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Capacity Building in Higher Education

(IoT-ECO)
IOT Green Transformation for Academic Society and Business Oriented Ecosystem in Western Balkans

101083018 (IoT-ECO) ERASMUS-LS, ERASMUS-EDU-2022-CBHE-STRAND-2

External Evaluation Report

Prepared by Assoc. Prof. Albana HALILI

Email: albana.halili@wbu.edu.al

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IoT-ECO Project Evaluation Progress Report

This report provides an external evaluation of the IoT-ECO project (101083018), funded under the Erasmus+ program, assessing its implementation against planned objectives for the whole project period (M1-M36). The evaluation, part of the project's Quality Assurance Work Package (WP7), was requested by the project coordinator and project Quality Assurance Board and is co-funded by the European Education and Culture Executive Agency (EACEA).

The primary goal of this evaluation is to assess the fulfillment of expected outcomes, verify the compliance with goals for target groups, and measure the results achieved during the whole project implementation (M1-M36). The evaluation aims to systematically and objectively assess the project's relevance, effectiveness, efficiency, impact, and sustainability.

The evaluation uses both qualitative and quantitative approaches to measure progress, ensuring the project remains aligned with its objectives. This report serves as a tool for monitoring the project throughout its lifecycle, tracking milestones, evaluating performance, and identifying challenges. It also facilitates communication among project teams and stakeholders, fostering transparency and trust.

Key components of the report include:

- **Project Overview**: This section provides a summary of the project's scope, objectives, timeline, and key deliverables. It ensures alignment among all stakeholders and highlights any changes in project scope or objectives. This clarity helps reinforce the shared vision and goals.

- **Performance Metrics**: This section includes indicators such as task completion rates, adherence to timelines, and the quality of deliverables. These metrics offer a clear picture of the project's progress, helping stakeholders make informed decisions about necessary adjustments.

- **Risk Management**: The report mentions some risks encountered during the reporting period, evaluates their impact, and details the actions taken to address them.

- **Conclusions and Recommendations**: The report concludes with an analysis of successes and challenges encountered during the first reporting period and highlights some areas for improvement in the next phase.

In summary, this Progress Report Evaluation provides stakeholders with a comprehensive account of the project's status, performance, and challenges, enabling informed decision-making and ensuring the successful achievement of the project's objectives.

1. Executive Summary of the Project

The IoT Green Transformation for Academic Society and Business-Oriented Ecosystem in Western Balkans (IoT-ECO) project addresses the need for green transformation and sustainable development in the Western Balkans (WB), specifically in Albania, Kosovo, and Montenegro. These countries share common priorities such as economic growth, EU alignment, and environmental sustainability. IoT-ECO is a capacity-building project designed to strengthen relationships between higher education institutions (HEIs) and broader societal and economic environments, particularly in the context of the European Green Deal and Sustainable Development Goals (SDGs).

Key aspects of the project include:

1. **Green Transformation through IoT/IoE Technologies**: The project focuses on leveraging IoT/IoE technologies to modernize higher education and address regional priorities in agriculture, tourism, and energy, aligning with the SDGs and EU standards.
2. **Capacity Building and Innovation Ecosystem**: The project aims to:
    - Build institutional and academic capacities within WB HEIs.
    - Create an innovative ecosystem that promotes sustainable economic growth and societal benefits through IoT/IoE solutions.
    - Enhance collaboration among six WB HEIs and three EU HEIs (from Bulgaria, Greece, and Austria).
3. **Key Deliverables** include:
    - **IoT-ECO Hub**: Establish a central platform for energy efficiency, air pollution monitoring, and technology transfer.
    - **Virtual Prototypes**: Develop green transformation ecosystem models for the Port of Durres and university campuses in Pristina and Podgorica.
    - **Updated Curricula**: Integrate IoT-related courses into study programs to provide students with skills relevant to Industry 4.0.
4. **Broader Societal Impact**:
    - Provide specialized training for academic staff to improve expertise in green ecosystems and IoT technologies.
    - Raise public awareness about IoT's potential for sustainable transformation.
    - Engage diverse stakeholders, including younger students, individuals with disabilities, businesses, and government representatives, through dissemination and networking activities.

By fostering cooperation, innovation, and knowledge exchange, IoT-ECO aims to establish a sustainable green future in the Western Balkans while strengthening ties between higher education and the region's economic and social development goals.

Project Card

Project Name: IoT Green Transformation for Academic Society and Business Oriented Ecosystem in Western Balkans

Project Acronym: IoT - ECO

Call Type ERASMUS-EDU-2022-CBHE-STRAND-2

Project Duration: 3 years

Coordinator: Assoc. Prof. Dr. Galia Marinova (TUS) (BG)

Consortium:

COO Technical University of Sofia – TUS (BG)

BE002 Polytechnic University of Tirana - UPT (AL)

BE003 Aleksander Moisiu University Durres - UAMD (AL)

BE004 University of Prishtina - UP (XK)

BE005 University for Business and Technology - UBT (XK)

BE006 Mediterranean University of Montenegro – UNIM (ME)

BE007 University of Montenegro – UoM (ME)

BE008 Technical University of Graz (AU)

BE009 University of Patras (GR)

AP001 Innovation Fund of Montenegro

AP002 Port Authority of Durrës

2. IoT-ECO project at a glance

The IoT-ECO project aims to modernize education and industry collaboration through the adoption of Internet of Things (IoT) technology. The initiative, funded under the Erasmus+ Programme, seeks to integrate IoT-based learning and research into Higher Education Institutions (HEIs) across the Western Balkans region, fostering a sustainable digital transformation.

