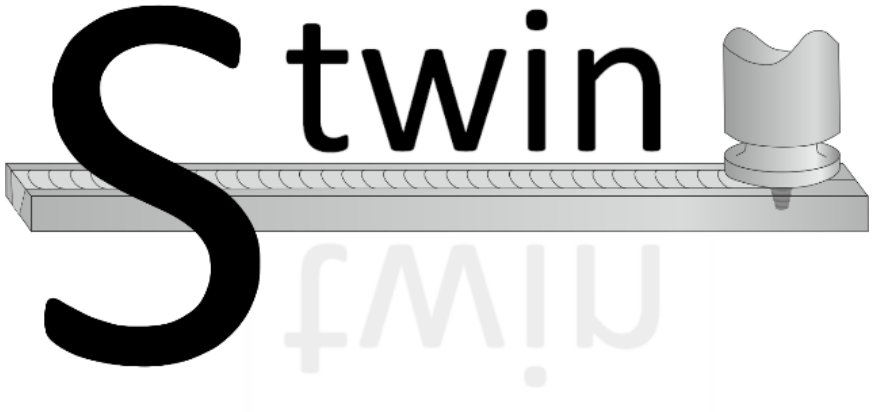
Funded by the
European Union

Advanced, non-destructive technologies to improve friction stir welding of steel through artificial intelligence and smart digital twins (Acronym: STWIN)



Research Fund for Coal and Steel
Grant Agreement Number 101112504

Deliverable 1.1: Project Management Handbook

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Project & Deliverable Information Sheet

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0.1	25/10/2023	Initial ToC
0.2	20/11/2023	First consolidated version
1.0	18/12/2023	Consolidation of review comments

Executive summary

This deliverable D1.1 documents the approach to be followed during the project to achieve the established objectives within the defined timeframe and resources. In essence, the Project Management Handbook is intended to be a support tool for the daily execution of the project activities, therefore it takes into account both management aspects and those related to project administration. It also includes tools for communication and collaborative work, quality control and risk and data management.

Under this context, the document begins by presenting the objectives of the project and then exposes the work plan and the roles of the team. Additionally, it describes the communication plan that will be followed and how compliance with the DoA will be guaranteed. Finally, the deliverable refers to the risk and data management plans.

All information that appears in the deliverable is based on the terms and conditions established in the Grant Agreement. Furthermore, note that this document has to be considered as a working tool, which can be improved during the project lifetime.

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1 Project Overview

STWIN is an initiative whose objective is to develop a flexible friction stir welding (FSW) robotic cell, capable of working on the surface of three-dimensional parts, carrying out different joint configurations and assembling steels of different grades and thickness, in particular of the characteristics of those used in the automotive, transport and loader crane industries. All through the application of an artificial intelligence-based real-time weld process monitoring system. From this approach, STWIN aims to improve the productivity of the metal-processing sectors, improve the working conditions of welders and cope with the shortage of skilled welding personnel in Europe.

In this connection, within the project, the friction stir welding process will be explored in combination with innovative non-destructive testing through the application of Artificial Intelligence (AI). This will lead to zero-defect manufacturing approach that will contribute to ensuring the robustness, stability and repeatability of the welding process, and therefore the production excellence.

For this purpose, a multidisciplinary work group, formed by 10 members of different nationalities from all over Europe, is involved.

1.1 Project Objectives

In general terms, STWIN intends to develop a flexible friction stir welding (FSW) system with which zero defects are achieved through the concept of digital twin, understanding this as the virtual copy of the process controlled by Artificial Intelligence. In view of the difficulty, this general objective has been divided into several specific objectives, which are detailed below:

1. Development of specific tooling for FSW of three-dimensional parts.
2. Optimisations of friction stir welding process parameters in 3D joints of high strength steels and for dissimilar joints (steel-aluminium and sheets with different thicknesses).
3. Real-time weld quality prediction using AI models, based on real measurements data and innovative non-destructive testing.
4. Validation of the applicability of the concept of digital twin applied to FSW in real workshop circumstances.
5. Demonstration of the techno-economic advantages of the system developed using demonstrators. In particular, loader cranes, vehicle differentials and a transport trailer.
6. Demonstration of the environmental benefits of using Digital Twin in friction stir welding.

1.2 Work Plan

To meet the objectives, a work plan has been drawn up that started on 1st July 2023 (M1) and ends 30th June 2026 (M36). In essence, STWIN's work plan is organised in six

different work packages, each one led by a partner of the consortium. The interdependencies between work packages can be seen schematically in Figure 1.

