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R2.2.3 “Digital Water” – a harmonised compendium of teaching and learning materials

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DIGIWATER

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TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

GENERAL

The value of water as a primary resource for life is well known. There are many reasons to consider in order to improve the qualification of higher education teaching staff and water professionals, including but not limited to: better exchange of knowledge between academia and industry, reducing the skills disparity, especially digital skills mismatch and smart use of digital tools, in education and industry.

To achieve the above objectives, one of the main DIGIWATER project's goals is the teaching and learning by using multidisciplinary curricula integrated with digital learning tools. To ensure that the courses content is consistent and coherent, and to promote effective teaching and learning regardless of which curriculum is being used, courses content harmonization is more than necessary.

Content harmonization refers to the process of aligning or standardizing the course materials, such as lecture slides, practical exercises, and other instructional resources, across multiple curricula for the same subject. This is an important process because it can enhance the quality of instruction, improve student outcomes, and make the teaching process more efficient and effective. Harmonizing course content ensures that all students are receiving the same core knowledge and skills, which can enhance their learning experience and help them achieve better and consistent learning outcomes.

There are several reasons why course content harmonization is important, for example: **consistency**, **efficiency**, **quality**, and **accessibility**. When multiple trainers are teaching the same subject, it can be confusing for students if the course content varies significantly from one instructor to another. Harmonizing course content can help reduce duplication of effort and streamline the development and improvement of curricula. By identifying and standardizing the most effective teaching practices and resources, instructors can save time and effort when developing new courses. Also, the harmonizing process can help ensure that the most effective teaching practices and resources are used. By providing a consistent framework for course content, instructors can more easily modify the content to meet the needs of individual students. Harmonizing teaching materials can make it easier for instructors to adapt course materials for students with different learning needs.

OBJECTIVES

To upgrade the water curricula with digital subjects and embed training on innovation & entrepreneurship, the WP2 objectives involve:

(i) design of a curriculum relevant to the market and societal needs,

(ii) development of teaching and learning materials that can be used in university or lifelong learning courses both in-class and via e-learning,
(iii) design and development of the e-learning platform,
(iv) train teachers in academia and companies,
(v) testing and implementation of the upgraded curricula in partner universities.

After the analysis of partner's digital water curricula elements (T2.1.1) and a complete review of best practices in teaching digital water relevant subjects (T2.1.2), the project partners planned and designed the Digital Water curriculum (T2.1.3) for the following subjects: (i) IoT and Big data and (ii) Cybersecurity in Critical Water Infrastructure. Based on the resulting curriculum, the partners developed detailed syllabi specifying the topics and content of the courses (T2.1.4). Those syllabi focused on two main subjects: (i) **Internet of Things (IoT)** and (ii) **Big data applications in the water sector**. Whereupon the content of slides for lectures and e-learning (T2.2.1), supplemented with practical exercises (T2.2.2) is harmonized, following the syllabi and the curriculum.

During the harmonization process, the course materials are reviewed and compared, and any inconsistencies or gaps are identified and addressed. The goal is to create a cohesive and comprehensive set of course materials that reflect best practices in teaching the subject and provide students with a clear and organized path for learning the material. The emphasis will be placed at this moment on the **consistency** and **quality** of the learning materials, following that the aspects related to **efficiency** and **accessibility** to be measured when feedback will be collected after the training of trainers and students at the partner universities and companies.

INTERNET OF THINGS (IOT)

GENERAL

This course aims to allow students to understand the basic notions of IoT, the current and future trends and implications and to know multiple real-life applications of this technology, especially in the field of water industry. The practical assignments are designed to allow students to improve their knowledge regarding IoT domain, the legal framework in the IoT and the water sector, given them the opportunity to design and implement some specific industrial IoT applications in which they can design and program IoT devices.

While the course is not designed to provide a deeper understanding of IoT and is focused mainly on IoT applications in water industry, it covers some advanced technical concepts such as cloud computing, too and is successfully complemented by course topics on Big data applications, such as: data analytics, artificial intelligence and machine learning.