2.1. Goals and objectives of the IoT-ECO project

The general objective of IoT-ECO Project is to enhance the capacity of Higher Education Institutions (HEIs) in the Western Balkans region by integrating IoT technology into academic curricula, research, and industry collaboration. The project is designed to foster green transformation and improve digital education in the region.

The specific objectives (SO) of IoT Project are:

SO1: Capacity Building – Provide training and workshops for academic staff and students to enhance IoT expertise and green transformation skills.

SO2: Develop IoT-ECO Hub – Establish a centralized platform for IoT-based education and research, promoting interactive learning and real-world applications.

SO3: Enhance Academic Curricula – Introduce six new IoT courses focused on sustainable technologies, ensuring alignment with industry needs.

SO4: Industry –Academia Collaboration – Strengthen partnerships between HEIs and industry stakeholders to ensure practical implementation and job market relevance.

SO5: Digital Twin Development – Create virtual models for real-world IoT applications, including monitoring energy efficiency and environmental impact.

SO6: Policy and Dissemination – Engage with policymakers to integrate IoT solutions into national digital and sustainability strategies.

SO7: Sustainability and Continuation – Ensure long-term project impact through institutional support, funding strategies, and continued stakeholder engagement.

By achieving these objectives, the IoT-ECO project seeks to modernize education, improve research capabilities, and contribute to the green transformation of the Western Balkans.

2.2. Expected achievements

The IoT-ECO project is expected to deliver significant advancements in education, research, and industry collaboration. Below are the key expected achievements:

Expected achievements	Indicators
1. Education and Curriculum Development	
	Accreditation and implementation of 6 new IoT courses in partner HEIs.
	Training of at least 50 academic and administrative staff and 150 students in IoT and green transformation technologies.
	Development and integration of digital learning resources through the IoT-ECO Hub.
2. Research and Innovation	
	Establishment of an IoT-ECO Hub that serves as a research and education platform.
	Development of digital twin models for monitoring energy efficiency and sustainability in industrial and academic settings.
	Publication of research papers and conference presentations on IoT applications.
3. Industry – Academia Collaboration	
	Strengthened collaboration between academia and industry through joint research projects and internship programs.
	Creation of partnerships with at least 10 companies to facilitate practical applications of IoT solutions.
	Organization of workshops and networking events with over 500 stakeholders, including students, researchers, policymakers, and business leaders.
4. Policy Influence and Sustainability	
	Engagement with policymakers to integrate IoT strategies into national digital transformation plans.
	Development of a sustainability plan to ensure long-term maintenance and expansion of the IoT-ECO Hub.

	Establishment of funding and institutional commitments to support ongoing IoT education and research beyond the project's duration.

2.3. Target groups of the IoT-ECO project

Key partners of the project include WB universities (specifically Albania, Kosovo and Montenegro), EU academic institutions (TU-Graz/Austria, TU-Sofia/Bulgaria, UPAT/Greece), and industry collaborators like the Port of Durres and Innovation Fund of Montenegro, fostering a holistic IoT ecosystem. The main target beneficiary with mobilities, courses and trainings are the staff and students in the WB HEIs. A larger impact on society is expected to be obtained through networking and dissemination activities with focus to younger students, people with disabilities, business representatives and governmental institutions till the end of the project and beyond.

3. Methodology of the external evaluation

3.1. Purpose and scope of the external quality evaluation

As specified in the above sections, the external evaluation of the project is delineated as a specific task within WP7, Quality Assurance and Evaluation. The primary objective of this evaluation is to conduct a comprehensive, independent, and objective assessment of the project's performance from Month 1 to Month 36. This evaluation critically examines the extent to which the project achieves its stated objectives, emphasizing evidence of successful outputs as outlined in the original project proposal. The principal findings and recommendations from this evaluation will be documented in two distinct reports: the midterm quality report and the final quality report. A first interim report was submitted to the coordinator for the first period of project implementation (M1-M18), and this was then used to build up the remaining period of project implementation. The final external evaluator report will be submitted at the end of project after all activities have been performed.

This external evaluation encompasses all project work packages and is designed to augment the existing internal quality assessment framework. It aims to provide the project consortium with evidence-based recommendations for further enhancement.

The evaluation approach equally considers both the *development perspective*, by assessing the extent to which project objectives are met with the expected quality and capacity, with particular focus on the practical application and impact of project outcome and the *project management perspective*, which evaluates the efficiency and effectiveness of administration, communication, collaboration, and adherence to deadlines.

The external evaluator conducted the assessment independently and without bias while maintaining flexibility, fostering open collaboration, and ensuring close communication with the project coordinator and the quality team throughout the process.

3.2. Evaluation phases

The external evaluation of the IoT-ECO project for the whole implementation period (M1-M36) was conducted using a structured, evidence-based methodology and transparent approach to ensure a comprehensive assessment of progress, achievements, and challenges.

The primary objectives of the external quality evaluation were to:

- Ensure alignment with evaluation standards and principles
- Assess the effectiveness and progress made in term of achieving intended outputs and outcomes
- The manner in which the partnership performed as a transnational collaboration (cross-cultural understanding, sharing of activities, effectiveness of communication, meeting deadlines, etc.);
- The effectiveness and impact of dissemination activities
- The extent to which a strategy for sustaining the project activities has been applied within the project; with the inclusion of the target groups (teachers, students, families, local communities, public stakeholders) in project planning and activities
- Provide actionable recommendations to enhance project performance and sustainability.

The criteria that guided the evaluation, both conceptually and operationally were:

- Relevance of the objectives and needs achieved
- Effectiveness: available resources and quality of the project outcome; achieving planned outputs and project objectives
- Efficiency: overall objectives to which the project purpose should contribute.
- Impact: the number of target groups reached
- Sustainability: strategies to have long-term impact and continuation of the project.
- Transparency

External Evaluation was based on all relevant external and internal documents that were available in different forms.

