Artificial Intelligence for Operation and Maintenance of PV Plants

Deliverable D5.1

Project management plan

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Disclaimer

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1.0	31 August 2021	Final version	

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ABBREVIATIONS AND ACRONYMS

Acronym	Meaning
CA	Consortium Agreement
DMP	Data Management Plan
KER	Key Exploitable Result
PC	Project Coordinator
PCC	Project Co-ordination Committee
PMP	Project Management Plan
QAP	Quality Assurance Procedure
WP	Work Package

1. INTRODUCTION

This document is entitled "Project management plan" and it is developed as part of the AI4PV project within Task 5.1 of WP5.

The main objective of the Project Management Plan (PMP) is to provide all partners with an overview of the project's governance structure, schedule of actions, communication, management and monitoring procedures, including administrative and financial considerations. In addition, the internal review procedure is briefly explained, as well as a framework for both internal and external communications aiming to engage partners in a clear, informative and two-way communication that are planned and effectively linked together with key messages.

The PMP will ensure the successful execution of the AI4PV (*Artificial Intelligence for Operation and Maintenance of PV Plants*) project and it has developed based on the terms and conditions established in the Grant Agreement (GA) and its Annexes.

This document is framed by the work package 5 (Project Management) to act as deliverable D5.1, and it will be used to guide all members of the consortium throughout the entire duration of the project. Procedures for an effective management or communication will be continuously improved by taking into account the lessons learned from all consortium members.

1.1 SCOPE OF REPORT

This document provides guidelines for many day-to-day operating procedures by summarizing the best practices for a good communication and management of the AI4PV project, in terms of administrative and financial aspects. An overview of all objectives, work packages, deliverables and milestones of the AI4PV project is formally presented, as well as the roles and responsibilities of the consortium members.

The PMP describes the procedures towards an effective management and monitoring of AI4PV by proposing conventions for communicating and reporting along with some IT tools and templates that will be used by partners. This document provides orientations required to raise the awareness of the project to different audiences such as, general public, industry and academia; by communicating its added value and benefit to address important technological problems. The PMP is also focused on the dissemination of the research and outcomes generated by the project which aims to assure that the progress made in AI4PVis assimilated into the scientific and industrial community's state of the art.

Moreover, it also introduces formal mechanisms to monitor, identify, assess and mitigate both expected and unexpected risks that might occur during the course of this action as well as internal procedures that are planned to ensure that deliverables and documents have the quality expected by all AI4PV consortium partners.

This document will be used by all partners to efficiently develop their individual or collective activities since it provides a harmonized set of support documents and practical guidelines that can be used for

optimizing the project implementation. The PMP will be kept up to date as needed throughout the project lifecycle, as new information becomes available or new decisions are made.

1.2 OUTLINE OF REPORT

This document articulates over 9 different section.

Section 2 provides an overview about AI4PV project, establishing timelines and responsibilities as well as the objectives that the project aims to reach. A list of milestone and deliverables is reported, which represent the outcome of the work to be done.

Section 3 describes the governance structure, pointing out clear responsibilities for each consortium member as well as the power of each governmental body established.

Section 4 explain the communication procedures in place, aiming at ensuring proper communication between the partner as well as to track and monitor both technical and financial progress. The project repository is therein described as well as the IT tools to be used for the project's meetings.

Section 5 describes the clauses of the GA related to IPR issues and management.

In Section 6 the risk management plan and contingency plan is explained, whose goal is to identify and mitigate risks that might arise throughout the project lifetime so to ensure proper development and fulfilment of all the established objectives.

Section 7 introduces the quality assurance procedure to be followed in order to ensure high-quality of the project results and outcomes. A review procedure for all the deliverables is therein explained as well as deadlines and roles of each member.

Section 8 introduces communication and dissemination strategies that will improved further within WP5.

Finally, Section 9 briefly introduces the Data Management Plan which will be developed in D5.2 by M5 of the project.

2. PROJECT OVERVIEW

The main goal of the AI4PV project is to increase the operational performance of PV plants through the development of a Digital Twin combined with Data Analytics of plant signals.

The expected result of the Project is a set of tools for PV plant O&M and Asset Managers for:

- **increasing the operational reliability and efficiency of PV plants**: high accuracy of early detection of faults and degradation problems and Optimization of O&M activities;
- **enhance economic performance**: reduction of downtimes of elements, detection of underperformance problems that can affect the energy production.

To achieve these high-level objectives, digital tools will be developed and validated using different technologies as: modelling & simulation, data analytics, predictive maintenance and data gathering and interoperability.

In this sense the AI4PV project aims at reaching two specific objectives.

<table>
<tr><td colspan="4">Specific objective 1 – Increasing PV Plant reliability through development and validation of models, simulation tools and AI-based data analysis for fault prediction and detection</td></tr>
<tr><td colspan="4">SO 1.1 Early fault detection tools through advanced monitoring, automated data analysis and comparison with model-generated values. Development of advanced and automated functions for data analysis for fault detection for critical elements of PV plant and its grid integration. Comparing real data with simulation, providing insights of problems at early stages.</td></tr>
<tr><td>KPI:</td><td>Number faults and problem detected automatically through data analysis.</td><td>Target:</td><td>8</td></tr>
<tr><td colspan="4">SO 1.2 Predictive maintenance tools for increased reliability. Provide improved plant reliability optimizing the O&M tasks and procedures through an AI based recommendation engine tasks based on the impact of failures or underperformance.</td></tr>
<tr><td>KPI:</td><td>Number of maintenance actions at validation site</td><td>Target:</td><td>25 actions/month</td></tr>
<tr><td colspan="4">Specific objective 2 - Optimizing PV Plant generation performance</td></tr>
<tr><td colspan="4">SO 2.1 Early degradation and underperformance detection tools. Underperformance and degradation problems at PV plants can lead to a loss of production, but usually they don´t trigger an alarm so that the O&M or the Asset Management teams start a correction action. This way they are usually unnoticed until they get to a certain level, but meanwhile there has been loss of energy production during months. The objective is to detect this at early stages through advanced data analysis from Scada and sensor data.</td></tr>
</table>

KPI:	Percentage of losses & degradation underperformance quantification	**Target:**	less than 5%
SO 2.2 Root cause analysis for prescriptive maintenance tools. Based on faults/failures and trend-based losses detection, the objective is to translate it into actions from the O&M teams, prioritizing them with a ROI-based action plan.			
KPI:	Percentage of impact in energy production	**Target:**	4% avoided energy losses through early detection problems

2.1 WORK BREAKDOWN STRUCTURE AND SCHEDULE

The project activities are organized as a set of interrelated work packages (WPs) as show in Figure 2-1.

