiti Putra Malaysia	Malaysia
22	203242@student.upm.edu.my	Nur Farisha binti Shoeid	Universiti Putra Malaysia	Malaysia
23	GS63781@student.upm.edu.my	Li Jingwei	Universiti Putra Malaysia	Malaysia
24	benney56@qq.com	LU LI	Universiti Putra Malaysia	Malaysia
25	198772@student.upm.edu.my	Muhammad Zaki Bin Luhur Bambang Subiantoro	Universiti Putra Malaysia	Malaysia
26	199602@student.upm.edu.my	MARDIANA BINTI DOL HAJI	UPM	Malaysia
27	196798@student.upm.edu.my	AINA ZAHIDA BINTI AZMAN	UPM	Malaysia
28	202466@student.upm.edu.my	NORSYAFIQAH ATIRAH BINTI MUHAMAD NAZRI	Universiti Putra Malaysia	Malaysia
29	nurluqmansaleh@upm.edu.my	Nur Luqman Saleh	UPM	Malaysia
30	202783@student.upm.edu.my	MUHAMMAD AIMAN SAFWAN BIN ZAIDI	UPM	Malaysia
31	shabilizdiyar@gmail.com	Shabil izdiyar bin ahmad azmi	Universiti Putra Malaysia	Malaysia
32	196448@student.upm.edu.my	RAHIMI BIN RAHMAN	UPM	Malaysia
33	196298@student.upm.edu.my	Muhammad Firdaus bin Mazlan	Universiti Putra Malaysia	Malaysia
34	202787@student.upm.edu.my	INTAN AIDA ZULAIQA BINTI ABDUL AZIZ	University Putra Malaysia	Malaysia
35	195806@student.upm.edu.my	Amjad Alnasrallah	UPM	Malaysia
36	gs63570@student.upm.edu.my	Nur Mahirah Binti Katmin	Universiti Putra Malaysia	Malaysia

37	200359@student.upm.edu.my	Ahmad Qayyum Fikri bin Ahmad Jazimin	Universiti Putra Malaysia	Malaysia
38	jalal170375@gmail.com	jalal faraj salem Almadani	UPM	Malaysia
39	200365@student.upm.edu.my	NURNAZIERA NATASHA BINTI NORHIZAN	UPM	Malaysia
40	196877@student.upm.edu.my	Nurhafizah binti Kamaluddin	UPM	Malaysia
41	00akmalrizal@gmail.com	Mohamad Akmal Rizal Bin Mohamad Rosli	UPM	Malaysia
42	198483@student.upm.edu.my	WAN AHMAD ARIFUDDIN BIN WAN HASSAN	UPM	Malaysia
43	202606@student.upm.edu.mu	Muhammad nor hilmie bin nor harli	Upm	Malaysia
44	amirulhussin@gmail.com	AMIRUL HUSSIN BIN MOHAMAD ANSAHARI	UPM	Malaysia
45	202788@student.upm.edu.my	Aidil Harith Anwar	UPM	Malaysia
46	201419@student.upm.edu.my	Aryo Bimo Damarjati Nugroho	Universiti Putra Malaysia	Malaysia
47	201001@student.upm.edu.ny	MUHAMMAD ARIF BIN JAFFAR	UPM	Malaysia
48	196285@student.upm.edu.my	NUR ALIAH DALILAH BINTI ZULKIFLI	UPM	Malaysia
49	203136@student.upm.edu.my	AMMAR YUSOFF BIN FAISAL IBRAHIM	UNIVERSITY PUTRA MALAYSIA	Malaysia
50	203732@student.upm.edu.my	NURUL AIDA BINTI ZAIROL AKMAR	UPM	Malaysia
51	hakimi9923@yahoo.com	Muhammad Arif Hakimi bin Mohd Azmi	Universiti Putra Malaysia	Malaysia
52	204615@student.upm.edu.my	Nur Alifah Ilyana binti Mohd Sharihan	UPM	Malaysia
53	203733@student.upm.edu.my	nik muhammad farhan	UPM	Malaysia
54	zuhurathaputra@gmail.com	Zuhura Juma Ali	UPM	Malaysia
55	gs63085@student.upm.edu.my	Ibrahim Hassan Alasow	University Putra Malaysia	Malaysia
56	haikalsobri23@gmail.com	Wan Muhammad Haikal Bin Sobri	UPM	Malaysia
57	fazirul@upm.edu.my	Fazirulhisyam Hashim	UPM	Malaysia
58	200342@student.upm.edu.my	NUR AIN MD FAIZA RIZA	UPM	Malaysia
59	200318@student.upm.edu.my	Aishah binti Abd Rahman	Universiti Putra Malaysia	Malaysia
60	ma_azizi@upm.edu.my	Azizi Mohd ali	Universiti Putra Malaysia	Malaysia
61	200422@student.upm.edu.my	Fareed Ridha	Universiti Putra Malaysia	Malaysia
62	203714@student.upm.edu.my	ROS AFRINA SYAHIRAH BINTI SHAMSUL ZARIMAN	UPM	Malaysia
63	200268@student.upm.edu.my	ALYA MAISARAH BINTI MASSUHUT HAYATI	UPM	Malaysia
64	201144@student.upm.edu.my	nur syamimi zainal abidin	UPM	Malaysia
65	dinie.dayana@gmail.com	Dinie Dayana Binti Mohamad Azri	UPM	Malaysia