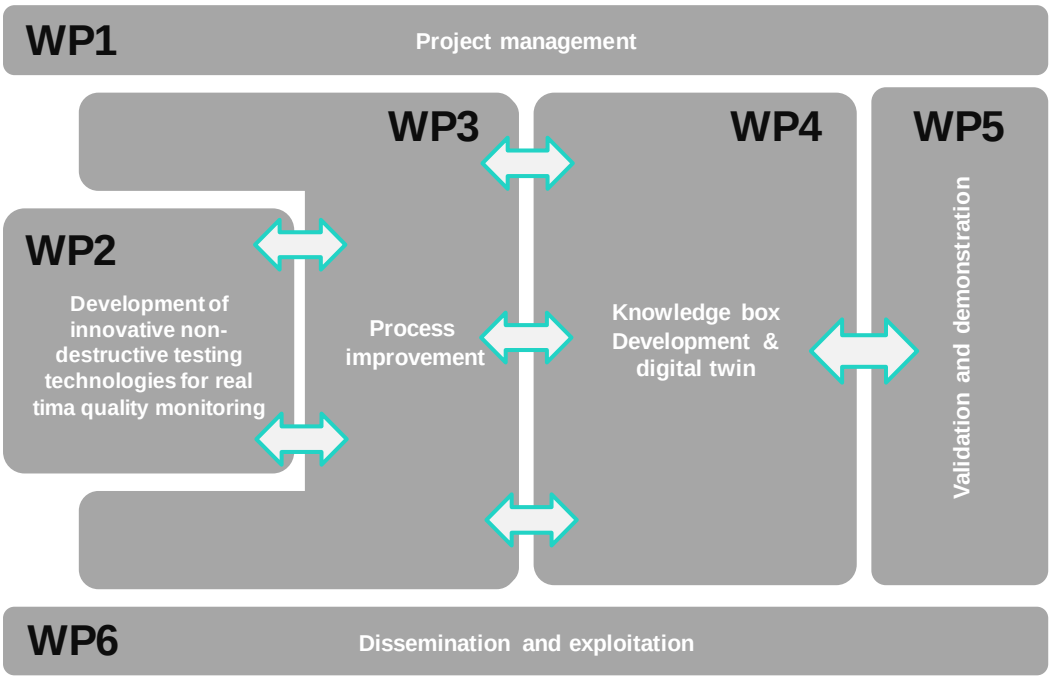


FIGURE 1 STWIN WORK PLAN AT WORK PACKAGE LEVEL

In few words, WP1 (led by CIDAUT) monitors the overall project progress, including the management of costs and time. WP2 (led by BWI) investigates the connections between process parameters and weld defects through non-destructive testing. WP3 (led by TRICYLON), for its part, is focused on the design of tools for FSW and the exploration of a novel robot concept capable of realising complex joints. WP4 (led by CIDAUT) addresses the design of a digital twin system using machine learning technology to identify welding quality issues before they occur. WP5 (led by HIAB) demonstrates the feasibility of applying a digital twin to the friction stir welding process in three industrial cases: a loader crane, a vehicle differential and a transport trailer. Finally, all work packages feed WP6 (lead by BWI) for the Dissemination and Communication activities and to promote the use of high-strength steel among the industry.

1.3 Deliverable and Milestone Schedule

Broadly speaking, the deliverables and milestones serve to reflect the progress of the project over time. In the case of the deliverables, the Project Coordinator must submit them to the EC platform, in accordance with the established timing and conditions. By contrast, milestones are only control points that help to chart progress.

1.3.1 Deliverables

Due to the work plan, in which all WPs are interconnected among them, in STWIN the deliverables feed up each other. These deliverables are basically a set or reports. However, although some of them are demonstrators (DEM), the European Commission requires that all deliverables are properly documented in the form of a report.

The following table (Table 1) summarises the official deliverables that the PC must submit to the EC.

TABLE 1 OFFICIAL DELIVERABLES

#	D	Deliverable name	WP	Lead Beneficiary	Type	Delivery date (M)
1	D1.1	Project Management Handbook	1	CIDAUT	R	3
2	D1.2	Comprehensive overview of STWIN	1	CIDAUT	R	6
3	D2.1	Measurement test setup description	2	BWI	R	9
4	D2.2	Influence of processes parameters on joint properties	2	CIDAUT	R	18
5	D2.3	Monitoring system quality assessment report	2	ISEND	R	21
6	D2.4	Welded joint quality assessment report	2	BWI	R	21
7	D3.1	FSW requirements definition	3	HIAB	R	9
8	D3.2	Specimens & DoE	3	BWI	R	12
9	D3.3	Optimised FSW tools	3	STIRWELD	DEM	18
10	D3.4	MONARCH welding robot	3	TRICYLON	DEM	21
11	D3.5	FSW feasibility report	3	STIRWELD	R	24
12	D3.6	Optimised stamping tools	3	CIDAUT	DEM	24
13	D4.1	Digital Twin requirements	4	BWI	R	18
14	D4.2	Digital Twin decision support platform	4	CIDAUT	R	24
15	D4.3	Digital Twin Deployment	4	CIDAUT	DEM	27
16	D4.4	Digital Twin Knowledge Base	4	BWI	R	30
17	D4.5	Stamping process simulations results	4	CIDAUT	R	24
18	D5.1	Pilots setups for demonstrators manufacturing	5	CIDAUT	DEM	27
19	D5.2	Loader crane demonstrator	5	HIAB	DEM	36
20	D5.3	Automotive assembly demonstrator	5	HORSE	DEM	36
21	D5.4	Trailer demonstrator	5	GRANALU	DEM	36
22	D5.5	Evaluation report of FSW real-time weld quality monitoring technologies	5	BWI	R	36
23	D5.6	Evaluation report of FSW real-time	5	TRICYLON	R	36

		quality control system				
24	D6.1	STWIN website	6	BWI	DEM	3
25	D6.2	Communication and dissemination plan	6	BWI	R	6
26	D6.3	Dissemination Plan – First Release	6	BWI	R	12
27	D6.4	Dissemination Plan – Second Release	6	BWI	R	24
28	D6.5	Dissemination Plan – Final Release	6	BWI	R	36
29	D6.6	Exploitation Plan – First Release	6	HIAB	R	17
30	D6.7	Exploitation Plan – Final Release	6	HIAB	R	36
31	D6.8	Public publishable report	6	BWI	R	36

1.3.2 Milestones

While the deliverables are documents on which there is a delivery commitment, the STWIN milestones mark moments in time. These, listed in the table below (Table 2), will be used to track project progress at key point throughout its lifetime.

TABLE 2 STWIN MILESTONES

Milestone #	MS Name	WP	Due date	Means of verification
1	MS1	2	9	Test setup available and results documented in D2.1.
2	MS2	3	15	FSW tools designed and manufactured to enable the start of the welding trials.
3	MS3	3	24	Optimum welding parameters documented in D3.5.
4	MS4	4	27	Digital Twin infrastructure deployed.
5	MS5	4	24	Simulation results reported in D4.5.
6	MS6	5	30	Loader crane, transport trailer and vehicle differential demonstrators ready.
7	MS7	5	30	Monitoring and control method applied on the demonstrators and documented in D5.5 and D5.6.
8	MS8	5	36	Demonstrators test results documented in D5.2, D5.3 and D5.4.

2 Project Organization

STWIN has a working group made up of 10 partners of different nationalities from all over Europe (see Table 3). Specifically, the partners were selected on the basis of the profiles and expertise required to undertake the planned actions, as well as their influence within the metal industry. Under these premises, STWIN consortium consists of the following organisations:

TABLE 3 STWIN CONSORTIUM COMPOSITION

Participant No.	Participant organisation name	Short name	Country
1 (Coordinator)	FUNDACION CIDAUT	CIDAUT	Spain
2	HIAB	HIAB	Sweden
3	ELEMENT SIX	E6	Ireland
4	SVENSKT STÅL AB	SSAB	Sweden
5	BELGISCH INSTITUUT VOOR LASTECHNIEK VZM	BWI	Belgium
6	INGENIERA Y SISTEMAS DE ENSAYOS NODESTRUCTIVOS SA	ISEND	Spain
7	STIRWELD	STIRWELD	France
8	HORSE	HORSE	Spain
9	TRICYLON ROBOTICS AB	TRICYLON	Sweden
10	GRANALU TRANSFORMACIONES SL	GRANALU	Spain

Given the heterogeneous nature of the group, it is important that the project has an efficient and well-documented management plan. In this regard, the following describes the governance structure to be followed and the assignment and distribution of responsibilities among the members of the consortium.