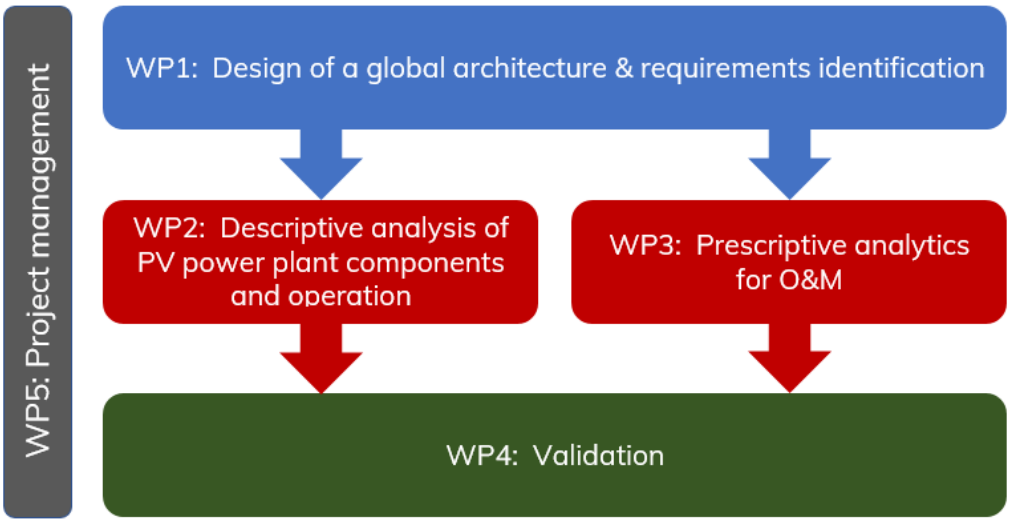

FIGURE 2-1: PERT DIAGRAM.

In **WP1** the global requirements, functional specifications and system architecture will be developed according to several pre-defined use-cases aiming at providing a general overview of the tools, their high-level requirements and information flows between the different modules. As result of this WP1 there will be a definition of the global system, its use cases, as well as the interfaces between the different modules.

In **WP2** a set of tools for modelling the most critical elements at a PV plant, that can affect its stability and performance, will be designed and implemented. These models will be fitted with machine learning and optimization algorithms to get the best fit to suspected problems, feeding them with real data and this way obtaining the accurate characterization of the problem or set of combined problems.

AI-based methodologies (validated and trained using historical data) will be developed in **WP3,** which combined with models designed in WP2 can deliver advices to plant operators about actions prioritization and preventive maintenance.

The ultimate goal of **WP4** is to integrate, test and validate the models and methods developed in WP2 and WP3 into two real PV parks (Montes das Flores in Portugal and the Green Energy Park in Morocco). The diversity of the environmental and operating conditions of the two demonstrators will allow to prove the replicability, adaptability and versatility of the developed solutions able to operate with different setups and PV technologies.

WP5 deals with Project Management, Communication and dissemination strategies of the AI4PV project. This WP aims at ensuring effective operation of the project, timely delivery of the results within the pre-defined budget while guarantying high-quality standards. Any possible risk that might arise during the project will be managed and mitigated within this WP. Moreover, dissemination and exploitation strategies will be drafted in order to ensure clear and deep outreach of the project's results.

The breakdown of activities and their scheduling are presented in the Gantt chart in Figure 2-2.

WP/Task #	WP/Taks name	WP/Task leader
WP1	**Design of a global architecture & requirements identification**	**ISOTROL**
T1.1	Use case definition for digital twin tools and data analytics hybrid approach	INESCTEC
T1.2	Functional specification and system architecture	ISOTROL
WP2	**Descriptive analysis of PV power plant components and operation**	**ISOTROL**
T2.1	Data management and modelling tools for digital twin simulation	ISOTROL
T2.2	Normality analysis and digital twin parameters fitting with AI	ISOTROL
T2.3	Out of normality analysis at critical components through digital twin analysis	ISOTROL
WP3	**Prescriptive analytics for O&M**	**INESCTEC**
T3.1	Root cause analysis and asset replacement	INESCTEC
T3.2	Return-on-investment (RoI) prediction	EDP
T3.3	Cost-optimized predictive maintenance	ISOTROL
WP4	**Validation**	**EDP**
T4.1	Setup of descriptive and prescriptive systems in the validation framework	ISOTROL
T4.2	Validation in PV farm	EDP
T4.3	Validation of results and Cost-Benefit analysis	EDP
WP5	**Project Management**	**EDP**
T5.1	Overall project coordination	EDP
T5.2	Dissemination, communication	EDP
T5.3	Exploitation and IPR management	EDP

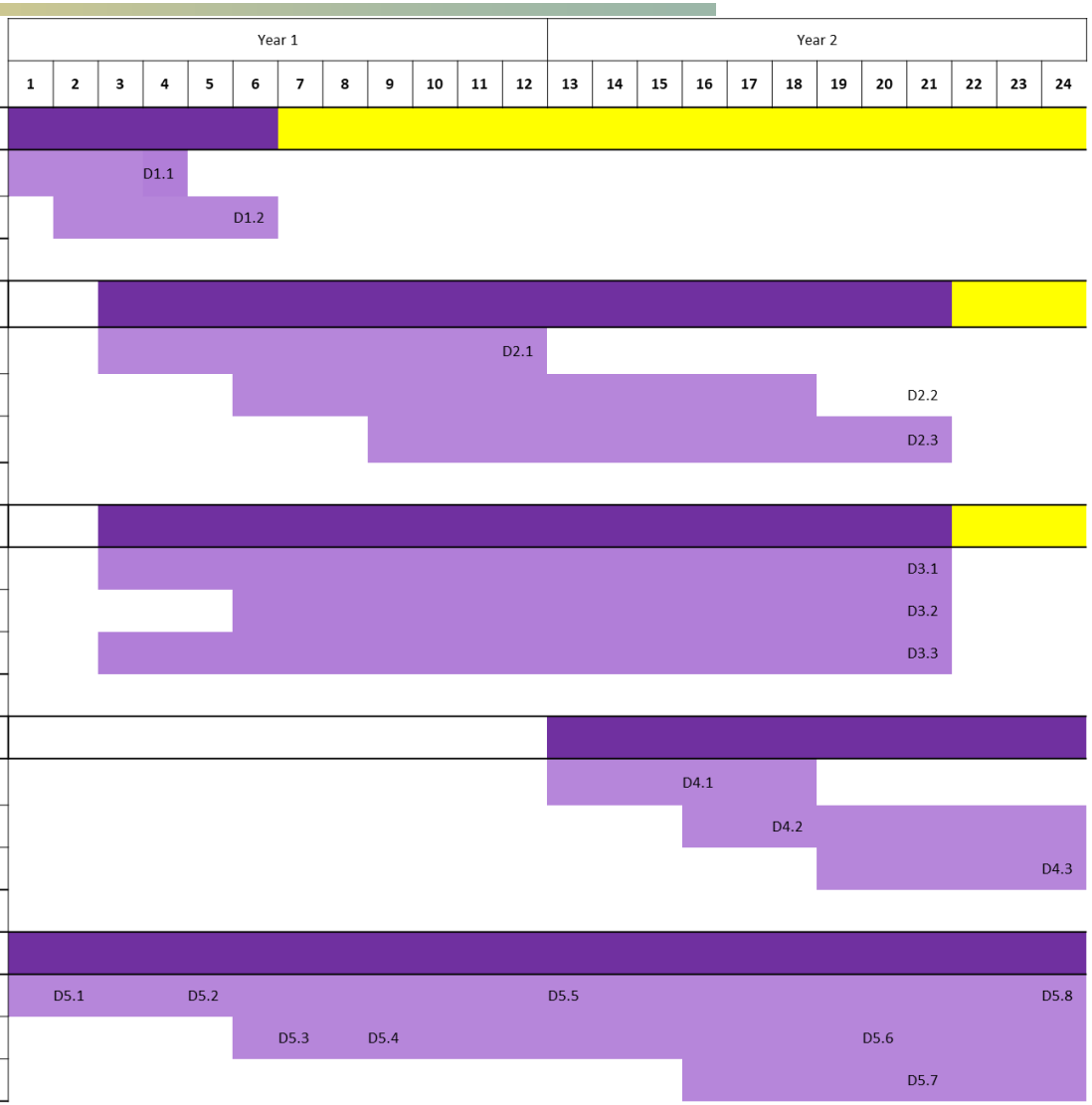

FIGURE 2-2: GANTT CHART OF THE AI4PV PROJECT

2.2 PROJECT MILESTONES

Table 2-1 below presents AI4PV's milestones. For each milestone a description is provided, together with the related work package, due date (month number from project start) and its means of verification.