66	200830@student.upm.edu.my	SYAQIRA BINTI ABD AZIZ	Universiti Putra Malaysia	Malaysia
67	202784@student.upm.edu.my	Mohamad Adham bin Azri	UPM	Malaysia
68	201403@student.upm.edu.my	QIN ZHEYANG	Universiti Putra Malaysia	Malaysia
69	202785@student.upm.edu.my	EISYATUL HANNIE BINTI MOHAMMAD RUSHDAN	Universiti Putra Malaysia	Malaysia
70	202602@student.upm.edu.my	SYAHINDAH HAZIQAH BINTI MOHD SAING	UPM	Malaysia
71	203709@student.upm.edu.my	SITI ZAIZATUL ASHIKIN BINTI AHMAD TARMIZI	UNIVERSITI PUTRA MALAYSIA (UPM)	Malaysia
72	202746@student.upm.edu.my	Wan Muhammad Amnan bin Wan Zulkifly	Universiti Putra Malaysia	Malaysia
73	209471@student.upm.edu.my	LIN ZHUOFAN	Universiti Putra Malaysia	Malaysia
74	202686@student.upm.edu.my	NURSARAFINA NADHIA BINTI ABD MALEK	UPM	Malaysia
75	adisir20@gmail.com	Abdul Hadi bin Abdul Basir	UPM	Malaysia
76	202786@student.upm.edu.my	Sharifah Sakinah binti Syed Abdul Hamid	UPM	Malaysia
77	209469@student.upm.edu.my	GUO ZIXIAN	Universiti Putra Malaysia	Malaysia
78	200277@student.upm.edu.my	Ain Ismail	UPM	Malaysia
79	202604@student.upm.edu.my	NUR HAIFA JULIA BINTI MOHD JOHAIDI	UNIVERSITI PUTRA MALAYSIA	Malaysia
80	204525@student.upm.edu.my	CHEN SIYI	Universiti Putra Malaysia	Malaysia
81	198579@student.upm.edu.my	NUR FATINAH BINTI MD HAFIZ	UPM	Malaysia
82	203734@student.upm.edu.my	NURUL NAJIHAH BINTI SAYOTI	UPM	Malaysia
83	202688@student.upm.edu.my	Siti Nur Nabilah Binti Abd Rahim	UPM	Malaysia
84	clerencemichael@gmail.com	CLERENCE LEWIN CHAMPIN	UNIVERSITI PUTRA MALAYSIA	Malaysia
85	197729@student.upm.edu.my	NURUL NADIAH BINTI ZULKEFLEE	UNIVERSITI PUTRA MALAYSIA	Malaysia
86	najiharamlandmys@gmail.com	Najiha Ramlan	UPM	Malaysia
87	200593@student.upm.edu.my	Nurul Afifah binti Azman Shah	UPM	Malaysia
88	nurul_adilah@umt.edu.my	Nurul Adilah Abdul Latiff	UMT	Malaysia
89	198651@student.upm.edu.my	Nur Rafiqah Mubarakah Binti Muhammad Ramdhan	UPM	Malaysia
90	LUQMAN.MLH00@GMAIL.COM	MUHAMMAD LUQMAN HAKIM BIN MOHD PAUZI	UPM	Malaysia
91	202687@student.upm.edu.my	HION YUEN SAN	UPM	Malaysia
92	amjad.mahfida@student.upm.edu.my	Mahfida Amjad Dipa	University Putra Malaysia	Malaysia
93	Gs63781@student.upm.edu.my	Li Jingwei	UPM	Malaysia
94	kshalghum@gmail.com	Khaled Shalghum	UPM	Malaysia
95	198312@student.upm.edu.my	Muhd Akmal bin Muhd Fadhil	UPM	Malaysia