TOPIC CONTENT

The content of the course, as established in T2.1.4, includes the following lectures:

1. Introduction in IoT – UCY
2. Sensors in IoT – DOSCON
3. Instrumentation and SCADA – SmarTech
4. Cybersecurity in IoT – UGAL
5. Standards and good practices (including legal framework) - NMBU
6. Case studies based on simulations – SumAqua
7. Future trends in IoT – NMBU

To assess the consistency and the quality of the teaching materials provided by the partners for the lectures are organized around five general topics, as can be seen in Table 1. Each main topic is then detailed in sub-topics. These topics cover some of the most key aspects of the subject in accordance with the scope of the course and the specific expected learning outcomes: the basics of IoT, the ecosystem in which IoT operates, standardization and protocols, governance, privacy, and security issues and IoT applications.

IOT INTRODUCTION

Both subtopics of IoT introduction, *IoT description & importance* and *IoT trends & implications* are relevant and important for providing a comprehensive introduction to IoT, being addressed by the first lecture, *Introduction in IoT* and the last two, *Case studies using IoT in the water sector* and *Future trends in IoT*.

IoT description & importance subtopic provides a foundation of understanding IoT and covers the basics, including what IoT is, how it works and why matters. It includes the definition of IoT, the architecture of IoT systems, the types of devices and sensors that are used, and the benefits and challenges of IoT.

IoT trends & implications subtopic provides a broader context for understanding the current state and future directions of IoT. In this subtopic, to further help students to develop a more complete understanding of the subject and its significance, besides the impact of IoT in society, economy, environment and industries, **the potential social and ethical implications of IoT must be addressed**.

Moreover, **to avoid the danger of overlapping content, especially regarding new technologies that support and combine with the development of IoT, this subject could only be reviewed in the introductory lecture, followed by the presentation of some details and examples of applications, in the other two lectures,** being in accordance with the expected learning outcomes of this course.

Table 1: The topics of the Internet of Things course

No.	Topic	Subtopic	Lecture(s)	Partner
1	IoT Introduction	IoT Description & Importance	Introduction to IoT	UCY
		IoT Trends & Implications	Introduction to IoT	UCY
			Case studies using IoT in the water sector	SumAqua
			Future trends	NMBU
2	IoT Ecosystem	IoT Components	Introduction to IoT	UCY
			Sensors in IoT	DOSCON
			Instrumentation and SCADA	SmarTech
			Cyber Security in IoT	UGAL
			Standards & good practices (incl. Legal framework)	NMBU
			Case studies using IoT in the water sector	SumAqua
		IoT Architecture	Introduction to IoT	UCY
			Sensors in IoT	DOSCON
			Instrumentation and SCADA	SmarTech
			Standards & good practices (incl. Legal framework)	NMBU
3	IoT Standardization and Protocols	IoT M2M & Network Protocols	Introduction to IoT	UCY
			Sensors in IoT	DOSCON
			Instrumentation and SCADA	SmarTech
			Cyber Security in IoT	UGAL
			Future trends	NMBU
		IoT Data Protocols	Sensors in IoT	DOSCON
			Instrumentation and SCADA	SmarTech
			Case studies using IoT in the water sector	SumAqua
4	IoT Governance, Privacy and Security	IoT Governance	Cyber Security in IoT	UGAL
			Standards & good practices (incl. Legal framework)	NMBU
		IoT Security & Privacy	Introduction to IoT	UCY
			Instrumentation and SCADA	SmarTech
			Cyber Security in IoT	UGAL
			Standards & good practices (incl. Legal framework)	NMBU
			Future trends	NMBU
5	IoT Applications	IoT Applications for Industry	Introduction to IoT	UCY
			Instrumentation and SCADA	SmarTech
		IoT Applications for Water Sector	Sensors in IoT	DOSCON
			Case studies using IoT in the water sector	SumAqua

IOT ECOSYSTEM

Two subtopics, *IoT components* and *IoT Architecture* are identified to provide a comprehensive description of the IoT ecosystem, together being essential for understanding how IoT works and how it can be used in various applications.