TABLE 2-1: MILESTONES.

Nº Milestone	WP	Due Date (Start month + N)	Lead Beneficiary	Milestone Title	Means of verification
M1.1	1	M6	INESCTEC	Global system technical specifications	D1.1 validated
M2.1	2	M21	Isotrol	AI and model-based normality analysis achieved	D2.2 validated
M3.1	3	M21	INESCTEC	Prescriptive analytics approach fully validated	D3.1, D3.2 and D3.3 validated
M4.1	4	M24	EDP NEW	System validated approved by project management Board	D4.3 validated
M5.1	5	M2	EDP NEW	Project management plan ready	D5.1 validated

2.3 PROJECT DELIVERABLES

Table 2-2 below presents the project deliverables. For each deliverable a brief description is provided as well as the corresponding work package, the leading partner, the type of deliverable (R – report, DEM - Demonstrator, pilot, prototype, plan designs, DEC - Websites, patents filing, press & media actions, videos, etc.), the dissemination level (CO – within consortium, PU – public) and due date (month number from project start).

TABLE 2-2: DELIVERABLES.

Nº Deliverable	WP	Due Date (Start month + N)	Lead Beneficiary	Deliverable Title	Type	Dissemination
D1.1	WP1	M4	INESC TEC	Use cases for O&M of solar power plants	R	PU

D1.2	WP1	M6	Isotrol	Functional specification and system architecture	R	PU
D2.1	WP2	M12	Isotrol	Data management and modelling tools	DEM	CO
D2.2	WP2	M21	Isotrol	Normality Analysis tools	DEM	CO
D2.3	WP2	M21	Isotrol	Out of normality analysis report	R	PU
D3.1	WP3	M21	INESC TEC	Models for root-cause analysis with data analytics	R	PU
D3.2	WP3	M21	EDP NEW	Method for return-on-investment prediction	R	PU
D3.3	WP3	M21	Isotrol	Method for cost-optimized predictive maintenance	R	PU
D4.1	WP4	M16	Isotrol	Validation framework definition	R	PU
D4.2	WP4	M18	EDP NEW	Demonstration Plan	R	PU
D4.3	WP4	M24	EDP NEW	Validation results and Cost-Benefit analysis report	R	PU
D5.1	WP5	M2	EDP NEW	Project management plan	R	PU
D5.2	WP5	M5	EDP NEW	Data Management plan	R	PU
D5.3	WP5	M7	EDP NEW	Dissemination and communication plan	R	PU
D5.4	WP5	M9	INESC TEC	Project website	DEC	PU
D5.5	WP5	M13	EDP NEW	First year advancement report	R	PU
D5.6	WP5	M20	EDP NEW	AI4PV Workshop for dissemination and communication	DEC	PU
D5.7	WP5	M21	EDP NEW	Exploitation and IPR management report	R	PU

D5.8	WP5	M24	EDP NEW	Second year advancement report	R	PU

3. GOVERNANCE STRUCTURE AND RESPONSIBILITIES

3.1 PCC OR GENERAL ASSEMBLY

The Project Co-ordination Committee (PCC), as enshrined in the Consortium Agreement (CA) signed by all AI4PV's partners, is the ultimate decision-making body of the consortium. It consists of one representative of each partner, known as PCC Member.

The PCC is chaired by the Project Coordinator (PC, Christian Verrecchia from EDP NEW) who shall convene meetings of the PCC at least once every four months or at any time upon written request of any Party in case of emergency situation.

The PCC shall be in charge of:

a) Making proposal to the Parties for the review and/or amendment of terms of the CA;
b) Deciding to suspend all or part of the Project;
c) Taking action against Defaulting Party in accordance to the clauses enshrined by the CA;
d) Deciding upon the entering into the Project of new Parties;
e) Deciding upon major changes in the Project plan;
f) Deciding on technical roadmaps for the Project;
g) Review the selection of subcontractors;
h) Agreeing press releases and publications by the Parties in accordance with the clauses enshrined by the CA.

The decision-making process is as follows:

1) The PCC shall not deliberate unless the quorum (2/3 of its Members) are represented or present.
2) If the quorum is not reached, the PC shall convene another ordinary meeting within 15 calendar days. If in this meeting the quorum is not reached once more, the PC shall convene an extraordinary meeting which shall be entitled to decide even if less than quorum of PCC Members is not represented or present.
3) Each PCC Members shall have one vote.
4) Decision shall be taken by a majority of 2/3 of the votes cast.

Table 3-1 shows the composition and Members of the PCC.

TABLE 3-1: PCC COMPOSITION.

PCC Chairperson/ Project Coordinator	
EDP NEW	Christian Verrecchia
Partner	**PCC member**
EDP NEW	João Formiga

INESCTEC	Ricardo Bessa
Isotrol	Jose Garcia Franquelo

3.2 WP LEADER

The AI4PV project is made up of 5 WPs. The leaders of each WP are listed in Table 3-2.

TABLE 3-2: WP LEADERS.

WP	Partner	WP LEADER
1	Isotrol	Rubén González Bernal
2	Isotrol	Rubén González Bernal
3	INESC TEC	Luis Guimarães, Louelson Costa
4	EDP NEW	Christian Verrecchia
5	EDP NEW	Christian Verrecchia

Each leader identified above is responsible for:

- producing work plans and progress reports;
- timely and effectively executing the work plan, producing deliverables according to quality standards;
- reviewing results and identifying issues;
- reporting to the Coordinator to provide inputs for management reports;
- participating in and representing the WP at the project follow-up and technical meetings;
- identifying non-performing partners and reporting to the PC.

Day-to-day decision making within the WPs is also the responsibility of the WP leader. Whenever issues arise during execution of the WP, these will be handled together with the Task Leader(s). In case they fail to solve them, then it should be taken to the PC and successively to the PCC.

WP leaders act as Technical and Quality Manager for the deliverables to be produced within their own WP. WP leader is responsible to:

- check the technical quality and that the deliverables strictly follow the formatting template;
- monitor the overall planning and timely submission of all deliverables;
- ensure the consistency of the deliverables across work packages.
- revises a deliverable with input from partners when appropriate to ensure uniformity across the deliverables produced within the project.

The AI4PV consortium does not consider ethics as simply an external limitation on its research and will actively deal with any ethical issues that might arise as part of the research activities carried in the context of the project. Therefore, the Ethics Monitor plays an important role and is responsible for:

- Monitoring the compliance of experiments and research procedures, in accordance with the national and international legislations (including data protection and intellectual property rights);
- Guaranteeing the good governance of data, research integrity and academic ethics;
- Periodically reporting to the PC on the ethics aspects of the project, advising on external expert consultation when required;
- Documenting any ethical issues that may arise to contribute to the understanding of ethics in AI research.