3.2.1. External evaluation steps performed

The methodology consisted of the following key steps:

Establishment of the evaluation approach

At the outset of the assignment, the external evaluator conducted several online consultations with the project coordinator and the project quality team. These discussions aimed to establish a clear understanding of the objectives of the external quality review and to identify the key issues that needed to be addressed. This phase was crucial for finalizing the methodology and selecting appropriate reporting methods.

Determine evaluation objectives

The specific aspects of the project that need to be evaluated, such as progress toward objectives, effectiveness of capacity-building activities, stakeholder engagement, and alignment with green transformation goals were defined. Then, the criteria and performance indicators to measure the project's success (e.g., milestones achieved, stakeholder involvement etc) were determined.

Desk research and document review
All relevant project documents and reports shared by the coordinator were reviewed. Documents included all deliverables submitted and approved till M18, reports written and published in the project website and other reports shared by the project coordinator such as the list of milestones, interim report etc.. Moreover, project timeline and key deliverables were analyzed in order to compare the actual progress against planned objectives and milestones.

Assessment of progress toward project objectives
Achievements made during the first half of the project were evaluated by comparing the actual outputs and outcomes with the project's initial targets and expected results. Based on what is reported by the consortium, the effectiveness and relevance of activities such as training programs, prototype development, and IoT-ECO Hub establishment was assessed.

Impact analysis
The impact analysis phase focused on clearly identifying the performance of each project activity and deliverable in comparison to the established project milestones. This analysis aimed to assess the effectiveness and impact of the project activities.

Identify challenges and adaptive strategies
Challenges faced during the implementation phase, such as resource constraints, technical issues, or limited stakeholder participation were identified and the project team's adaptive strategies and their effectiveness in overcoming these challenges was evaluated.

Synthesis and reporting
All the data, insights and findings were compiled into a structured report.

Conclusions and Recommendations
The final phase involved synthesizing the findings and formulating conclusions and recommendations. The first draft of the report, before finalization, was submitted to the consortium for any technical or factual errors.

4. Analysis and Findings

4.1 Purpose and Scope of the Progress Report

This final evaluation report assesses the overall implementation, achievements, and impact of the IoT-ECO project upon its completion. It examines the extent to which the planned objectives have been fulfilled, evaluates the quality of outputs and processes, and identifies strengths and areas for future improvement and sustainability. The evaluation is based on project documentation, partner feedback, quality monitoring reports, and evidence collected throughout the entire implementation period.

The project's quality framework, as defined in the original proposal and detailed in the Project Quality Assurance Plan, provided a comprehensive structure for ensuring high-quality processes, deliverables, and outcomes. The framework integrated internal and external quality controls, including performance indicators, documentation standards, event quality procedures, peer-review mechanisms, and monitoring tools. All quality procedures were fully aligned with the Grant Agreement and Partnership Agreements, and the consortium adhered consistently to the established standards. As a result, project activities, outputs, and management procedures were implemented with rigor, transparency, and accountability.

4.2. Effectiveness

Effectiveness in a European Commission–funded project reflects the degree to which the consortium collaborates successfully to achieve meaningful outputs and ensure European added value. In IoT-ECO, collaboration across institutions and countries functioned at a high level throughout the project. Partners consistently reported excellent project management, clear coordination, and strong mutual support.
The following points demonstrate the effectiveness achieved:

- From project initiation to completion, the coordinator ensured continuous guidance, structured coordination, and proactive monitoring across all levels of implementation.
- Partnership agreements were duly signed, and financial management was carried out in full compliance with Erasmus+ administrative and financial guidelines, ensuring timely distribution of funds and accurate reporting.
- The coordinator maintained ongoing, constructive communication with all partners, supporting progress tracking, problem-solving, and adherence to deadlines.

- The Project Management and Quality Assessment Plan was prepared at the outset, shared with all partners, and regularly updated. This document provided detailed descriptions of activities, responsibilities, and internal deadlines, ensuring that all partners clearly understood their tasks throughout the project.
- Documentation for periodic and final reporting was collected efficiently, with partners contributing materials, evidence, and deliverables in a structured and timely manner.
- A strong visual identity was established early in the project, including a logo and website. All project materials were produced in accordance with Erasmus+ visibility requirements.
- Despite the cultural and institutional diversity among partners, the consortium established a highly effective communication culture. Partners with extensive EU project experience supported those with less experience, resulting in a cohesive, well-coordinated team effort.

Overall, the consortium demonstrated excellent effectiveness in collaboration, management, and delivery of the project's core outputs, reflecting a strong commitment to shared goals and European added value.

4.3. Internal and External Communication

This section on communication covers both internal communication between partners, across the different stages of the project and external communication, which focuses on dissemination, communication and awareness raising which is covered by the project.

Throughout the project, both internal and external communication was structured, consistent, and effective. Internal communication benefited from a combination of formal coordination mechanisms (online meetings, project assemblies, work package leadership interactions) and frequent bilateral exchanges between the coordinator and partner teams. Communication remained clear, timely, and solution-oriented, enabling smooth progress and efficient handling of tasks during and between meetings.

The partnership demonstrated strong coherence despite geographic and cultural diversity. Partners communicated openly, fulfilled responsibilities on time, and supported each other in achieving the expected results. The clarity of instructions provided by the coordinator, combined with the responsiveness of partners, contributed significantly to the project's success.

External communication and dissemination activities were also carried out with high quality and professionalism. Events were well organized, well attended, and demonstrated strong engagement from academic, industry, and community stakeholders. These events fostered meaningful exchanges, expanded the project's network, and enhanced its visibility.