First subtopic refers to various physical and logical elements that make up an IoT system, reviewing their role and function: sensors, devices, networks, gateways. security mechanisms, cloud infrastructure, applications, and users. All these elements are covered in the following lectures with **little or no overlap**: *Introduction to IoT*, *Sensors in IoT*, *Instrumentation and SCADA*, *Cyber Security in IoT*, *Standards & good practices, Case studies using IoT in the water sector*.

Understanding the architecture of an IoT system, usually organized into three main layers: Perception (sensors), Network (devices, gateways, cloud), and Application is important for understanding how the different components of the system work together to achieve specific goals or outcomes. *Introduction to IoT*, *Sensors in IoT*, *Instrumentation and SCADA*, *Standards & good practices* includes different elements from this subtopic. However, as in the case of the previous subtopic **the overlapping is lacking**.

In addition to above mentioned subtopics, there are other that are relevant to the IoT ecosystem, but those are addressed as separate topics due to their importance: IoT data management, communication protocols, application and use cases, standards, and regulations.

Furthermore, **information regarding IoT business models and strategies is missing from the course**, although it could be interesting and up to date because this topic focuses on the **creating and capturing value from IoT and could promote entrepreneurship among students and university staff**: **IoT revenue model and IoT value chains**. Partially certain aspects are only mentioned in passing in the first course, *Introduction in IoT*.

IOT STANDARDIZATION AND PROTOCOLS

The topic of IoT Standardization and Protocols covers specifically *IoT M2M & Network* Protocols and *IoT Data Protocols*. IoT M2M & Network Protocols refers to the various protocols used for machine-to-machine (M2M) communication and network connectivity in IoT systems: ModBus, Zigbee, Bluetooth, Wi-Fi, LTE, and 5G/6G. IoT Data Protocols refers to the various protocols used for data exchange and communication between IoT devices and the cloud or other systems. This includes protocols such as AMQP, MQTT, HTTP, CoAP, and WoT. Understanding the features, capabilities, and limitations of these protocols is important for designing and implementing IoT systems that are efficient, reliable, and secure.

The following lectures *Introduction to IoT*, *Sensors in IoT*, *Instrumentation and SCADA*, *Cyber Security in IoT*, *Case studies using IoT in the water sector*, *Future trends* incorporates these subtopics and, because it is possible to meet some parts (e.g. the communication protocols in industrial IoT networks and the industrial communication networks within SCADA systems or the standards & protocols for M2M communication and standards & protocols for networks), **it would be beneficial to introduce different communication protocols in each course to provide students with a comprehensive understanding of the various protocols used in IoT systems**. It's important **to extend the evaluation of the specific focus and depth of coverage in each course to determine the extent of the overlap and its potential impact** on the curriculum.

In addition, there are several subtopics that could be relevant in the context of this topic, such as: IoT Security Standards, IoT Interoperability Standards, IoT Quality of Service Standards, IoT Protocol Stacks, or IoT Standardization Bodies. Some of them, such as IoT protocol stack, security, interoperability standards, or IoT standardization bodies are treated in this course as separate topics and are covered in other lectures, but some, such as **IoT Quality of Service Standards could be taken into consideration only if partners consider them relevant**, depending on the focus and the audience of the course.

IOT GOVERNANCE, PRIVACY AND SECURITY

IoT Governance, Privacy and Security topic is covered during several lectures, **there appears to be an intersect, particularly on the security and privacy side and in the areas of IoT security and standards/guidelines,** between the two lectures approaching cybersecurity, *Cyber Security in IoT* and *Standards & Good practices.* They also touch upon **cybersecurity best practices, incident response, and risk management**, which are relevant to both IoT security and general cybersecurity. Also, *Instrumentation and SCADA* lecture includes security threats for SCADA systems.