2.1 Management structure

In essence, the STWIN management structure will be based on the following four key pillars:

- Ensure that the project's contractual obligations are met. In this sense, continuous progress monitoring -managed by the Project Coordinator-, communication and a shared understanding of responsibilities will be necessary.
- Ensure that the project management decisions comply with the project's priorities.
- Make easier to deliver high-quality research and innovation. For this purpose, the coordination of the technical tasks and the integration of their results will be critical.

- Ensure and validate the project impact on both industry and the research community.

With that in mind, the organizational structure of the Consortium shall comprise of following Bodies:

- The **General Assembly** (GA): Included in the Consortium Agreement, this body will be responsible for making strategic decisions, following the project's progress, initiating corrections and resolving conflicts. It will be led by CIDAUT and represented by Mr. Javier Romo (project coordinator). Basically, its actions will be focused the following fields: (1) general project management; (2) monitoring of technological and scientific progress, (3) management of IPR and dissemination activities and (4) management of exploitation activities. For this purpose, it will have one representative from each entity in the consortium, in addition to the project coordinator.
- The **Coordinator**: The person who serves as liaison between the project and the European Commission. Among his/her functions are to ensure the punctual delivery of reports and deliverables, coordinate the consortium and perform risk management. In STWIN, Mr. Javier Romo (CIDAUT) will assume the role of the Project Coordinator and will therefore become the intermediary between the consortium and the EC. Additionally, he will be responsible for the overall contractual, ethical, financial and administrative management of the project. This also will include the supervision of the technical activities and with it the supervision of the work package leaders.
- The **Work Package Leaders** (WPLs): They are the people in charge of all communication and coordination of the work packages. They must ensure the performance and progress of the work package for which they are responsible. Thus, his or her responsibilities are as follows: (1) monitoring the progress of the WP; (2) ensuring that the WP is aligned with the general budget; (3) meeting the milestones and deliverables and (4) alerting the coordinator in case of any delay. In STWIN, each WP Leader will report formally to the PC on the progress of the work and related administrative aspects every six weeks.
- The **Task Leaders** (TLs): They are responsible for coordinating activities within their respective task. Additionally, it is up to them to ensure that the deliverables are submitted on time. In STWIN, each task leader will also be in charge of reporting on progress and risks of their task to their WPL. For more details, the assignment of Task Leaders can be found in the DoA.

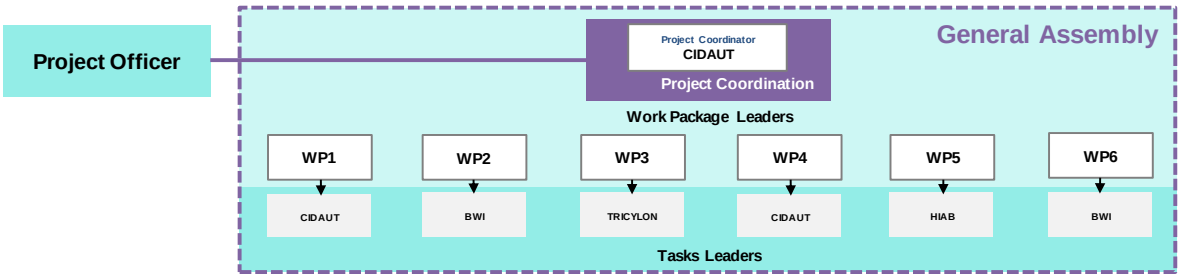


FIGURE 2 STWIN MANAGEMENT STRUCTURE

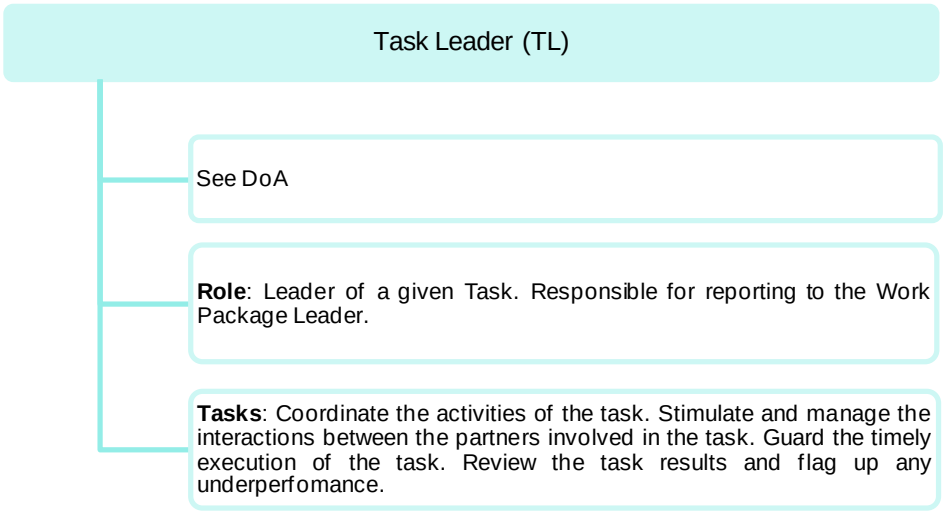
2.2 Persons & Roles

Given the management structure, this section will explain in more detail who is responsible for each body presented. Specifically, through the following tables:

TABLE 4 PROJECT NOMINATED MAIN PERSONS

Project Coordinator (PC) **CIDAUT**
Mr. Javier Romo Garcia, javrom@cidaut.es
Role: Leader of the whole project, including scientific and technical activities. Intermediary betweent the partners and the EC. Strategy manager.
Tasks: Contact with the EC. Monitoring the project status and checking progress against schedule and whether milestones and deliverables are met. Submit deliverables and reports to EC. Coordinate consortium and perform risk management.