4. MANAGEMENT OPERATING PROCEDURES

In this section a set of procedures aiming at ensuring alignment with project schedule are described.

4.1 PROCEDURES FOR MONITORING AND REPORTING PROGRESS

The project meetings of AI4PV will be organized at different governance levels to ensure an efficient and continuous communication among partners.

4.1.1 PROJECT MEETINGS

The project meetings will take place in a frequent basis to monitor the progress of the project and prepare corrective measures where needed. Three types of meeting are identified.

Coordination and management meetings will define the strategic orientation of the project at technical and communication level. These meetings intend to monitor the effective and efficient implementation of the project and to verify the alignment of the activities of AI4PV with the Grant Agreement and potential decisions made during PCC meetings. These meetings will plan the content and timing of joint press releases. In case of dispute, and if needed, it will seek a consensus among the partners. Finally, they will help tracking the status of the project, discussing technical, operational and administrative issues.

Technical meetings consist of a plenary session to report the advancements of the WPs, which will be organized by the PC. These meetings will monitor the effective and efficient implementation of the work plan, by collecting through the WP Leaders information about the detection of non-compliances with the work plan, identifying technical problems and conflicts that may arise among partners in their respective WPs. These meetings facilitate the discussion between WP leaders, supporting them in the solutions to be taken, and assure that information is shared among WP leaders at horizontal level. They will assure that all milestones are met in time and deliverables are technically sound with a good quality. The WP leaders will provide feedback about activities, results and outcomes originated in their own WP as well as they will report potential deviations. In detail, WP leaders should present the overall progress towards milestones, actions already completed, status of deliverables, update on risk table, actions being performed at that moment and expected date to finish each action, next steps and date foreseen.

WP meeting assures a day-to-day management of the WP, ensuring that proper procedures are adopted and followed, that all deadlines and/or milestones are met, and deliverables and reports are of high quality. The meeting is organized by the WP leader that will foster a good communication with and among the partners participating in the work package through the Task Leaders, and supervises the accomplishment of the project work plan. During these meetings Task Leaders and WP leaders will provide technical follow-up and information on IPR issues in connection with the Work Package, feedback about activities, actions already completed, status of deliverables, actions being performed and expected date to finish each action, next steps and date foreseen. Moreover, cost statements, information and data (financial and other) necessary for the mid-term and final review and the implementation plan for corrective actions in case of misalignment with the work plan will be provided by Task Leaders. WP Leader will define responsibilities and actions to take in the scope of the WP,

and share ideas and clarify questions or doubts of participants, and collaborate with partners on the tasks of each work package in order to assure the quality of work and present the results in reports according to the project description.

Table 4-1 presents a summary of the main meetings, in terms of: type of the meeting, participants, and the person chairing the meeting, the expected frequency and the attendance type.

TABLE 4-1: MEETING SCHEDULE.

Type of meeting	Governance Body	Meeting organizer	Frequency of meetings	Attendance type
Coordination and management	PCC members	Project coordinator	Four-month	Personal / virtual
Technical	WPs Leaders	Project coordinator	Bi-monthly	Personal / virtual
Work package	WP leader and task leaders	WP leader	Bi-weekly	Personal / virtual

The general rules for the project meetings are the following:

1. The partners shall receive an invitation to the meeting. Details of the meeting such as the date, hour and attendance type should be selected by the participants (e.g., in a previous meeting or by launching a Doodle in advance to find the most optimal date to participants).
2. The invitation should include the agenda for the call and preparatory work for each participant in case that is needed.
3. A first version of the **minutes** will be made available for the attendees. The chairperson will produce written minutes and upload the document to AI4PV repository. The minutes must include:
    - **Date** (*mandatory*);
    - **Agenda** (*mandatory*);
    - Attendees (*if applicable*);
    - **Discussion and decisions made** (*mandatory*);
    - Action points (*if applicable*).

    The minutes will be uploaded directly to the project repository. Files should be deposit in the folder associated to the scope of that meeting, for instance, a meeting with a scope internal to a specific work package **X** should be placed on *AI4PV_Technical/WP**X**/WP_Meetings* however, a meeting with a general scope should be placed on *AI4PV_Management/Meetings*.

4. Attendees can update the meeting minutes that are available in the AI4PV repository
5. The organizing person will update the "**Follow Up Actions (FUA) File**" that is also available in the documental repository of AI4PV, in the folder AI4PV_Technical. This file provides a clear understanding of responsibilities for each person/partner and it is used to better track the progress of the project.

4.1.2 EXTERNAL REPORTS

The Project Coordinator will describe the activities that were conducted during a twelve (12) month period in a **publishable report** that include a presentation of technical and non-technical aspects of the project, the achievement of milestones, potential deviations to the schedule/plan, envisioned contingency actions and the update of the list of critical risks.

These public reports, as described in Grant Agreement, include:

1. **first year advancement report** for the period of M01 to M012;
2. **second year advancement report** for the period of M13 to M24.

These reports are composed by the "*Introduction*", "*Technical description*" and the "*Financial reporting*". The "*Technical description*" section will highlight the results and their exploitation and dissemination, the outcomes on the action and the socio-economic impact of the action. The "*Financial reporting*" section will provide an overview of costs, resources committed to the project, information on subcontracting and in-kind contributions.

Moreover, the **periodic progress reports** have to be delivered to the national Agency and Eureka on a yearly basis. The AI4PV project lasts for 24 months and it is divided into the following 2 Reporting Periods (RP):

- **RP1**: from month 1 (01/07/2021) to month 12 (30/06/2022);
- **RP2**: from month 13 (01/07/2022) to month 24 (3006/2023).

These reports will be submitted by the Coordinator and will be generated in collaboration with all beneficiaries. They will be used to follow the technical progress and the budgetary situation of the project on the basis of the costs statements received from the partners.

The periodic progress reports will make possible to detect any deviations from the work plan with the progress being monitored against the project milestones defined in the CA.

Each periodic progress report will be discussed by the PCC in a dedicated virtual meeting at the deadline (M12 or M24).

4.1.3 SCHEDULING AND RESCHEDULING

The work plan is detailed in the Grant Agreement and during the execution of the project it might be necessary to reschedule certain project activities due to intrinsic or extrinsic needs of activities enrolled in AI4PV, for instance, the alignment of actions with other important events/initiatives or a delay in concluding some action where the participation of entities outside the consortium is required.

Modifications to the work plan shall be minimized however, in very specific cases, the WP Leader will announce and initialize a rescheduling procedure with PCC and the PC, that includes:

1. The identification of tasks that need to be rescheduled and the analyses of their dependency to on-going/forthcoming activities as well as the expected impact to the achievement of milestones/deliverables described in the CA.

2. The assessment of the proposed modification carried out by project partners. The rescheduling of tasks must be synchronized with other partner activities, and approved by project partners. If needed, partners will approve these changes in consensus by the PCC.
3. If agreed, the PC will record the change of work plan in the Gantt chart and update the deliverables and milestones tables.
4. The changes to the current work plan shall be communicated by the PC to the Portuguese Authority and by Isotrol to the Spanish Authority and approval must be acquired.
5. A new schedule enters into force once approved by both National Authorities.