The project communicated effectively in all participating countries. The website served as a clear and accessible public platform and was strengthened by the integration of project outputs and good practices collected during implementation. Social media channels, printed materials, public events, and participation in national and regional activities further ensured that the project reached a broad and diverse audience.

4.4. Project Implementation and Key Performance Indicators (KPIs)

4.4.1. Work Package Progress

The project is organized in 8 work packages:

WP1: Management
WP2: Preparation
WP3: Pilot Experience and sharing know-how with EU partners on the establishment of the IoT-ECO hub
WP4: Establishing IoT-ECO hub
WP5: IoT-ECO hub for teaching materials, new and updated courses, and research
WP6: Networking of WB HEIs on IoT-ECO as a resilient solution toward the green transformation for society and business
WP7: Quality Assurance and Evaluation
WP8: Dissemination and Exploitation

The progress achieved during the implementation period from Month 1 to Month 24 demonstrates consistent advancement toward the project's objectives, with strong coordination among partners and a high level of commitment across the consortium. In the following section a detailed description of expected outcomes and completed achievements till now is provided:

WP1: Management

Work Package 1 (WP1) of the IoT-ECO project focuses on effective project management to ensure the successful execution of project activities. Through this WP, the coordinator and project partners have ensured smooth governance, transparent communication, and timely coordination of activities.

WP1 activities of IoT-ECO project started with the kick-off meeting organized by the coordinator, TU-Sofia, Bulgaria during January 2023. During this meeting the role, tasks, and responsibilities of each partner and associate partner were defined, and the Partnership agreements were prepared and signed. The members of the Project Management Board and the Quality Board were nominated and elected. During project implementation, each partner has fulfilled the duties shared accordingly, TU-Sofia prepared the Project Management Plan

that has been regularly updated and communicated to partners, UP developed the Project Quality Monitoring Plan and UAMD developed the Project Dissemination Plan. There is a good framework of the project which allowed a good management, quality, dissemination, therefore, a good project implementation.

At the start of the project, for a better management efficiency of the project, the consortium members have made a thorough analysis and pilot testing in terms of which document sharing and project management tools can be used. They have decided to use two instruments: File Storage Service Google Drive and Project Management tool Trello. Using a project management tool is very positive, since in this way project coordinator has managed better to check and control deadlines and tasks achievement by each partner.

The consortium has developed project templates for reporting activities to be used regularly for each activity held. Before each specific meeting, meeting agenda and invitations where prepared and shared and after the meetings, the respective attendance lists, photos, meeting minutes and other dissemination documents and news have been prepared and shared in the website and other social media platforms on the project.

The project management approach is agile, and communication between coordinators and project partners is effective. The project managerial structures, including the Project Management Board and Project Quality Board, were established within the planned timeline and included representatives from all consortium partners. The Project Management Plan, a comprehensive document, which details all project activities, progress indicators, methodology for project implementation, and project risk management assessment, was prepared and shared. The consortium benefited from a strong and transparent management structure, clearly defined roles, and consistent communication among all partners. Regular online meetings, bilateral discussions, working group coordination, and monitoring tools (Trello, shared repositories, and official communication channels) supported timely decision-making and problem resolution. Moreover, for preparation of this report, the coordinator gave access to the evaluator to Google Drive, thus there was a clear and transparent reach to all information related to the IoT-ECO project documents.

The project coordinator ensured the smooth execution of administrative, financial, and technical responsibilities. Periodic management reports, internal updates, and structured documentation helped maintain alignment with the Grant Agreement and facilitated early detection of potential delays or challenges. All required reporting obligations, including technical and financial documentation, were prepared and submitted in line with Erasmus+ requirements.

Furthermore, project risk management procedures were implemented effectively. When technical delays occurred (particularly regarding licensing procedures in WP4), the

consortium addressed them promptly and transparently, securing an approved extension that enabled full completion of activities without compromising quality.

Overall, WP1 is assessed as **highly effective**, demonstrating excellent coordination, clarity of processes, proactive problem-solving, and strong internal communication across partner HEIs and external stakeholders.

WP2: Preparation

Work Package 2 (WP2) focuses on assessing the current landscape of IoT and green transformation within the Western Balkans' academic and business sectors. The primary objective is to identify existing skills, competencies, and gaps to inform targeted capacity-building initiatives.

The expected outcomes of WP2 were:

- **Comprehensive Needs Analysis:** Conduct surveys and studies to evaluate the inclusion and application of IoT and green transformation technologies among students, academic staff, and companies in Albania, Kosovo, and Montenegro.
- **Identification of Skill Gaps:** Determine the readiness of universities and businesses to integrate advanced IoT technologies, highlighting areas requiring development.
- **Foundation for Capacity Building:** Utilize the findings to design tailored training programs and curricula that address identified deficiencies, aligning with industry demands.

To achieve the aim of this WP, first surveys were prepared for three stakeholders, namely, the students, academic staff and companies in WB countries, which were then shared among them, analyzed and presented in a workshop where partners assessed the IoT landscape and presented national findings, as planned in the proposal. The results revealed a positive trend in IoT awareness but gaps in practical experience, resources, and green transformation projects. Discussions addressed challenges in implementing IoT solutions and established future priorities, including integrating IoT technologies into curricula and fostering academic-industry collaboration. Recommendations included in the report are modernizing curricula, increasing IoT/IoE training, and strengthening institutional capacities. This WP is completed and the achievements can be listed as follows:

- **Needs Analysis Report:** A detailed report was produced, offering insights into the current state of IoT and green transformation integration within the education and business sectors. This report serves as a baseline for future project activities.
- **Stakeholder Engagement:** Active participation from students, academic staff, and industry professionals was secured through surveys and workshops, ensuring a comprehensive understanding of the regional IoT landscape.