Work Package Leader (WPL)
WPL1 - Mr. Javier Romo Garcia, javrom@cidaut.es WPL2 - Mr. Koen Faes, koen.faes@bil-ibs.be WPL3 - Mr. Ilker Erdem, ilker.erdem@tricylon.com WPL4 - Mr. Javier Romo Garcia, javrom@cidaut.es WPL5 - Mr. Kurt Broeckx, kurt.broeckx@hiab.com WPL6 - Mr. Koen Faes, koen.faes@bil-ibs.be
Role: Leader of a given Work Package. Responsible for reporting to the Project Coordinator.
Tasks: Produce detailed work plans. Guard the timely and effective execution of the WP tasks and that the deliverables are completed. Review WP results and flag up any underperfomance.



As far as the General Assembly is concerned, it will be composed of one representative from each partner, Table 5.

TABLE 5 GENERAL ASSEMBLY COMPOSITION

GENERAL ASSEMBLY		
Participant organisation name	**Short name**	**GA Representative**
FUNDACION CIDAUT	CIDAUT	Javier Romo
HIAB	HIAB	Kurt Broeckx
ELEMENT SIX	E6	Mathew Hackett
SVENSKT STÅL AB	SSAB	Mikael Reinberth
BELGISCH INSTITUUT VOOR LASTECHNIEK VZM	BWI	Koen Faes
INGENIERA Y SISTEMAS DE ENSAYOS NODESTRUCTIVOS SA	ISEND	Raúl Velasco
STIRWELD	STIRWELD	Yann Mace
HORSE	HORSE	Fernando García
TRICYLON ROBOTICS AB	TRICYCLON	Ilker Erdem
GRANALU TRANSFORMACIONES SL	GRANALU	Javier Sánchez

3 Project Implementation

It is common knowledge that the successful implementation of a collaborative research project, such as STWIN, requires a constant flow of information. For this to happen, planning and management are essential. This section describes in detail the management processes and procedures that will be following within STWIN to meet the project scope within the defined time and cost limits. In essence, the implementation of these processes and procedures is intended to facilitate risk and quality management and to ensure that the innovation is attained.

3.1 Internal Communication

Generally speaking, communication is critical to ensure the success of the project. That is why this section describes the general outline of how important project information will be communicated to the key members of STWIN. In particular, the intention of all of this is for the team to understand who should receive what type of notifications and when it is appropriate to inform the other project members.

From this perspective, in STWIN practically all communication actions will be centralised in the figure of the Project Coordinator, specifically in Javier Romo from Cidaut. The coordinator will meet with the consortium every 6 weeks in order to catch up on the project progress and resource consumption. In addition, he will maintain email relationship with the consortium almost daily. In this way, an upward communication flow is established that always ends at the coordinator, who will be responsible for the following:

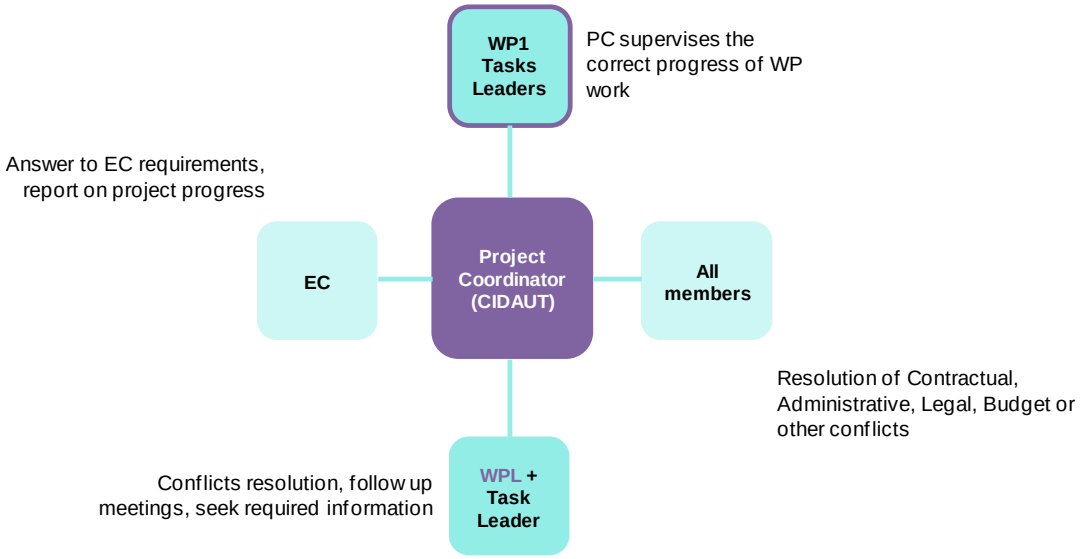


FIGURE 3 SCHEME OF RELATIONSHIPS WITH THE PROJECT COORDINATOR

In relation with the figure, the following guidelines for communicating with the PC are established:

- WP Leaders collect the requests from the Task Leaders. Before communicating them to the WPL, task Leaders must agree on the priority of the issues.
- WP Leader escalates the issue to the PC.

- PC, according to the type of issue, may contact the Project Officer to solve the issue.

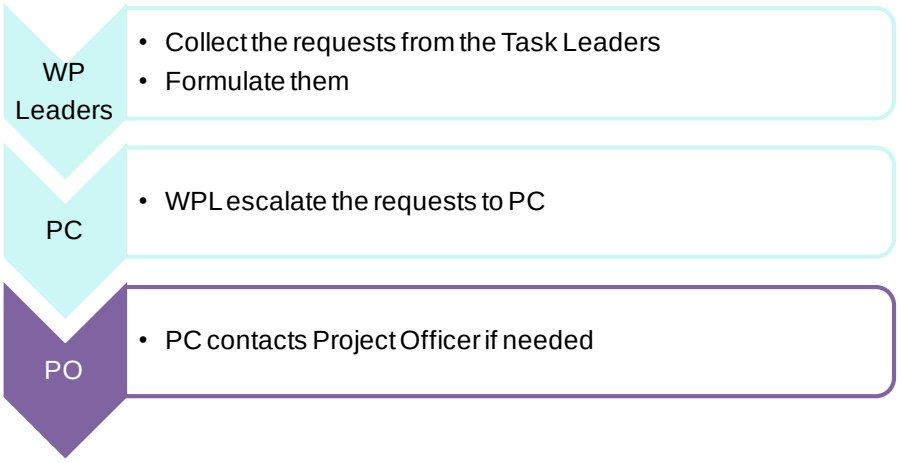


FIGURE 4 SCHEME OF COMMUNICATION FLOW

The mechanisms that will be used to ensure that there is good internal communication will be described in WP6, specifically in deliverable 6.8 “Communication and dissemination plan”. On the other hand, some of the tools that will be used for the correct management of the project’s communication are:

- SharePoint
- Contact list
- Templates
- Web
- ...