However, it's important to note that each lecture have its specific focus and depth of coverage. The second lecture emphasizes relevant standards, regulations, and architectural frameworks specific to IoT, while the first one provides a broader introduction to cybersecurity, covering security goals, cybercriminal categories, common threats (including IoT threats), and security countermeasures. The last lecture has some relevance to industrial IoT (IIoT) Security, including broader discussions on critical infrastructure security. Topics such as **secure communication protocols, access control, and protecting against cyber threats are areas of overlap**.

The overlapping content can be leveraged to establish connections and reinforce learning across the two courses**. Students who have taken both courses can benefit from a more**

comprehensive understanding of IoT and SCADA security within the broader context of cybersecurity.

To ensure a coherent learning experience, it would be beneficial for the instructors and curriculum designers to **carefully coordinate and align the content between the two courses**. This could involve **identifying the overlapping topics, avoiding unnecessary repetition**, and ensuring that students can build upon their knowledge from one course to the other.

By **establishing a clear roadmap for the students and promoting coordination between the instructors**, the courses can complement each other and provide a well-rounded education in both IoT security and cybersecurity.

Finally, there are **some additional topics** that may be relevant and further covered, if necessary, in the lectures dealing with this topic, such as **secure supply chain management** or **secure development practices**.

IOT APPLICATIONS

For the last topic, concerning the applications of IoT for smart house, smart cities industry, and mainly, for water sector, **there is no intersection between the case studies** and the examples presented, discussed, or solved within the practical activities. The examples provided in *Introduction to IoT*, *Instrumentation and SCADA*, *Sensors in IoT*, and *Case studies using IoT in the water sector* lectures cover an extremely wide range of applications showing how IoT technology can support water management and digitalization in the water sector.

BIG DATA APPLICATIONS IN THE WATER SECTOR

TOPIC CONTENT

The content of the second course, as established in T2.1.4, includes the following lectures:

1. Introduction to Big Data - KU Leuven
2. Big data analytics (incl. Artificial Intelligence and machine learning tools) - UCY
3. Visualization of data - DOSCON
4. Cybersecurity in Critical Water Infrastructure - NMBU
5. Data safety and standardization (incl. Crash course on Open data) - DOSCON
6. Case studies - SumAqua
7. Data assessment exercises - TH OWL
8. Future trends - NMBU

To assess the **consistency** and the **quality** of the teaching materials provided by the partners for the lectures are organized around five general topics, as can be seen in Table 2.

Table 2: The topics of the Big data applications in water sector course

No.	Topic	Subtopic	Lecture(s)	Partner
1	Big Data Introduction	Big data origins, description & importance	Introduction to Big Data and	KU Leuven
			Big data analytics	UCY
		Big data technologies	Introduction to Big Data	KU Leuven
			Visualization of data	DOSCON
			Big data analytics	UCY
			Data safety and standardization	DOSCON
			Case studies using Big Data in the water sector	SumAqua
			Data assessment exercises	TH OWL
		Big data challenges & future trends	Big data analytics	UCY
			Future trends	NMBU
2	Basic Concepts & Terminology	Data types	Introduction to Big Data	KU Leuven
			Big data analytics	UCY
			Visualization of data	DOSCON
			Data safety and standardization	DOSCON
		Algorithms	Introduction to Big Data	KU Leuven
			Big data analytics	UCY
			Data assessment exercises	TH OWL
			Future trends	NMBU
3	Data Analytics Workflow	Pre-processing, modeling, post-processing	Introduction to Big Data	KU Leuven
			Big data analytics	UCY
			Case studies using Big Data in the water sector	SumAqua
			Data assessment exercises	TH OWL
			Future trends	NMBU
		Data visualization	Big data analytics	UCY
			Visualization of data	DOSCON
			Case studies using Big Data in the water sector	SumAqua
			Data assessment exercises	TH OWL
4	Big Data Governance, Privacy and Security	Data management	Big data analytics	UCY
			Cybersecurity in Critical Water Infrastructure	NMBU
			Data safety and standardization	DOSCON
		Privacy and security issues	Cybersecurity in Critical Water Infrastructure	NMBU
			Data safety and standardization	DOSCON
			Case studies using Big Data in the water sector	SumAqua
			Future trends	NMBU
5	Big Data Applications	Big Data, AI & ML applications	Introduction to Big Data	KU Leuven
			Big data analytics	UCY
		Big Data, AI & ML applications in the water sector	Introduction to Big Data	KU Leuven
			Big data analytics	UCY
			Case studies using Big Data in the water sector	SumAqua
			Data assessment exercises	TH OWL
			Future trends	NMBU