- **Data-Driven Strategy Development:** The collected data has informed the creation of targeted strategies for curriculum development and capacity-building initiatives, ensuring relevance to the identified needs.

The findings identified considerable interest in IoT technologies across the region, although significant gaps were observed in practical training, institutional equipment, and integration of green transformation practices. These results guided the design of the capacity-building activities and informed subsequent curriculum and training developments. In summary, WP2 achieved successfully all its expected outputs and provided a solid analytical foundation for the remainder of the project.

WP3: Experience and sharing know-how with EU partners on the establishment of the IoT-ECO hub

WP3 is dedicated to sharing experiences and know-how with EU partners to establish the IoT-ECO hub. This initiative aims to foster collaboration between WB HEIs and EU partners, focusing on innovative IoT applications within the framework of green transformation.

The expected outcomes of WP3 were:

- **Knowledge Exchange:** Facilitate workshops and training sessions where EU partners share best practices and solutions in IoT and green transformation across academia, business, and society.
- **IoT-ECO Hub Development:** Leverage the shared knowledge to develop the IoT-ECO hub, serving as a collaborative platform for innovation and technology transfer among HEIs and industry stakeholders.

To achieve the objectives of WP3, the consortium held first a workshop on good EU IoT and green transformation practices and solutions in academia, business and society, conducted at Graz University of Technology. This workshop targeted academic staff, providing them with insights into successful implementations and strategies. Presentations and training sessions offered by EU partners provided participants with valuable insights into IoT principles, green transformation technologies, and their implementation in various sectors. Highlights included an introduction to digital twin technology and practical demonstrations of its application in sustainability-focused projects. These sessions were designed to enhance participants' understanding of IoT frameworks and their potential to address environmental challenges.

WP3 activities were then followed by the realization of a study visit to learn best practices on HEI capacity building on IoT green applications, from which 27 teachers and 31 students could benefit. Therefore, listed achievements for WP3 are as follows:

- **Workshop Completion:** A comprehensive workshop focusing on EU IoT and green transformation practices, which marked a critical milestone in fostering collaboration and knowledge sharing between WB HEIs and their EU counterparts.
- **Study visit realization:** The visit was realized to learn best practices on HEI capacity building on IoT green applications with hands-on experience offered participants a deeper understanding of state-of-the-art technologies and their practical applications in solving real-world problems.
- **Deliverable Submission:** Deliverables 3.1 and 3.2 were successfully completed and submitted, marking the successful fulfillment of WP3's objectives.

In summary, WP3 has effectively achieved its goals by facilitating valuable knowledge exchange between EU partners and WB HEIs, laying a solid foundation for the development of the IoT-ECO hub and advancing the project's mission of integrating IoT solutions for green transformation. Deliverables associated with this WP were submitted on time, and the activities significantly contributed to strengthening staff competencies across partner institutions. The experience-sharing dimension of the project is widely recognized by partners as a key factor enabling the successful design of subsequent project components, particularly the IoT-ECO Hub.

WP4. Establishing IoT-ECO Hub

WP4 is dedicated to establishing the IoT-ECO Hub, a modular platform designed to facilitate educational and experimental initiatives among partner institutions. Among expected outcomes are:

- **IoT-ECO Hub Development:** Design and implement a modular hub allowing each partner to develop and deploy their respective educational and experimental modules, ensuring efficient interactions among them.
- **Training for Educators and Staff:** Provide online training sessions to equip teachers and staff with the skills to create, upload, and share content on the IoT-ECO hub.

In order to achieve these outcomes and objectives, the consortium held various activities such as the fully active involvement of each partner country in the establishment of the IoT-ECO Hub design and implementation, which serves as a common space for the teaching materials and virtual prototypes of all project partners and also training of staff to create, upload and share content at the IoT-ECO Hub. The HUB was successfully designed with a focus on modularity, enabling each partner to develop and deploy their respective modules. Efficient interactions among these modules were defined and implemented, ensuring a cohesive platform.

The hub is structured around modular principles, allowing each project partner to contribute their own educational and experimental components while ensuring seamless integration across modules. Its overarching mission is to create a shared space for educators, students, and other stakeholders to access resources, collaborate, and explore innovative IoT-based solutions for sustainability.

The **educational component** of the hub leverages the Moodle Learning Management System (LMS), providing users with access to teaching materials, datasets, Azure-based IoT solutions, and forums for discussion and knowledge exchange. Teachers are empowered to develop and share course content, including assignments, tutorials, and practical exercises, while students can engage with these resources to build hands-on experience in IoT and green transformation. Features include the ability to configure courses, integrate external data repositories, and utilize IoT-generated datasets for analysis and experimentation.

The **experimental component** focuses on the creation of virtual prototypes that model green transformation ecosystems. These include a 3D digital twin of the Port of Durres and virtual prototypes for university campuses in Pristina (UBT) and Podgorica (University of Montenegro). The digital twin of the port will include terrain maps and infrastructure details, enabling simulations to analyze energy consumption, CO2 emissions, and other sustainability metrics. These virtual environments will provide students and researchers with opportunities to explore real-world challenges in green transformation and develop data-driven solutions.

In conclusion, the IoT-ECO Hub serves as a critical platform for enabling collaboration, knowledge sharing, and innovation in IoT and green transformation. Its dual focus on education and experimentation positions it as a valuable resource for achieving the project's goals and promoting sustainable development in the Western Balkans. The completion of the hub and its effective utilization will be vital in supporting capacity building and advancing the green transformation objectives of the IoT-ECO project.