3.2 Collaborative Workspace and Repository

Partly related to the communication flow, the Coordinator has enabled a collaborative workspace in MS Teams that is accessible to all member of STWIN. Each partner has access to the Project Teams Space and can actively participate in communication and content creation.

Only the Coordinator can modify who has access to the STWIN Teams Area. This includes both adding and removing members. When a new member is added, the individual receives an email invitation and a link to join the STWIN Project Team.

The members invited to the workspace can use the web interface or the desktop application to download and upload documents, as well as to edit files directly in the Teams area. On the other hand, multiple team members can work on the same document at the same time, which facilitates collaborative work.

In relation with the structure, each WP has its own individual channel where members can generate posts and comment on them. All team members will be able to see the post; however, no specific notification will be sent to them in this regard. In the event that a

notification is wanted to appear, members can mention another member (using @[member's username]). In this case, the designated member will receive a notification.

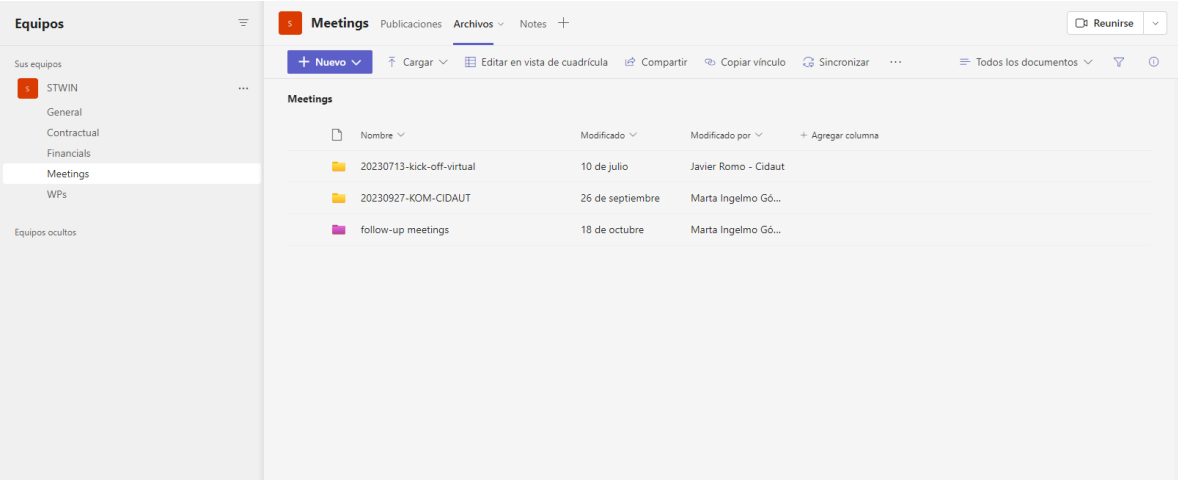


FIGURE 5 STWIN MS TEAMS AREA

For more details, the different channels in which the workspace is structured, as well as a brief description of each one, are listed below in table format.

TABLE 6 MS TEAMS CHANNELS

Channel Name	Description	Primary audience	Access rights
General	General files for all Consortium	All team members	All team members
Contractual	Contractual documents (GA, CA and amendment)	All team members	All team members
Financials	Project Financials	Financial Officers	All team members
Meetings	Overview of the project meetings, presentations, agendas and minutes	All team members	All team members
WPs	All WPs deliverables, shared documents, meeting related files, planning information and posts related to the progress of WPs should be included here.	Partners collaborating with the WPs	All team members

Finally, no team member, with the exception of Coordinator, will be able to create new channel or delete the existing ones. In case a partner requires the creation of a new channel, he/she must inform the Coordinator.

3.3 Project-Wide Meetings

Lastly, as part of the communication strategy, regular meetings will also be held. The Coordinator will be responsible for establishing and updating the calendar of meetings. On

the other hand, online meetings will be pursued whenever feasible and appropriate, using available technologies. This will make it easier for all members to attend.

At a high level, these are the meetings planned throughout the project (Table 7):

TABLE 7 OVERVIEW OF STWIN'S MEETINGS

Meeting	Frequency	Participants	Objectives
Kick off	2 days F2F meeting at the beginning	All partners	Launch project administration and financial matters. Review and confirm the work plan and timing.
General Assembly	3 (F2F) meetings every 6 months. Each one will have a duration of 2 days.	All partners	Follow up of the project development
Periodic review meetings	Follow up meeting every 6 weeks	All partners' representatives	Revision and discussion of the technical activities and results. Coordination among WPs. Review of budgetary issues.
WP & Task meetings	Varying frequency	WP/Task leader and participants	Technical aspects, procedures, technical results, progress in each task, inputs received from other WPs, etc. – referring the WP/Task.
Final meeting	2 days F2F meeting at the end of the project	All partners	Revision of the project achievement and last Milestone. Agreement on the strategy to provide continuity of the project results.

The partners who host the meetings, as they will not always be organised by the Coordinator, should inform the project leader for the administrative preparation of the meeting. On the other hand, in case of a physical meeting, they will be responsible for the meeting's administrative and planning costs, as well as the agenda and the minutes of meeting (MoM).

For the agenda, those responsible for the meeting must contact the Coordinator. Once there is a consensus on what topics will be discussed and times, the organizer will distribute the agenda among the Consortium. In this sense, the agenda must contain the following information:

- Title of the meeting
- Date/Time
- Meeting Venue
- A tentative time plan

As for the minutes, the hosting partner, in collaboration with the Coordinator, will be responsible for drafting the minutes. Once done, a representative of the hosting partner shall send the draft minutes to all attendees. The minutes will be deemed accepted if,

within one week (seven calendar days), no member raises any objection. These are the fields to be covered by the MoM:

- Title of the meeting
- Date/Time and location of the meeting
- Names and organisation of all attendees
- Any noteworthy comments by attendees
- List of action items resulting from the meeting
- Agenda

4 Quality Assurance Procedures

Quality Assurance (QA) is understood as the set of actions that seek to guarantee that the project complies with what is established. In short, these procedures apply mainly to the deliverables, since they are the ones that reflect the progress of the project and, therefore, allow assessing whether the planned results have been achieved.