Each main topic is then detailed in sub-topics. These topics cover some of the most key areas of the subject in accordance with the scope of the course and the specific expected

learning outcomes, providing a comprehensive understanding of the subject: big data introduction, basic concepts & terminology, data analytics workflow, big data governance, privacy and security and Big Data applications.

Even if a wide range of important aspects related to Big Data are included, **there are a few additional areas that could be considered to further enhance the course content**, covering various technical, ethical, and practical aspects: **data integration and fusion** to address the challenges associated with data coming from multiple sources, **scalable computing and distributed Systems**, **Big Data ethics and responsible data use**.

BIG DATA INTRODUCTION

Big Data Introduction serves as an introductory section, providing an overview of Big Data concepts, challenges, and opportunities. It sets the background for understanding the significance of Big Data in various domains, especially from water sector.

Three subtopics, Big Data origins, description & importance, Big Data technologies, and Big Data challenges & future trends provide students with a broad understanding of the origins, significance, tasks, and technological aspects of Big Data. They lay the basis for further exploration and discussion of Big Data applications, analytics workflows, governance, privacy, and security issues, as well as data visualizations.

Regarding this topic, there is a **significant overlapping content between the first two lectures**, *Introduction to Big Data* and *Big data analytics* on subjects such as: general definition of Big Data, basic terminology, introduction to data types, introduction to types of algorithms, introduction to the data science workflow, skills required for a data analyst and data scientist. However, it can be observed that the lectures also cover distinct areas within the field of Big Data.

To avoid redundancy and ensure coherence, it would be beneficial for the instructors of both courses to communicate and align the content, so that students receive a cohesive and well-rounded education in Big Data. By coordinating the topics, exercises, and learning outcomes, the courses can provide a comprehensive understanding of Big Data with a focus on water-related applications, while also addressing broader Big Data challenges, techniques, and technologies.

BASIC CONCEPTS AND TERMINOLOGY

This topic is concerned with different types of data and algorithms encountered in the field of Big Data. From the viewpoint of data types utilized in big data, there are possible common areas between the content of the lectures: *Introduction to Big Data*, *Big data analytics*,

Case studies using Big Data in the water sector, *Data assessment exercises*, and *Future trends*, since **all the mentioned lectures cover, with different degrees of expansion, the fundamental concepts**. But these common areas provide a foundation for understanding data types in big data, and each course may approach these topics from different angles, pointing up specific aspects based on their objectives and focus areas.

The content analysis similarly reveals that the four lectures share **common subject matters when it comes to the utilization of different algorithms in Big Data** for classification, regression, clustering, and reinforcement learning. Nevertheless, it's important to note that **the depth and breadth of algorithm coverage may vary across the lectures**.

DATA ANALYTICS WORKFLOW

Data analytics workflow topic explores the end-to-end process of working with Big Data, including data acquisition, preprocessing, visualization, analysis, and interpretation. It covers techniques such as data cleaning, feature selection and machine learning algorithms for analysis as well as various ways to visualize data and results.