The achievements of this WP in detail can be listed as follows:

- **IoT-ECO Hub Design and Implementation:**
    - Completed tendering procedures for infrastructure, software, and hardware
    - Developed the IoT-ECO hub
    - Defined the mission and vision for managing and regulating the IoT Hub
    - Administered and registered the IoT-ECO Hub

- **Online Training for Educators and Staff:** Comprehensive online training sessions were conducted, enabling teachers and staff to effectively create, upload, and share content on the IoT-ECO hub. This initiative ensured that all participants are well-prepared to utilize the hub's capabilities.

In conclusion, WP4 successfully met its objectives by establishing a functional and modular IoT-ECO hub and providing essential training to educators and staff, thereby enhancing the project's capacity to support educational and experimental activities in IoT and green transformation. Regarding Deliverable 4.2, additional time has been asked and approved by PO for preparing the first version of the platform (including the acquisition of all licenses, etc.) and, subsequently, for preparing the relevant material pertaining to the online training of teachers and staff, etc. What remains important to be considered for this WP outcome is the management and enhancement of the IoT-ECO Hub in the future and its sustainability after the project ends.

WP5 – IoT-ECO Hub for Teaching Materials, New and Updated Courses, and Research

Work Package 5 (WP5) plays a central role in ensuring that the educational and research objectives of the IoT-ECO project are fully realized. It focuses on the creation and integration of new IoT-related teaching materials, the development of new and updated courses, and the organization of research-oriented activities connected to the IoT-ECO Hub. While most tasks in this WP are scheduled for the second half of the project, substantial progress has already been achieved during the reporting period (M1–M24).

Expected tasks of WP5 were as shown below:

- Develop teaching materials, including white papers and lecture notes
- Create new courses and modules, integrating them into WB HEIs curricula
- Integration and probation of new courses, modules, practice and students' projects in the syllabi and/or curriculums of WB HEIs
- Invited/guest lecturer from business or associated partners
- Collection of Students' feedback about the implementation of the new topics about IoT-ECO

During the second half of project period, partners developed an **extensive set of teaching resources**, including white papers, lecture notes, tutorials, and problem-based learning materials. These resources were prepared in alignment with international standards and tailored to the specific needs of Western Balkan HEIs.

Six new IoT-related university courses, which address key aspects of IoT technology and sustainability and form the basis for strengthening institutional capacity in this field, were created and accredited across the partner universities as follows:

- *Introduction to IoT* (UAMD),
- *IoT and Cloud IoT* (UPT),

- *Advanced Mechatronic Systems* (UoM),
- *Internet of Things* (UNIMED),
- *Green Wireless Communications* (UP),
- *IoT* (UBT)

To support the probation of the new courses, partner HEIs organized guest lectures delivered by experts from industry, associate partners, and leading research institutions, including the Port Authority of Durrës and and even top research institutes like CERN. A total of **11 guest lectures** were conducted across the six partner HEIs. The diversity of lecturers' spanning fields such as embedded systems, cloud services, telecommunications, healthcare, and logistics ensured that students gained valuable insights into real-world applications of IoT and its relevance to green transformation. The lectures were scheduled in the first weeks of the new courses probation in order to promote the new courses and to confirm the interest of associate and business partners to the topics connected to IoT for Green transformation.

Student feedback related to the lectures was systematically collected through standardized evaluation forms. Out of 156 students who attended the guest lectures, 125 provided feedback (80% response rate). Feedback across institutions highlighted high satisfaction with the clarity, relevance, and practical value of the lectures and course content. Students expressed particular interest in practical demonstrations, hands-on sessions, and extended industry involvement. This feedback provides useful guidance for strengthening the pedagogical approach during full course implementation.

Overall, WP5, as one of the most impactful components of the IoT-ECO project, has been successfully implemented and has demonstrated strong alignment with the project's academic and technical objectives. The development and accreditation of new IoT-related courses, the creation of high-quality teaching materials, the delivery of guest lectures, and the active engagement of students all contributed to establishing a solid educational foundation for IoT and green transformation across partner HEIs. The integration of resources into the IoT-ECO Hub, together with systematic student feedback and industry collaboration, provides a sustainable platform for continued teaching, research, and innovation. WP5 stands out as a key achievement of the project, with clear long-term benefits for institutional capacity building and regional cooperation.

WP 6. Networking of WB HEIs on IoT-ECO as a resilient solution toward the green transformation for society and business

The activities, milestones and deliverables of WP6 planned to be realized in the second period of the project. The tasks planned to be performed during this project were:

- Organization of roundtables and workshops with universities (academic and administrative staff)
- Organization of roundtables and workshops with Professional High Schools
- Organization of roundtables and meetings with businesses, organizations, and local government
- Organization of open days for informing citizens regarding IoT technology as a challenge for development and with a focus on the application field.
- Fostering collaboration and networking between universities, businesses, and society (workshops)

WP6 is now fully completed and has achieved significant impact at institutional, regional, and societal levels. The activities implemented under this Work Package successfully increased the project's outreach beyond academia and strengthened the contribution of IoT-ECO to the green transformation agenda in the Western Balkans.

The consortium organized a broad range of community-oriented events, including open days, high-school outreach sessions, youth workshops, roundtables with public authorities, events for children with disabilities, and university-industry gatherings. More than **1,200 external participants**, engaged across 14 events, benefited from WP6 activities, demonstrating the project's ability to reach diverse audiences. The Summer Academy 2025 and participation in 26 international conferences like SoSE 2025 and CSIT 2025 further expanded the project's global footprint, positioning IoT-ECO as a leader in green digital education and innovation.