This section describes what the quality criteria for deliverables are and what procedures should be followed.

4.1 Authoring Guidelines

In general, STWIN deliverables will be subject to an exhaustive QA process that will include several reviews by the parties involved. This will ensure that deliverables handed to the EC are of good quality and demonstrate the work done adequately.

To that end, authors shall respect the Deliverable Templates and comply with the guidelines contained in the documents. Those responsible for deliverable should also ensure that they do not to produce reports longer than 100 pages (exceptions can be made if there are too many figures). In addition, the deliverables should be written in British English, and it is preferable to use plain English. Of course, technical language will be used where necessary.

Lastly, the deliverables should satisfy the following quality criteria:

TABLE 8 QUALITY CRITERIA FOR DELIVERABLES

Category	Criterion
Content Quality	The objective(s) of the deliverable are clearly addressed.
	There is a complete, scientifically sound and justified methodology.
	The results follow the DoA and contribute to STWIN's project plan.
	References are used effectively to avoid plagiarism.
	The deliverable's conclusions are justified from the content.

Structure	The project's Tasks are clearly identified.
	It is easy to keep track of the main contributions.
	Nomenclature and other notations are well-defined.
	The project's deliverable template has been applied properly.
Readability	The key vision, ideas and contributions are discussed explicitly and are easy to understand.
	Fonts, figures and tables are clearly legible.
	The deliverable uses appropriate English and is easy to read.

In essence, these criteria aim to ensure that deliverables:

- Contribute to project objectives.
- Make clear which work was carried out under which project Tasks.
- Are readable.

4.2 QA Process Explanation

To ensure that the quality criteria explained in the previous section are met, a process has been established, that will be described below. In short, it includes 3 QA stages: Table of Contents (ToC) approval, Draft approval and Final Version submission.

- **ToC approved and ready**: It is established that every deliverable's ToC need to be approved by the Coordinator and the WPL at most 1 month prior to the submission deadline of the corresponding task. Task end dates can be consulted in the DoA. In this regard, the task leader shall meet with the potential contributors of the deliverable to determine the ToC of the document. It will be important to include the short names of the partners who will be responsible for writing the sections. Once it this is done, the responsible for the deliverable will upload the ToC in the repository and will notify the WPL and the PC. The WPL and the PC will reply with their comments to the author. The deliverable leader will update the uploaded version and notify it via email. The WPL and the PC will confirm that their comments have been addressed.
- **Draft approval**: The draft of the full version of the deliverable must be produced at most three (3) weeks before the submission deadline. The approval of this version will go through a quality review by the partners involved in the deliverable. In essence, they will check that the established quality criteria are met in those parts that they have not written themselves. They have a period of one week to do so. Once this has been done, all partners involved in the deliverable will be notified of the aspects to be corrected. To include the comments, those responsible for the sections have a maximum period of one week. Once the deliverable has been corrected, the responsible will upload the updated version again to the repository and notify all the authors, with a copy to the WPL and the PC.

- **Final Version submission**: At most two (2) days before the final submission deadline, the Coordinator will upload the final version of the deliverable to the repository. The Coordinator must ensure that the quality remarks have been taken into account. If necessary, the PC will request last-minute change from the responsible for the deliverable who should be accessible during these final days. After it is confirmed by the Coordinator that the deliverable is indeed ready for submission, he will submit the final document on the EC Portal before the deadline.

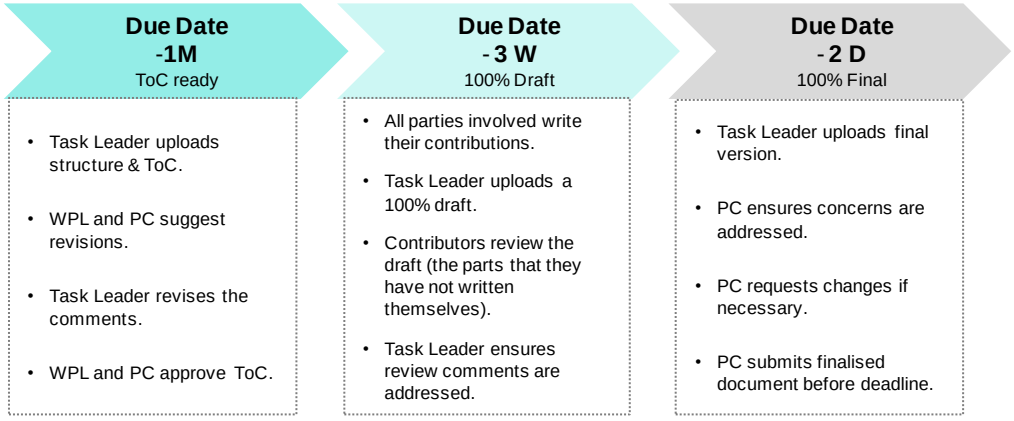


FIGURE 6 QA PROCESS STEPS

5 Risk Identification and Management Strategy

Risk management in STWIN is not only the responsibility of the Coordinator, but also of WP and Task leaders. Thus, it is important to note that all project partners are responsible for risk management. To better understand how risks will be identified and managed in STWIN, here is explained the strategy that will be followed to identify risks, and then the measures that will be taken to minimise their effects.

5.1 General Strategy

In general, risks arise in projects due to various reasons. For example, there may be events which are difficult to predict, such as the war in Ukraine, which leave multiple difficulties. Other constraints may also come into play, such as incompatibilities between software, leading to delays in the project schedule. On the other hand, even though STWIN aim to produce innovative technologies, the interest of business actors in these technologies is not always guaranteed, and there may be barriers in the adoption.

Addressing such risks is crucial to guarantee the success of any project. That is why it is so important that the consortium knows how to do the following: (1) identifying the potential risks; (2) assessing whether these risks are significant; (3) determining suitable actions to mitigate or at least contain these risks and (4) monitoring the risks closely.

To tackle these actions, STWIN will use a framework inherited from other projects for risk analysis. In short, this framework will record risks according to their category and assign them monitoring priority based on the probability of occurrence and expect impact on the project. Indicatively, priority assignment will work as follows:

- **High (H)**: These will be critical risks that may affect the success of the project, or at least a combination of WPs. These risks will be managed by the Coordinator.
- **Medium (M)**: These risks will have medium consequences and may affect a specific WP. WPLs will manage these risks after informing the PC.
- **Low (L)**: These risks will only affect the outcomes of a particular task. Task leaders will manage these risks after reporting them to the WP leader.