Several overlaps can be identified between the lectures from a *Data Analytics Workflow* perspective, too. For example, *Introduction to Big Data* and *Big data analytics* present the data science workflow, including problem statement, data selection, data cleaning, and data transformation, and introduce techniques for data analysis and interpretation, which are essential in the modeling and post-processing phases. *Visualization of data* and *Data safety and standardization* intersect in terms of data representation and visualization. *Big data analytics* and *Data safety and standardization* lectures overlap in terms of data pre-processing.

On the other hand, **with adequate planning and close collaboration between instructors**, these overlaps might demonstrate how **different lectures** within the curriculum **could be aligned** with different stages of the Data Analytics Workflow, **to help develop a holistic understanding** of the entire process applied in Big Data analytics.

BIG DATA GOVERNANCE PRIVACY AND SECURITY

This topic focuses on the ethical and legal considerations surrounding Big Data, including data governance frameworks, privacy regulations, security challenges, and data protection strategies. In two subtopics, *Data management* and *Privacy & security issues*, it addresses concerns related to data ownership, consent, anonymization, and compliance.

From a data management perspective, there are potential overlaps in the content covered across four lectures. The *Cybersecurity in Critical Water Infrastructure* lecture specifically addresses cybersecurity challenges, threats, and vulnerabilities in the water sector while the *Data safety and standardization* lecture incorporates data security regulations and steps to

secure data in case of breaches. **There is a possible overlap in terms of understanding security measures and protecting data from cyber threats**. Also, both lectures emphasize the **importance of understanding data sensitivity and complying with relevant regulations**.

The *Case studies using Big Data* lecture and *Future trends* lecture discuss data analytics, machine learning, and advanced analytics technologies, highlighting the importance of leveraging these approaches for extracting insights and improving efficiency in the water sector. It is important to have a **consultation between partners so that each lecture can offer different perspectives and emphasize specific aspects** of data management.

Moreover, **there are a few aspects that might not be sufficiently covered** in the data management context, such as **data lifecycle management** from its creation to archival or disposal and **ethical consideration** regarding use of data.

Even in the context of security and privacy issues, **some overlap can be seen to varying degrees** with respect to the four lectures cited above: **cyber security challenges and security threats and vulnerabilities**. To **minimize areas of overlap and ensure a mutually complementary presentation of subjects**, it will be necessary to **engage in discussions and provide clarifications** where needed.

BIG DATA APPLICATIONS

This topic covers various applications of Big Data across industries, discussing case studies and real-world implementations, emphasizing the challenges in the water sector, and showing how Big Data can support water management. **There were no overlaps between the case studies and the examples presented, discussed, or solved in the practical activities.**

DURATION OF TOPIC

Harmonizing course content involves ensuring that the learning outcomes, topics, and depth of coverage are comparable across different courses or lectures. Duration plays a significant role in achieving this comparability. Longer courses may have the opportunity to delve deeper into specific topics or cover additional material, while shorter courses may focus on core concepts and skills.

The duration of the lectures is comparable, varying between 2 and 4 teaching hours, sometimes including the time allocated to solving the practical activities such as the first lecture, *Introduction in IoT*. For the some of the themes that are allocated 4 teaching hours, half of the time is allocated for hand-on and practical activities, such as the lecture *Cyber Security in IoT*. However, **since the lectures approaching cybersecurity,** *Cyber Security in IoT* and *Standards & Good practices* **and those that presents and introduction in Big Data,**

Introduction to Big Data and *Big data analytics* **overlap quite enough on certain sections regarding security best practices, a redistribution of the duration could be made among these**.

The time allocated to solving assignments is also important. This helps ensure that the core knowledge and skills are adequately covered, even if the duration varies. The range is between a few hours (e.g., 3 hours for *Introduction in IoT* topic) and a few weeks, after the end of the lecture (e.g., 3 weeks for *Instrumentation and SCADA* topic, 2 weeks for Data assessment exercises and 1 week for *Cyber Security in IoT*, *Standards & good practices*, *Future trends*). There are also topics in which a deadline for assignments was not clearly and explicitly defined or required (e.g., *Case studies using IoT and Big Data in the water sector*, *Data safety and standardization*, or *Future Trends* topics), because it is not applicable.