4.2 DOCUMENT REPOSITORY

The AI4PV project use an integrated and secure tool for collaborative document writing and management. All documents produced by partners shall be placed in the dedicated **EDPON cloud repository.** The organization of the AI4PV drive is the following is represented in Figure 4-1.

The folder **AI4PV_Coordinaton** is used for depositing files related to activities of the PCC (on the dedicated **PCC folder**) such as, meeting minutes, administrative and draft documents, advisory board and financial reports. This folder has visibility restrictions. In the folder **Management** files related to deliverables produced, risk management, IPR management, scientific publications and periodic reports are collected. Visibility restrictions may be applied for periodic reports and IPR management.

The folder named **AI4PV_Technical** is used for depositing files related to technical aspects of the action namely, the work packages. The team members of a partner involved in the **WPx** will have access to the sub-folder "**WPx**". In each folder, files related to task, documents and meeting will be stored. For each sub-folder "**Task X.x**" working file - such as reports, codes, etc - will be stored in the dedicated "**Documents**" sub-folder as well as related reference documents (where available in electronic format) in the dedicated "**Bibliography"** sub-folder.

The folder **AI4PV_General** is used for depositing files related to dissemination activities, internal and external events and templates. Moreover, it will be used to keep the list of contacts and follow up actions. This folder is accessible to all elements from the consortium.

The team members of partners shall request external access to the document repository which will be granted by the PC. A team member should inform the PC about a potential access restriction or instead if the access given to a (sub-)folder goes outside the scope of his/her role.

These folders have different visibility levels:

- **Members of the PCC** have access to "*AI4PV_Coordination"*.
- The **leader of WP X** is responsible for managing a folder within "*AI4PV_Technical_WP**x***".
- **Partners from the work package x** will have access to "AI4PV*_Technical/WP**x***".
- **All partners have access to** "*AI4PV_General"*, "*AI4PV_Coordination/Management/Deliverables"*

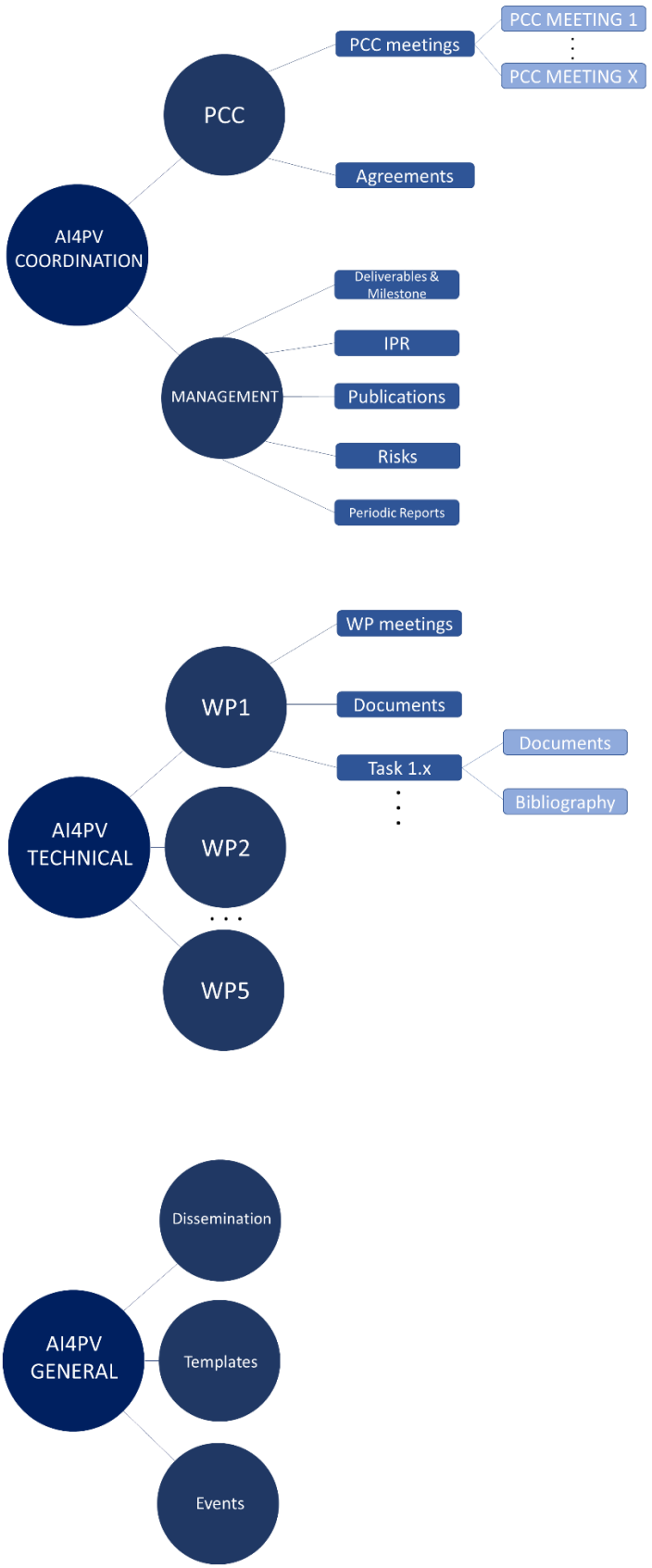

FIGURE 4-1: STRUCTURE OF THE PROJECT REPOSITORY.

4.3 INTERNAL COMMUNICATIONS

E-mail correspondence is the principal means of communication in AI4PV and, therefore, the title should have an explicit reference to the project name and the context of the message. Thereby, it is important that the title of all e-mail correspondence is headed by "***AI4PV"*** followed by the subject.

- ***AI4PV [subject]***

In this way, it would be easier to identify and follow-up the correspondence. Each partner is encouraged to create a dedicated folder within his/her e-mail inbox and to retain all project communications, including all copies of sent e-mails. Partners should inform the PC of any period when they will be out of contact and provide an alternative contact that will cover that absence.

The PC have created a **list of all persons** having a role in the project, which is organized by name, contact (email and phone), institution, and their participation in different work packages. This list is available in "AI4PV_*General*").

The following rules should ensure the suitable use of the e-mail communication:

- All relevant persons should be included in the email communication. Address information ONLY to involved parties in communication.
- Attachments should be avoided in the e-mail messages. Documents should be uploaded directly to the document repository and then cited in the body of the message (and eventually direct link should be provided).
- Partners are responsible for keeping their team informed of the project and circulate correspondence amongst them as appropriate.
- Partners are responsible for indicating the contact persons for administrative issues as well as contact persons for the development of the activities.
- Partners are responsible for requesting to add or remove a member from the list, which should be sent directly to the PC.

Telephone communications will be strictly used for urgent matters or when reliable confirmation is needed. The phone numbers should be kept up to date by Partners.

Virtual meetings will be held regularly by conference calls, using the official tool **Microsoft Teams**. In case of unavailability the meeting organizer will decide on the best alternative.

The agenda should be provided regularly by the organizer **about 2 (two) days in advance of the meeting date** by e-mail and all necessary working documents should be uploaded to the document repository and contextualized by a proper folder "Meetings/Meeting_DATE".