Please note that all risks must be reported one level above i.e. from the Task leader to the WP leader and from the WP leader to the Coordinator.

That said, during the proposal, a number of potential risks were already identified and assessed following this methodology. These can be seen in Table 9.

TABLE 9 STWIN RISKS IDENTIFIED IN THE DOA

#	Type	Description	WP(s)	P	I	Mitigation Strategy
1	ADO	Inability of partner to commit required resources and time to the project.	WP1	L	M	All partners are fully committed. If a partner fails to respond according to the plan, there will be alternatives e.g., the use of alternative project resources.
2	ADO	Delay of work plan execution.	WP1	M	M	Regular meeting will be held to enhance the sound communications and the continuity of the project among the partners. In case of failure in the expected actions, the project management procedures will be reassessed.
3	TEC	Difficulties to monitor the weld quality in real-time using defined NDT methods.	WP2	L	H	Increasing efforts in the instrument settings definition and the required conditions in order to ensure real time monitoring of the welded joints.
4	TEC	Dissimilarity between the NDT measurements and the destructive tests results.	WP2	M	M	A redefinition of test methods will be considered. However, the expertise of both industrial and research partners ensure that the test will be carried out correctly.
5	TEC	Failure of welded joints according to the specifications set.	WP3	L	M	If the welded joints do not perform well according to the established specifications, a redefinition of materials to be joined, thicknesses, surface properties... will be considered.
6	TEC	Welding tools not available, causing delay in deliverables.	WP3	M	M	Propose re-planning of activities whenever necessary. Additionally, external datasets will be considered to start building the Digital Twin.
7	TEC	Data required to feed Digital Twin is not available, insufficient or incomplete.	WP4	L	H	In the absence of data, external datasets, such as Open Data sources, will be used and processed to build the Digital Twin.
8	TEC	The available data is insufficient to build accurate Digital Twin models.	WP4	H	M	In case of insufficient property datasets, missing data can be estimated exploring patterns exhibited by available data.
9	TEC	Lack of correlation between simulation and the part forming behaviour.	WP4	M	H	This risk will be addressed by collecting more experimental data and re-feeding simulations. Also, deviations between parts and simulations behaviour can be reduced by parameter fitting.

10	TEC	Poor demonstrators' behaviour due to failures in the prototyping phase.	WP5	M	H	Establishing a redundant verification system during the prototype manufacturing to ensure the conformity of the parts with the high quality of the manufacturing process.
11	TEC	Advanced joints result in too expensive demonstrators.	WP5	M	M	Industrial partners will start manufacturing the demonstrators as soon as the process specification are defined, giving feedback to research partners to optimise the parameters and reduce the cost associated, proposing alternatives.
12	ADO	Failure to engage external interest to the STWIN activities. Failure to establish links with the industry.	WP6	L	M	The industrial partners are already engaged in the consortium and will act as multipliers of innovation. In addition, STWIN will further strengthen dissemination efforts by the organization of events.
13	TEC	Market competition emerges before exploitation.	WP6	L	M	On-going assessment of potential competitors throughout the project.
14	ADO	Confidentiality issues prevent the creation of a credible decision support platform.	WP3, WP4, WP2	L	M	The consortium agreement will include a section dedicated to handle data where it will be considered confidential.
15	TEC	Availability of other/new technologies that may make the quality monitoring system developed obsolete.	ALL	L	M	The coordinator will constantly monitor other monitoring technologies and on-going projects addressing similar problems. Additional quality monitoring technologies will be adopted to build the DT platform, when possible.

5.2 Response plan

With a number of risks already identified, STWIN will follow a strategy to reduce their impact in the event that they occur. For that purpose, it is essential to first understand the risks that exist and to accept them. Having done so, a series of steps will be followed to comprehensively reduce their effects. Specifically, the followings:

- **Risk assessment**: Periodically, the consortium will meet to quantify the level of risk faced by the project in different events. During this activity, potential solutions and measures to reduce risk levels will also be sought.
- **Risk rating**: With the risks updated, the consortium must determine which WPs are most at risk. This is the most difficult step, as the consortium will also have to quantify what is the accept level of risk per WP.
- **Risk tracking**: Finally, this step corresponds to the monitoring of risks that the Coordinator will have to do throughout the project. During this activity, the Coordinator will also note how the severity of the risks changes in relation to the project. To do this, it will be important to establish strong metrics that the consortium may use as a reference point.

If after following the previous steps there is still a high probability that a certain risk will materialise, then the contingency plan associated with that risk will be executed. This will imply a greater workload for the Coordinator, as he will be responsible for monitoring

whether the measures are effective. If the Coordinator determines that the plan fails to mitigate the risk, then the consortium will need to make adjustment to the plan.

5.2.1 Amendment

While contingency plans are the solution when a risk materialise, they sometime involve a change in the work plan (e.g. rescheduling of certain activities, changes in task/activity, changes in workload, etc.). In such circumstances, the WP Leader shall inform the Project Coordinator as soon as he/she acknowledges the situation and initiate the amendment process.

The procedure of amendment will be based in the following steps:

- The modifications requests shall be presented by the concerned WPL to the Project Coordinator and discussed within a follow-up meeting to be submitted to a voting process.
- If agreed, the changes will be incorporated by the Project Coordinator to a draft new version of the project plan, highlighting the agreed changes.
- After that, the introduced changes to the work plan shall be communicated by the Project Coordinator to the Project Officer and an amendment session in the EC portal will be opened. Approval of the amendment must be acquired before subsequent actions.
- Once the approval is obtained, changes will be incorporated to a definitive version of the project that will immediately enter into force.

6 Data Management Plan

The development of STWIN will contribute extensively to the digitalisation of the steel industry. In essence, the combination of welding process automation and information technology will improve the quality and productivity of a hitherto time-consuming process. On the other hand, the STWIN methodology will also help to fill the current shortage of qualified personnel. That said these benefits will not be seen in the industry in general if replicability is not ensured during the project. For this purpose, it is essential to have a Data Management Plan (DMP).