Furthermore, in the context of this WP, associate partners, such as the Port Authority of Durrës, municipal authorities, telecom operators, and private companies, actively contributed through guest lectures, joint activities, and advisory inputs. Their involvement ensured the long-term relevance of project outcomes and strengthened the ecosystem around IoT innovation.

Exploitation efforts focused on integrating project results into teaching, establishing new collaborations, promoting the use of digital twins in real-world contexts, and expanding partnerships with industry and educational institutions. The outcomes of WP6 show strong potential for sustainability, with several HEIs planning to continue using IoT-ECO materials, events, and collaborations after the project's completion.

WP6 is evaluated as high-impact and fully accomplished, demonstrating strong regional visibility, broad engagement, and successful exploitation of project outcomes.

WP 7: Quality Assurance and Evaluation

The focus of WP7 of the IoT-ECO project was on Quality Assurance and Evaluation, ensuring that project activities meet established standards and objectives. All the tasks of WP7 were completed as planned. It started with decision of Project Quality Board in the kick off meeting which was then followed by the next deliverable on preparation of the Quality Assurance (QA) Plan, which are among crucial documents needed to ensure project quality.

The QA Plan provides a comprehensive framework for maintaining and evaluating the quality of the IoT-ECO project's activities, deliverables, and outcomes. It defines key quality management roles and responsibilities, including the Project Management Board (PMB) and the Project Quality Board (PQB). These were the main bodies that overseed the internal quality assurance processes and external evaluations, ensuring adherence to the project's objectives and Erasmus+ standards. The QA Plan emphasizes also quality assurance for document-based deliverables, events, teaching materials, and the IoT-ECO Hub. Templates and standardized formats were provided for consistency across reports, presentations, and event documentation. The QA policies ensured that teaching materials are based on international standards, with a focus on inclusivity, industry relevance, and research-friendly content. Additionally, the report outlines mechanisms for assessing project outcomes, such as annual quality reports that evaluate event quality, IoT Hub functionality, teaching materials, and stakeholder engagement.

The established Project Quality Board monitored activities across all Work Packages and provided periodic recommendations for improvement. Quality reports were produced on schedule, documenting progress, identifying risks, and validating the compliance of deliverables with Erasmus+ standards. Course materials, digital tools, learning resources, and dissemination outputs were reviewed to ensure clarity, relevance, and alignment with project goals.

Feedback from students, academic staff, external experts, and industry partners was systematically collected and incorporated into improvements for teaching materials, digital twin prototypes, and dissemination practices. The quality monitoring process showed a high degree of transparency and adaptability, with the consortium responding effectively to recommendations. The external evaluation procedures were also clearly defined and initiated according to schedule.

WP7 is assessed as fully completed and highly successful, contributing significantly to the project's coherence, accountability, and continuous improvement and ensuring a high level of quality throughout the project's lifecycle.

WP 8: Dissemination and Exploitation

As the title implies, WP8 is dedicated to dissemination and exploitation activities, aiming to promote project outcomes and ensure their sustainability beyond the project's lifespan. This WP as expected continued throughout project period. Among implemented activities are:

- Development of a dissemination and exploitation plan
- Creation and maintenance of the project website and other social media tools
- Design of project promotional materials
- Organization of dissemination events
- Participation in other events to promote the project

IoT-ECO project's website and social media profiles, emphasizing their role as key tools for dissemination and communication. The website (https://iot-eco.eu/) serves as the primary platform for presenting the project, sharing updates, and engaging stakeholders. It includes sections such as project activities, work packages with progress bars, governance structure, and general project objectives. Developed using WordPress, the site incorporates tools like Google Analytics to track visitor engagement and is linked to social media accounts on Facebook, Twitter, Instagram, and LinkedIn.

Social media platforms were launched early in the project lifecycle to foster communication with stakeholders and promote project activities. These profiles aim to enhance visibility and community engagement through content sharing, likes, retweets, and subscriptions. The report highlights continuous efforts to update and improve the website based on feedback from the Quality Board, ensuring alignment with project objectives. Future plans include ongoing training for website administrators and a structured update schedule to maintain an active online presence throughout the project's duration.

Throughout the project, the consortium produced a rich set of dissemination materials, including promotional videos, brochures, posters, press releases, and digital content. These materials effectively communicated project goals, milestones, training activities, student events, and final outputs. Furthermore, IoT-ECO project has released three newsletters detailing its progress and activities. Each newsletter provides insights into various phases of the project, highlighting key events and developments. These newsletters collectively showcase the project's dedication to fostering collaboration, enhancing IoT competencies, and promoting sustainable development in the Western Balkans.

All partners actively contributed to dissemination through participation in conferences, workshops, IoT-ECO Open Days, media appearances, scientific publications, internal seminars, and regional education fairs. The project's visibility grew significantly, with digital engagement metrics and event attendance demonstrating strong interest across the Western Balkans.

The communication strategy ensured alignment with Erasmus+ guidelines and emphasized transparency, sustainability, and cross-institutional collaboration. With well-curated content and consistent updates, WP8 contributed to building a recognizable IoT-ECO identity and a strong communication culture among partners.

In summary, the project has been actively promoted through various channels, including the official website, newsletters, and social media platforms, to reach a wide audience. The reach was to large communities in the universities, at conferences, meetings, exhibitions, and celebrations through 30 communications and 20 dissemination events in and out of the countries involved in the consortium. The dissemination activities at the onsite events have reached more than 2000 representatives of academia, research, local, regional, and EU administration industry, innovators, etc. Through the social media communications more than 12000 people were reached.

WP8 is assessed as fully completed and highly effective, with a strong and lasting contribution to the project's visibility and recognition.

4.4.2. Key Performance Indicators used for External Evaluation

The following table outlines the qualitative and quantitative KPIs used to evaluate the performance of the IoT-ECO project.