96	suhazbelal72@gmail.com	Suhaila Zeinelabideen Omer	University Putra Malaysia	Malaysia
97	203711@student.upm.edu.my	MUHAMMAD SHAZMIE FAZRIN BIN MOHD FAZDLI	UPM	Malaysia
98	202687@student.upm.edu.my	HION YUEN SAN	Upm	Malaysia
99	209565@student.upm.edu.my	Zuo Chang	Universiti Putra Malaysia	Malaysia
100	200378@student.upm.edu.my	Abdullah Adli Bin Suhaimi	UPM	Malaysia
101	203710@student.upm.edu.my	CHE ISMAIL FAHMI BIN CHE UMAR	UPM	Malaysia
102	200633@student.upm.edu.my	Nur Athirah binti Othman	UPM	Malaysia
103	200762@student.upm.edu.my	Aida Nabilah Yusof	UPM	Malaysia
104	209455@student.upm.edu.my	CHEN RUIYUAN	Universiti Putra Malaysia	Malaysia
105	209426@student.upm.edu.my	CHEN MINGYUE	UPM	Malaysia
106	gs61862@student.upm.edu.my	Siti Noor Hajar Binti Abdul Hamid	Universiti Putra Malaysia	Malaysia
107	201001@student.upm.edu.my	MUHAMMAD ARIF BIN JAFFAR	UPM	Malaysia

#### Attendance for ToT Part 2 – Green Energy Wireless Network, 13th April 2022.

No	Email	Name	Organization	Country
1	gs61881@student.upm.edu.my	Norzilawati Binti Abdullah	UPM	Malaysia
2	gs63085@student.upm.edu.my	Ibrahim Hassan Alasow	Universiti Putra Malaysia	Malaysia
3	199612@student.upm.edu.my	ANUAR BIN ABDULLAH	UPM	Malaysia
4	GS63781@student.upm.edu.my	Li Jingwei	Universiti Putra Malaysia	Malaysia
5	gs61862@student.upm.edu.my	Siti Noor Hajar Binti Abdul Hamid	Universiti Putra Malaysia	Malaysia
6	gs61319@student.upm.edu.my	Liu Kaiyi	UPM	Malaysia
7	gs62040@student.upm.edu.my	LUTONG	Universiti Putra Malaysia	Malaysia
8	fazirul@upm.edu.my	Fazirulhisyam Hashim	UPM	Malaysia
9	muthanaa83@gmail.com	Ahmed Muthanna Shibel	UPM	Malaysia
10	nknordin@upm.edu.my	Nor K Noordin	UPM	Malaysia
11	ma_azizi@upm.edu.my	AZIZI MOHD ALI	UNIVERSITI PUTRA MALAYSIA	Malaysia
12	209426@student.upm.edu.my	CHEN MINGYUE	Universiti Putra Malaysia	Malaysia
13	gs63570@student.upm.edu.my	Nur Mahirah Binti Katmin	University Putra Malaysia	Malaysia
14	waellynn13@gmail.com	WAEI A.Y. ALIHUSSEIN	UPM	Malaysia
15	nurluqmansaleh@upm.edu.my	Nur Luqman Saleh	UPM	Malaysia
16	209455@student.upm.edu.my	CHEN RUIYUAN	UPM	Malaysia

17	benney56@qq.com	LU LI	Universiti Putra Malaysia	Malaysia
18	nurul_adilah@umt.edu.my	Nurul Adilah Abdul Latiff	UMT	Malaysia

## Annex 4

### List of Attendance of Training of Students

Attendance for ToS – Introduction to Cybersecurity, 13 June 2022.