5. INNOVATION MANAGEMENT AND IPR HANDLING PROCEDURES

Adequate exploitation of project results will consist of defining appropriate measures and methodologies for managing exploitation activities, including management of Intellectual Property, as well as definition of market exploitation intentions (how to present on the market, how to sell on the market, type of launching and marketing strategy for the initial steps etc.) for what it concerns project Key Exploitable Results (KERs) and innovation to be brought to the market.

An **Exploitation Plan will be created at M21**, within Task 5.3, identifying project KERs and understanding Background/foreground of the partner per each of them, also in order to updates Consortium Agreement declarations. The goal of such exploitation plan, is indeed to analyse exploitable results from a market perspective (competitors, value proposition, how to launch on the market, uniqueness, SWOT analysis for market introduction) and Intellectual Property (IP) (freedom to operate, existing similar patents, trademarks, model of use, etc.). At this purpose the exploitation plan will have the goal to define and protect partners' background and foreground on project outcomes as well as to foresee expected use and characterization of each result. The Exploitation and IPR strategies will be studied and a dedicated IPR manual will be provided.

With a proper attention not to divulgate sensitive information, outcomes coming from exploitation activities and seminars could be shared with identified external stakeholders to understand the effectiveness of identified exploitation measures.

6. RISK MANAGEMENT & CONTINGENCY PLAN

A methodical and systematic approach to risk analysis is essential in an ambitious project such as AI4PV.

6.1 RISK METHODOLOGY

The methodology for managing unexpected or uncertain events considers an iterative cycle of risk identification, analysis, management, and monitoring until the end of the project.

This involves the identification of a risk, the assessment and prioritization of risks, and the evaluation of whether the risk level is higher than the risk that could be accepted for the project. When a risk exceeds the acceptable levels or impacts forthcoming actions in a severe or crucial manner, a risk response planning will be instantiated to obtain mitigation strategies and contingency plans that will define a set of actions required to lower down the severity of the risk within acceptable levels since not all risks can be fully eliminated.

The responsibility of managing risks relies with the PC and the PCC. The effective risk management requires an informed understanding of relevant risks, and a rigorous mechanism to monitoring and controlling them. The Technical meetings will provide an early identification of potentially harmful risks and, therefore, the activities related with risk monitoring and mitigation are performed by the PC with collaboration of each WP leader (for issues relevant within every specific WP).

The methodology for risk monitoring and assessment follows closely:

1. **Risk identification and mitigation** is a proactive and iterative process for uncovering risks that might jeopardize current or future actions and the identification of alternative strategies to reduce the probability of impact of the identified risk. These activities are conducted by the PC and WP leaders. The risks will be reviewed at regular intervals to re-state current priorities as project priorities may shift over time (deadlines, budget re-forecasts etc.) and unforeseen difficulties might arise.
2. **Risk analysis (or evaluation)** aims to establish values for its potential effect on the work programme (i.e., schedule and costs) of the project. Activities are conducted by the PC and WP leaders, which will try to quantify risks wherever possible by using a scoring system (see Risk Matrix in Figure 6-1).
3. **Risk prioritization and management** ranks the risk through a qualitative risk analysis process that estimates its effect on the project activities using internal and external factors within the specific context of the AI4PV project. Activities are conducted by the PC. Risk responses in the project will fall under one of the types:
    a. Avoid the risk: This can be done by avoiding use of technologies feasible alternatives exist.
    b. Mitigate the risk: If a risk cannot be avoided, management will try to reduce the risk by making it either less likely or less consequential. This will include the development of contingency plans for those risks which cannot be avoided.
    c. Accept or retain the risk: Inevitably there will be some risks which are intrinsic in the nature of the work being undertaken and which it is not possible to mitigate, control

or avoid because the time and cost involved is too high to justify the benefits. The number and impact of these sorts of risks in the project is minimal.

4. **Risk response planning** decides what should be done for de-risking the event. Activities will be conducted by the PC (and validated by the PCC) and aim to analyse the ownership of risk (responsibility) and elaborate a contingency plan.
5. **Risk contingence** intends to keep track of the risk status by evaluating the effectiveness of the response actions. Activities will be conducted by all participants affected by the event and the PCC.

Risks can be quantified as Impact * Probability = Severity, and alerts are raised in case any of the identified risks increase its severity. Level of likelihood to occur: Low/medium/high. The likelihood is the estimated probability that the risk will materialise even after taking into account of the mitigating measures put in place.

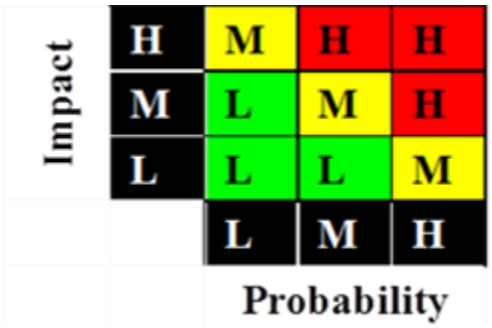

FIGURE 6-1: QUANTIFICATION OF RISK.

Definition of critical risk*: a critical risk is a plausible event or issue that could have a high adverse impact on the ability of the project to achieve its objectives*. The list of critical risks will be kept updated and available in the *"AI4PV_Coordination/Management/Risks"* sub-folder.

6.2 RISK ANALYSIS

The risk analysis in the AI4PV project follows two measures:

- Risk mitigation: pro-active measures to prevent problems. These are embedded in the project plan, including consortium composition and competence, quality assurance, risk management, internal progress monitoring and feedback from external stakeholders. The primarily objective is to avoid reasonless project breaks, uncontrolled time-schedule extensions and budget excesses. The risk mitigation began with the proposal of the AI4PV project where a number of internal and external risks were already identified (and included in Table 6-1) and will be constantly updated.
- Contingency actions: to be taken if the identified risks turn out to be real problems during project execution. The PC will stipulate a plan to minimize the effects of the critical risk to the point where it can be controlled This can be accomplished by defining a set of actions that should be executed once the risk has occurred which can involve, for instance, the modification of partial project tasks, the re-arrangement of the effort or the reschedule of specific tasks or deliverables. The PCC will decide about the contingency plan proposed by

the PC by taking into consideration the overall ambition of the project, as well as the available resources.

Identified risks and mitigation measures for the AI4PV are reported in Table 6-1, and they will constantly be updated throughout the project execution.

TABLE 6-1: LIST OF RISKS.