Table: Key Performance Indicators (KPIs) and Achievements of IoT-ECO Project

KPI Type	KPI Definition	Target/ Benchmark	Achievement	Evaluator's Comment
Quantitative	Number of training sessions conducted	Minimum 5 sessions	**Exceeded** - more than 5 training/workshop sessions were delivered across WPs 3, 4, 5 and 6 (including EU experience-sharing, teacher training, and hands-on labs).	Target met with strong capacity-building impact
Quantitative	Completion rate of project deliverables on time	95% of deliverables submitted according to timeline	**100% achieved** (minor delays in WP4 due to technical licensing but formally approved).	Excellent adherence to timelines; delays effectively managed.
Quantitative	Stakeholder engagement (participants in surveys,	At least 50 stakeholders	**Exceeded** - more than 1,200 participants engaged across needs analysis, open	Very high reach, surpassing expectations.

	consultations, and outreach)		days, workshops, industry meetings, and roundtables.	
Quantitative	Number of dissemination events	Minimum 20 events	**30+ dissemination activities** delivered (open days, info sessions, conferences, newsletters, social media campaigns).	Visibility and outreach are outstanding.
Quantitative	Number of students involved in IoT-related activities and courses	Not specified (but expected "significant student reach")	**231 students** attended and evaluated new courses in 2024/25; **670+ students** expected by project end; **200+ students** attended the IoT-ECO Summer School.	Excellent student involvement and growing demand
Qualitative	Stakeholder satisfaction with project activities	Minimum 90% satisfaction	**Achieved** - High satisfaction reported across student feedback forms, training evaluations, and workshop surveys.	High relevance and quality of activities
Qualitative	Quality of teaching materials developed	90% rated as high quality	**Achieved** - teaching materials (30+ lectures, 20 assignments, 5 tutorials) rated highly by peer reviewers and students.	Materials are pedagogically sound and up to date
Qualitative	Evidence of knowledge transfer and capacity building	Documented in at least 5 case studies	**Achieved** — Numerous examples of knowledge transfer (EU workshops, digital twin development, staff training, industry collaboration).	Strong capacity-building outcomes
Qualitative	Functionality and adoption of IoT-ECO Hub	Hub operational and used by partners	**Partially achieved / ongoing** - Hub designed, implemented, populated with materials; staff trained; prototypes integrated. Adoption expected to deepen in second half.	Hub is operational but sustainability measures needed
Qualitative	Industry collaboration	Not formally quantified	**Achieved** - 9 MoUs signed; > 20 guest lectures; joint workshops with companies; active	Strong and diverse industry-academia linkage

			collaboration with Port of Durrës in Albania	
Qualitative	Networking and cross-institutional cooperation	Not formally quantified	**Achieved** - 3 roundtables; multi-country workshops; additional participation in 26 international conferences; successful Summer Academy 2025.	Networking outcomes exceed expectations

6. Conclusions and Recommendations for Future Sustainability and Impact

The IoT-ECO project is a significant step towards addressing skill gaps in IoT applications for green transformation in WB. Its robust management and impactful dissemination lay the groundwork for enduring benefits. The consortium successfully established the foundations for capacity building in IoT and green transformation, developed critical digital infrastructure such as the IoT-ECO Hub, produced high-quality teaching materials, and fostered multi-stakeholder collaboration across the Western Balkans.

Based on what has been implemented during its implementation, the project demonstrated excellent management and communication among partners, high-quality training and knowledge transfer from EU partners, a strong engagement of students, staff and industry, significant dissemination reach and visibility and also innovative contributions through digital twins and prototype ecosystems. Therefore, the commitment of the coordinator and the participating universities is very good and to be appreciated. However, sustained support and engagement are essential to maximize long-term impacts.

The following recommendations can be outlined to be considered for the support of long-term IoT-ECO project's sustainability:

- **Institutional Sustainability** through integration of all newly developed courses permanently into HEI curricula and formalization of IoT-ECO Hub administration structures within each university. Adoption of an annual budget at each respective HEI for maintaining software licenses, servers, and hardware is of high importance.
- **Technical Sustainability** by continuously enhancing and updating Digital Twins with real-world data inputs. Upgrade of the IoT-ECO Hub with additional functionalities based on user feedback and establishment of a shared Western Balkan repository of IoT datasets and practical assignments would have a great long-term impact on the IoT area.
- **Human Capacity and Expertise:** training of additional academic staff to reduce dependency on a small core team and development of a regional IoT Training Certificate recognized by EU and WB institutions.
- **Industry and Ecosystem Sustainability** by expanding the network of companies and public bodies engaged with the Hub and formalizing internship schemes, student projects, and co-developed modules with industry.
- **Preparation of follow-up proposals** to Horizon Europe, other Erasmus+ KA2, Digital Europe, or other calls to keep the HUB continuous and active. Membership fees or co-funded maintenance models for the Hub can be explored.

- **Community and Outreach Sustainability** by integration of IoT-ECO activities into regular career fairs, innovation days, and school outreach programs. Moreover, preparation of a digital repository of lectures, prototypes, and promotional materials for public access is recommended (mentioned also by the consortium in the sustainability plans).
- **Strengthen policy engagement** by conducting targeted policy dialogues and present findings to relevant governmental bodies.

In summary, IoT-ECO project has demonstrated strong performance, generating high-quality outputs, strengthening institutional capacities in the Western Balkans, and contributing significantly to green digital transformation. Moreover, it remains a key driver for digital education and innovation in the Western Balkans. By implementing these recommendations, IoT-ECO has the potential to evolve into a long-term regional ecosystem for IoT education, research, and innovation, well beyond the lifespan of the Erasmus+ grant.