No	Email Address	Name
1	198579@student.upm.edu.my	NUR FATINAH BINTI MD HAFIZ
2	196719@student.upm.edu.my	NUR SHAHEERAH BINTI ABD HALIM
3	197729@studentmupm.edu.my	NURUL NADIAH BINTI ZULKEFLEE
4	198285@students.upm.edu.my	NURUL AIN BINTI ABDUL AZIZ
5	196691@student.upm.edu.my	NURUL HAZIQAH
6	196142@student.upm.edu.my	NURUL FARIESYA SUHAILA BINTI MD SAZIHAN
7	196279@student.upm.edu.my	AHMAD NAUFAL BIN TENGKU KAMALUDIN
8	196798@student.upm.edu.my	AINA ZAHIDA BINTI AZMAN
9	muszaffar27@gmail.com	MUHAMMAD MUSZAFFAR BIN MUSTAPHAR
10	198798@student.upm.edu.my	SITI AQILAH BT AZMAN
11	zalhazmi19@gmail.com	ZAL HAZMI BIN MOHMMAD ZIN
12	196448@student.upm.edu.my	RAHIMI BIN RAHMAN
13	m.ali.calgan@gmail.com	MUHAMMED ALI CALGAN
14	198827@student.upm.edu.my	NUR AKMA BINTI MD ZAINOL
15	196285@student.upm.edu.my	NUR ALIAH DALILAH BINTI ZULKIFLI
16	198651@student.upm.edu.my	NUR RAFIQAH MUBARAKAH BINTI MUHAMMAD RAMDHAN
17	198106@student.upm.edu.my	ADRIANA NABILAH BINTI AHMAD RIZAL
18	wildanazman072@gmail.com	MUHAMMAD WILDAN BIN AZMN
19	196410@student.upm.edu.my	MUHAMMAD ZUHDI BIN MD ZAHIR
20	198851@student.upm.edu.my	MOHD ABDUL HAKIM BIN LUTHFI
21	198772@student.upm.edu.my	MUHAMMAD ZAKI BIN LUHUR BAMBANG SUBIANTORO
22	197708@student.upm.edu.my	AHMAD IZZUL FAKRI BIN JIMI
23	196298@student.upm.edu.my	MUHAMMAD FIRDAUS BIN MAZLAN
24	198352@student.upm.edu.my	MUHAMMAD IRWAN HAKIMI BIN ISMADI
25	farahhimchan1999@gmail.com	FARAH HANANI BT AHMAD FAUZI

Attendance for ToS - Data Governance and Management, 13 June 2022.

No	Email Address	Name
1	196142@student.upm.edu.my	NURUL FARIESYA SUHAILA BINTI MD SAZIHAN
2	197812@student.upm.edu.my	SHABIL IZDIHAR BIN AHMAD AZMI
3	199207@student.upm.edu.my	AHMAD AZIM FIKRI BIN AHMAD TARMIZI