A. General Risks (Management & Dissemination Risks)				
Overestimation of work load and complexity of planned tasks	**Probability**	H	**Impact**	H
Establishment of the Project Management Board and its meeting schedule with defined agenda items to include the continuous monitoring of the work and prompt reallocation of resources to other WPs with tight resource allocation and requiring more in-depth research and development activity.				
Underperforming partners	**Probability**	M	**Impact**	M
Low quality of work/ deliverables; systematic delays, etc. Such issues will be clarified on the Consortium Agreement. Proper internal peer review procedures will be in place, to ensure quality of the deliverables and their preparation in a timely manner. Regular WP & technical meetings will be held to early identify and solve possible low quality work.				
Frequent dispute among partners affecting their performance	**Probability**	L	**Impact**	H
Early identification, monitoring and resolution of project coordination deficiencies by project management board, informed by the project management team. High level meeting with executives of the companies and institutes concerned.				
B. Technical Risks				
Interoperability between all technical developments from different partners.	**Probability**	H	**Impact**	H
Partners will progressively verify the suitability of the design and in case over-complexity emerge will streamline the design based on the analysis of the user preferences for functionality, ease of use and integration feasibility				
Difficulty in the project solution adoption and validation	**Probability**	L	**Impact**	H
Careful definition of technical requirements and especially of module interfaces. Take into account organizations' and users' interaction and procedures. Implementation of a permanent feedback to prevent misalignment.				
Continuously evolving environment in terms of devices, products and business models	**Probability**	M	**Impact**	M

Continuous monitoring of the market status and prompt reaction to changes in the technological energy issues, removing problems, retuning of the project goals. Research partners will co-invest more personnel to produce the results in time and with the quality needed.				
Unavailability of the pilot site for demonstration	**Probability**	L	**Impact**	L
The contingency plan is to rely on the consortium to provide a replacement pilot partner. Other pilots can assume its role				
Availability market landscape and potential opportunities BUC	**Probability**	L	**Impact**	M
WP and task timing were set to immediately start at the very beginning of the project and will be followed by the Project Management team to ensure their timely delivery.				
Not all interesting market/regulatory options can be investigated	**Probability**	H	**Impact**	M
Involvement from all the partners will be requested to ensure the prioritization of interesting concepts. Potential involvement of the advisory board throughout the process to assess adequacy of the identified concepts for the overall project.				
Proposed solutions are not aligned with the end-user's expectations	**Probability**	M	**Impact**	M
User-centred requirements for the platform, including co-design and co-development processes will be taken into account for stakeholders' needs, priorities, challenges and opportunities at early stages of the project and constantly reviewed.				

7. QUALITY PLANNING

The quality plan provides guidelines and procedures in order to quickly and efficiently meet the quality requirements. The quality assurance guarantees that the AI4PV outcomes will be consistently of high level of quality. **All deliverables and official reports produced by the work packages will be reviewed.**

The use of guidelines provides a better and easier collaboration among the consortium partners by assuring confidentiality, security and consistency of information exchanged, used or produced by the AI4PV project.

7.1 DOCUMENT PRODUCTION FORMATS

A set of templates is available for download on the AI4PV drive.

The use of these templates is mandatory for all official project documents and external presentations. All project documents produced shall be written in English. All templates are available at the document repository ("*AI4PV_General/Templates*") to make sure that quality standards are fulfilled. These templates include:

- The "*AI4PV_Deliverable_Template*" is given for all deliverables;
- The "AI4PV_Report_Template" is given for all reports;
- The "AI4PV_PPT_Template" is given for official presentations.

In addition, all deliverables shall be placed in "*AI4PV_Coordination/Management/Deliverables&Milestones*" folder. For convenience and to ensure uniform naming, each deliverable was saved in a file following the naming convention "**AI4PV DX.X - Working copy**", where **X.X** is the deliverable identification number according to the CA. These files are considered as formatting documents that will be used to prepare the deliverables.

7.2 DOCUMENT IDENTIFICATION POLICY

All reports produced by the AI4PV consortium members will have (at least):

- a title;
- a date;
- the dissemination level;
- the main author(s).

To classify easily all kinds of documents, in the broad sense, produced within the AI4PV project, a document system coding will be used as indicated below:

TABLE 7-1: TYPE OF DOCUMENTS.

Document code	Document type
R	Document report

DEM	Demonstrator, pilot, prototype
DEC	Websites, patent filling, videos, etc.
OTHER	
ETHICS	Ethics requirements
ORDP	Open Research Data Pilot
DATA	Data sets, micro data, etc.

All documents and deliverables will be usually prepared by using collaborative tools and, nevertheless, every document shall include a proper version naming and numbering and the deliverable will have a specific formal mechanism that will be explained in the next paragraph.

7.3 DOCUMENT REVIEW PROCEDURE

To ensure the submission of high-quality deliverables according to the contractual deadlines, a **Quality Assurance Procedure (QAP)** will be implemented. The Work Package Leader has the authority to enforce this procedure that he/she must control throughout the duration of the process. The preparation of each deliverable will follow the process presented in Figure 7-1.

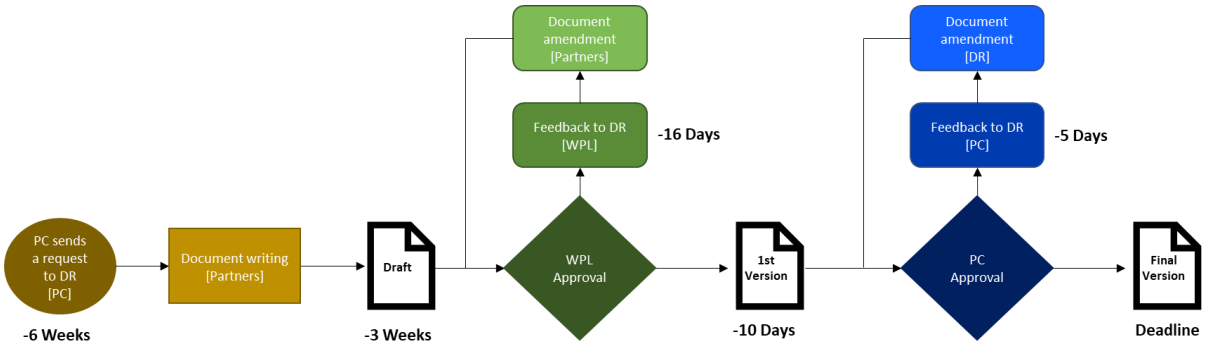

FIGURE 7-1: QUALITY ASSURANCE PROCEDURE.

Partners = All Partners assigned to the specific deliverable, **DR** = Delivery Responsible, **WPL** = Work Package Leader, **PC** = Project Coordinator.

TABLE 7-2: THE DESCRIPTION OF PHASES FOR A QAP.

Timing	Action
6 weeks prior to deadline	Project Coordinator sends a **request** for the deliverable to Deliverable Responsible.
3 weeks prior to deadline	Deliverable Responsible saves a **draft** of the deliverable and asks Work Package Leader for a review.

16 days prior to deadline	Work Package Leader sends **feedback** to Deliverable Responsible.
10 days prior to deadline	Work Package Leader approves and saves the updated draft as the **first version.**
5 days prior to deadline	Project Coordinator sends **feedback** to Deliverable Responsible.
Deadline	Project Coordinator approves and saves the updated second version as the **final version.** Project Coordinator submit deliverable to the Authority.

The QAP needs to start 6 weeks before the due date to effectively implement it. Table 7-2 describes the timing of the actions during a QAP. The person responsible for controlling the timing of the deliverable preparation is **the Work Package Leader which should be informed about the completion of every stage by email** in order to update the "Revision History" table, located at the second page of each deliverable.

There are formal stages for any deliverable:

- **Draft** version and it means that a document was prepared by all of participants of the deliverable.
- **First** version. The draft version is accepted by the Work Package Leader and, the document is saved as a first version after being update by the participants.
- **Final** version. This version is obtained after a last reviewing process made by the project Coordinator. Potential corrections must be addressed by the Deliverable Responsible. The Coordinator will submit this version to the Authority.