LEARNING ACTIVITIES AND ASSESSMENTS

The following types of learning activities are proposed to be used in the current courses: lectures, presentations, practical sessions, hand-on activities, quizzes, projects, and assignments.

To organize learning activities across lectures in the context of course harmonization, it's essential to establish a consistent framework while allowing for flexibility. **The objectives and expected outcomes of these activities are clearly stated**. While allowing room for creativity and customization, the **projects and assignments align with the learning outcomes of each topic**. Detailed instructions, assessment rubrics, and deadlines for projects and assignments are provided for students, too.

The **structure of presentations, practical assignments and syllabi is standardized** throughout the courses. Guidelines for content, presentation style, lecture duration, use of supporting materials, time limits and evaluation criteria were established in previous WP2 tasks. **Unfortunately, in this moment not all slides followed the template proposed in the project**. Collaborative discussions and continuous communication between the instructors involved can help **ensure uniformity in presentation format**.

There is no established common format for quizzes, including question types, difficulty levels, and assessment criteria. **The quiz questions must be aligned with the course** content and learning outcomes. A **question bank** or using a **standardized set of questions** that can be adapted to each course's specific context **is recommended**.

STANDARDS AND CRITERIA FOR GRADING

The **grading standards and criteria are aligned with the stated learning outcomes** of the course. The expectations for each assignment, project, or assessment **are clearly explained** in syllabi. Because they provide a concise summary of a student's achievement and are widely understood by students, parents, and academic institutions **letter grades are used** to assess the students.

Appropriate weightage to different assessments or components within a course is applied in order to ensure that the overall grading accurately reflects the relative importance of each assessment. **There are insignificant differences** for graded assignments, but nevertheless, even if they are included with different weights, the following important criteria are considered: class participation, individual and group assessment. The final grade is computed with a compatible breakdown of the ranges for each letter grade, plusses/minuses could be used, if greater granularity is necessary.

For transparency, **the grading standards and criteria must be communicated to students at the beginning of the course** and revisit them periodically to ensure clarity. Due to the fact that multiple instructors are involved in grading, to help **minimize discrepancies and ensures fairness and objectivity in the assessment process, guidelines for evaluation consistency must be established**.

CONCLUSIONS AND SUGGESTIONS FOR HARMONISATION

Aligning the content and learning outcomes of similar courses across different institutions and educational systems ensures **consistency**, **comparability**, and **transferability** of knowledge and skills among students. Some challenges may arise during the harmonization process, including cultural and contextual differences, diverse educational systems, and the need for collaboration among institutions. But, **with careful planning, collaboration, and a shared commitment among stakeholders** these challenges could be overcome. In addition to homogenization of teaching and learning resources and defining clear learning outcomes, **encouraging collaboration and communication, flexibility and adaptability**, and last but not least, **promoting student involvement** are some strategies that must be considered further.

Therefore, a list of top suggestions for content harmonization may well include the following:

- to ensure uniformity of the learning materials, the structure of presentations, practical assignments, and quizzes must be fully standardized and enforced,

- to avoid redundancy and to ensure coherence, it would be beneficial for the instructors of intersecting courses to align the content and to redistribute the duration of presentations and practical activities,
- in the introductory lectures, certain topics may be discussed and introduced in a broad manner, while subsequent lectures dip into specific details and provide examples of their applications,
- for cases where there are additional areas that could be considered to further enhance the courses content or to adapt the courses according to different contexts, additional discussions must take place between the partners,
- to promote entrepreneurship among students and university staff, information regarding IoT and Big Data business models and strategies could be included,
- to reduce eventually inconsistencies and promote fairness and objectivity in the assessment process, it is necessary to establish guidelines for ensuring evaluation consistency,
- the quiz questions must be aligned with the course content and learning outcomes and a question bank is recommended.