4	197974@student.upm.edu.my	MOHAMMAD HABIB SHAH ERSHAD BIN MOHD AZRUL SHAZRIL
5	farahhimchan1999@gmail.com	FARAH HANANI BT AHMAD FAUZI
6	198285@student.upm.edu.my	NURUL AIN BINTI ABDUL AZIZ
7	196455@student.upm.edu.my	MUHAMMAD AIMAN BIN ABDUL KHALIK
8	198772@student.upm.edu.my	MUHAMMAD ZAKI BIN LUHUR BAMBANG SUBIANTORO
9	198308@student.upm.edu.my	MUZAMMEL BIN MOKHTAR
10	196264@student.upm.edu.my	AMIRHILMI BIN MD HASSAN
11	198477@student.upm.edu.my	FAREESHA IRDEENA BINTI AZMAN
12	196172@student.upm.edu.my	MUHAMMAD SYAHIR BIN SETH
13	196172@student.upm.edu.my	MUHAMMAD SYAHIR BIN SETH
14	198579@student.upm.edu.my	NUR FATINAH BINTI MD HAFIZ
15	198377@student.upm.edu.my	MUHAMMAD WILDAN BIN AZMAN
16	192402@student.upm.edu.my	PRASSANT
17	197708@student.upm.edu.my	AHMAD IZZUL FAKRI BIN JIMI

Attendance for ToS - Introduction to Energy Management, 15 June 2022.

No	Email Address	Name
1	gs61862@student.upm.edu.my	SITI NOOR HAJAR BINTI ABDUL HAMID
2	adibf72@gmail.com	MUHAMMAD ADIB FIKRI BIN MOHD DESA
3	196172@student.upm.edu.my	MUHAMMAD SYAHIR BIN SETH
4	198579@student.upm.edu.my	NUR FATINAH BINTI MD HAFIZ
5	198739@student.upm.edu.my	AMIR ZAQUAN BIN YAZID
6	196279@student.upm.edu.my	AHMAD NAUFAL BIN TENGKU KAMALUDIN
7	196691@student.upm.edu.my	NURUL HAZIQAH
8	198285@student.upm.edu.my	NURUL AIN BINTI ABDUL AZIZ
9	gs61881@student.upm.edu.my	NORZILAWATI BINTI ABDULLAH
10	197974@student.upm.edu.my	MOHAMMAD HABIB SHAH ERSHAD BIN MOHD AZRUL SHAZRIL
11	muszaffar27@gmail.com	MUHAMMAD MUSZAFFAR BIN MUSTAPHAR
12	198842@student.upm.edu.my	NUR IZZATI THAQIFAH BINTI SAMSOL BAHARI
13	199612@student.upm.edu.my	ANUAR BIN ABDULLAH
14	196798@student.upm.edu.my	AINA ZAHIDA BINTI AZMAN
15	193508@student.upm.edu.my	MUHAMMAD ADIB BIN ABD RAZAK
16	196448@student.upm.edu.my	RAHIMI BIN RAHMAN
17	199602@student.upm.edu.my	MARDIANA BINTI DOL HAJI
18	196264@student.upm.edu.my	AMIRHILMI BIN MD HASSAN

19	198106@student.upm.edu.my	ADRIANA NABILAH BINTI AHMAD RIZAL
20	196161@student.upm.edu.my	NURSYAMIELA WAZIR
21	196285@student.upm.edu.my	NUR ALIAH DALILAH BINTI ZULKIFLI
22	muthanaa83@gmail.com	AHMED MUTHANNA SHIBEL
23	196298@student.upm.edu.my	MUHAMMAD FIRDAUS BIN MAZLAN
24	198772@student.upm.edu.my	MUHAMMAD ZAKI BIN LUHUR BAMBANG SUBIANTORO
25	196142@student.upm.edu.my	NURUL FARIESYA SUHAILA BINTI MD SAZIHAN
26	197729@student.upm.edu.my	NURUL NADIAH BINTI ZULKEFLEE

Attendance for ToS - Green Energy Wireless Network, 17 June 2022.

	gs57746@student.upm.edu.my	Mohammed Nawfal Yahya
	gs61881@student.upm.edu.my	Norzilawati Binti Abdullah
	gs61881@student.upm.edu.my	Norzilawati Binti Abdullah
	gs63570@student.upm.edu.my	Nur Mahirah Katmin
	gs61862@student.upm.edu.my	Siti Noor Hajar Binti Abdul Hamid
	gs61319@student.upm.edu.my	Liu Kaiyi
	gs63085@student.upm.edu.my	Ibrahim Hassan Alasow
	GS63781@student.upm.edu.my	Li Jingwei
	gs62040@student.upm.edu.my	LUTONGA





<http://www.shyfte.eu/>