If necessary, participants in the deliverable have to make the necessary changes and updates after each stage of the QAP. Comments shall not be removed before a prior notice but instead they should be discussed among the involved entities in a QAP. **All changes should be introduced using the "Track changes" function** of the "Collaboration" tools.

Finally, the delivery date corresponds to the last business day of the delivery month. The delivery date is the submission date.

7.3.1 FILENAME CONVENTIONS

To simplify the document life cycle management, a full directory structure was already prepared in the "*AI4PV_Coordination/Management/Deliverables&Milestones*" folder.

Three subfolders were created: "**Draft**", "**Versions**", "**Final**", corresponding to the deliverable life cycle stages. These folders are used to keep the version of the deliverable at each stage. During the preparation of the draft version, participants will edit the document with the postfix "**- Working copy.docx**". After completion, a copy of the document will be **saved in one of the subfolders by the responsible person, in two formats**: a MS Word and PDF.

The "**Versions**" folder will contain the first version generated from the QAP. The following naming convention is to be used during the deliverable preparation:

a) Working copy (it is the template to be used tailored to the specific deliverables): "**AI4PV DX.X - Working copy**" (in the top folder);
b) Draft: "**AI4PV DX.X - Draft**" (stored in the "**Draft**" folder);
c) First version: "**AI4PV DX.X - V1**" (stored in the "**Versions**" folder);
d) Final: "**AI4PV DX.X - Final**" (stored in the "**Final**" folder).

8. COMMUNICATION MANAGEMENT PLAN

The communication management plan provides frameworks for internal and external communication, dissemination, and networking and exploitation activities. Separate dissemination and exploitation strategy reports are regularly updated and delivered as part of WP5.

8.1 COMMUNICATION AND MEETING GUIDELINES

Main internal communication channels in the project are email, meetings and the document repository, which includes a shared project calendar. Email and meetings are for interpersonal communication, whereas the document repository is for document management.

Email is used for short correspondence between the partners, meeting invitations and other updates between meetings. Meeting memos and all other documents are shared and updated through the document repository, not via email. **Telephone communication** is used only in urgent matters. The use of email and telephone communication is described in more detail in Section 4.3. All partners are responsible for keeping the email contact and phone number lists up to date.

Meetings include both virtual and face-to-face meetings. Internal meetings are held regularly to update and review progress of work and to discuss any open questions between the partners. In WP and management level short but regular meetings are preferred to infrequent long meetings. All meetings need to have an agenda. After the meeting, meeting memo and possible action points are uploaded to the relevant folder in the document repository. The types of meetings and expected frequency are described in more detail in Section 4.1.1. Meeting times are shared in the calendar found in the document repository and should be visible also to those partners not attending the meeting in question.

Document repository and shared calendar are managed by EDP NEW. The document repository is used for document sharing and deliverable version control. The document repository includes also guidelines and material for the project visual identity, such as project logo and templates. Shared calendar is used to keep all partners up to date on project internal and external events, meetings and deadlines. The shared calendar is accessed through the document repository. All partners are responsible for keeping the calendar up to date. The document repository structure and access rights are described in Section 4.2. All partners are invited to set alerts for document and calendar updates.

8.2 COMMUNICATION ACTIVITIES PLANNED

External communication activities include continuous update of the project website and social media, scheduling of publications, conference and fair attendance, and planning of workshops and other stakeholder events. The website is managed by INESCTEC and social media pages are managed by EDP NEW but access to the social media accounts are available to all partners upon request. EDP NEW and INESC TEC have website editing access rights.

The AI4PV **website** provides a public showcase on the project aims and contents, development and achievements. The site is maintained and updated regularly, at least on a monthly basis, and will be active for at least 2 years after the end of the project.

Social media activity in AI4PV project consists of a Twitter and LinkedIn profile. LinkedIn will promote the project through blog posts on project results and shorter stories with links to events, press release and/or publication in the project webpage or in peer-review magazine. LinkedIn will be updated at least on a monthly basis. Twitter shares updates on all events where AI4PV is present and links information from the other social media channels and the project website. The Twitter account is managed at least on a weekly basis.

Other **activity planning** covers planning of AI4PV events and publications, and participation in conferences, fairs, workshops and other external events. The aim is to demonstrate the project concept and results to key stakeholders at international level through conferences, international fairs, exhibitions and business to business demonstrations AI4PV testbeds. Activity planning goes through regular meetings of WP5 and the relevant technical work packages and an activity planning document in the document repository that is open for all the partners to update. The activity planning document includes also coordination of writing of articles and press releases.

Potential **conferences and fairs** for participation include, but not limited to:

- Conferences: Photovoltaic Specialists Conference, European Photovoltaic Solar Energy Conference and Exhibition, PSCC, Powertech, EPE;
- Fairs: Solar Power Europe, EU PVSEC.

Potential **journals** for publishing include, but not limited to:

- Classic Journals: Solar Energy, IEEE Transactions on Sustainable Energy, Applied Energy, - IEEE Transactions on Power Electronics, IEEE Journal of Photovoltaics, IEEE Transactions on Industry Applications, IEEE Transactions on Industrial Electronics, IEEE Transactions on Industrial Informatics; and,
- Open access: Energies, AI, EPJ Photovoltaics, Artificial Intelligence Journal.
- Open access publishing should be chosen where possible.

8.3 DISSEMINATION STRATEGY

The initial dissemination plan presented here brings together the current knowledge of target audiences and networks, key messages to these communities, and dissemination success monitoring activities. It will be reviewed and refined regularly. A detailed dissemination strategy will be drawn out in deliverable D5.3 at M7.

The **main objective** of the dissemination activities is to pave the way for the exploitation of the project results, and in particular to attract the end-users (energy utilities) to the AI4PV approach. The purpose of the dissemination strategy is to ensure that the AI4PV research and practical outcomes are communicated to appropriate target communities at appropriate times via appropriate methods, and by those who can contribute to development and exploitation of the project outcomes. The partners

will use their industrial partnerships, standardization activities and long-standing experience in international and cooperative funded projects towards this aim. The dissemination and communication management consist of a) framework, b) processes and c) plans. Main communication points from the beginning of the project are:

- The importance of the objectives that are being addressed;
- The approaches and methods that are being used;
- The progress and results obtained during the project;
- The expected benefits both to stakeholders and society as a whole.

Among dissemination and communication activities a relevant aspect will be to create synergies with relevant EU Stakeholders and associations (i.e. SolarPower Europe) to facilitate project outcomes widespread. In this sense AI4PV consortium will identify key stakeholders and key events where to present AI4PV results and methods.

9. DATA MANAGEMENT PLAN

The AI4PV Data Management Plan (DMP) will describe the data management life cycle for the data to be collected, processed and generated by the AI4PV project. DMP will be drafted in D5.2 at M5 and it will evolve during the lifetime of the project to present the status of the project's reflections on data management. The plan will include information about the handling of research data during and after the end of the project, what data will be collected, processed and generated, which standards or methodologies will be applied. Moreover, the DMP will describe procedures and rules for data that will be shared or made open access which includes how this data will be preserved and curated after the end of the project.

10. CONCLUSIONS

This deliverable will be used as guideline for the entire project lifetime to put in place measures and procedures aiming at guaranteeing proper development of the project and the achievements of the targeted results.

The PMP will be updated during the entire project based on partners' experience and based on future events and needs.