Having a DMP will not only allow consortium members to work in an organised and coherent way, but also to avoid loos of data. Additionally, the Data Management Plan will also help to ensure the replicability of the project, that is why within STWIN an approach based on the FAIR principles (Findable, Accessible, Interoperable and Re-usable) will be used, that are explicitly oriented to this end.

6.1 STWIN Data Management Plan

In short, the STWIN DMP aims to provide a strategy for managing the data generated during the project, while at the same time (1) ensuring that data are not lost at the end of the project; (2) facilitating their custody from the time of their production; and (3) allowing

their preservation through documentation. This section introduces basic guidelines to be considered in relation to data management.

First of all, each data set created during the project will be assessed and categorised as open, embargo or restrictive by the owners. That done, all the datasets, regardless of their categorization, will be stored in each of the participant entities databases and in the STWIN repository. Additionally, those categorized as open or embargo will be publicly shared (in the case of embargo, after embargo period is over) through ZENODO. ZENODO is an open access repository for all fields of science that allows uploading any king of data file formats. This repository is recommended by the Open Access Infrastructure for Research in Europe (Open AIRE).

On the other hand, for the scripts and codes developed mainly during the WP4, version control through a specific repository, which can be private or public, will be mandatory. This will be done individually during the development and implementation of the digital twin. It is established that the codes that accompany the publications must be public.

6.2 FAIR Principles

Basically, the FAIR Principles, in which the STWIN DMP is based on, allude to a domain-agnostic, high-level, and measurable set of practices. On the other hand, the term “FAIR” refers to data that is Findable, Accessible, Interoperable, and Reusable. In practise, the FAIR principles’ elements are related, but they are independent and separable. In addition, any combination of the principles can be implemented gradually. This facilitates their application in a wide range of circumstances.

Additionally, it has to be borne in mind that there is a distinct difference between FAIR data and Open data, as the former does not always imply the latter. While the openness of data is encouraged by the European Commission, there are may be legitimate reasons to limit access to certain data/results, such as trade secrets. STWIN seeks that data comply with the “FAIR” principles, which do not interfere with the right of confidentiality, but in fact make them more usable and valuable. In this regard, it is advisable to follow the principle of “as open as possible, as closed as necessary”, meaning that research data should be open by default.

That said, the data produced within STWIN shall be “FAIR”. To get a clearer picture of what this means, the guiding principles of each of the four concepts of “FAIR” are presented in more detail in the following sub-sections.

6.2.1 Making data findable

According to the STWIN Grant Agreement, open access to research data should be ensured. This alludes to the commitment of scientific publications, workshops, etc. Apart from that, STWIN aims to ensure data findability by guarantying that the generated data is identifiable and easily discoverable. To that end, it is set that the dataset must be accompanied by rich metadata. Moreover, the project should ensure that a unique Digital Object Identifier (DOI) will be assigned to the data.

On the other hand, in order to keep track of the data, the files will be identified with the suffix “_vx._”, that will allow controlling the versioning and document history. Keywords will be also used to enhance the discoverability of the data and associated metadata.

Last but not least, the Consortium will register all non-confidential data in ZENODO as described in section 6.1.

6.2.2 Making data accessible

Back to the DMP explained in section 6.1, it is set that raw or processed data from the project must be preserved and archived in STWIN repository, and if appropriate, made openly available. In this respect, all data collected during the project will be available in the repository until the end of the project. In case long term storage is needed, the partner responsible for these data sets shall indicate how long the data needs to be retained. On the other hand, it is important that the data to be stored in the repository contains the following information:

- The term "Research Fund for Coal and Steel";
- The name of the project and grant number;
- The publication date and length of embargo period if applicable; and
- A persistent identifier which will make them easily retrievable

Apart from the above, specific data related to IPRs, license restriction and/or confidentiality issues may also be uploaded to the platform. However, access to them will be restricted by accessibility rules and shall only be made available to essential partners.

Finally, all project deliverables will be accessible to all partners through the project common online collaborative tool (Teams). The information related to deliverables will be available per work package and task, following a standardized format. On the other hand, although most of deliverables, as set out in the DoA, are confidential; all executive summaries, regardless the categorization of the deliverable, will be uploaded to the project's official website and the institutional repositories to make sure that the information is available long time afterwards the project finishes. Of course, public deliverables will be always shared openly.

6.2.3 Making data interoperable

In general, data exchange formats are critical to improve interoperability. The concept of interoperability refers to data being machine-readable and using consistent terminology. For this, standardization is essential, especially in a project such as STWIN, which uses disparate research tools and instruments.

The consortium will ensure the interoperability through the use of standard formats, this will facilitate data exchange and re-use between researchers. Additionally, all datasets generated during the project will be adhered to the same standards. On the other hand, for data that are shared openly, they will be made available in commonly used formats in order to ensure that it can be used easily by all interested parties.

Lastly, STWIN will ensue that the research data meets the interoperability standards by providing a sufficient metadata description.

6.2.4 Increase data re-use

Today, data re-use is becoming a distinguishing feature of modern scientific practice. This term refers to the ease with which one or more communities of research can use data

produced by other communities for legitimate scientific research. In short, data re-usability enables the reanalysis of evidence, the reproduction and verification of results and the building on the work of others.

The STWIN Data Sharing process, in addition to what is described in other sections, will entail describing how data is shared, technical mechanisms for dissemination and required software to increase re-usability; as well as determining whether access is broadly open or restricted to specific groups.

On the other hand, STWIN public data will be made available on ZENODO for re-use. Those data will remain re-usable after the end of the project by anyone interested.

6.3 Data security

This section refers to the protection of the data generated, and specifically to the set of measures that will be taken to ensure that the content delivered, stored and transmitted during the project is managed by the authorised person. In practice, all STWIN information will be centralised in the Teams collaborative space created by Cidaut. This space is, on its own, a safe environment, since it operates using two-step verification security. However, the following practices are recommended to minimize the risk of unauthorized access:

- Update devices regularly: Outdated devices make MS Teams vulnerable to attacks. In fact, new updates contribute to enhance safety as they provide protection against possible loopholes that cybercriminals can exploit to launch attacks.
- Use a secure internet connection: Using MS Teams requires an internet connection, which hackers can exploit if it is unsecured. Be sure to use an antivirus or some other internet security tool to decrease risks.
- Ask the Coordinator for access restrictions if the content is extremely sensitive: As administrator, the Coordinator can provide or restrict access to particular folder/data by setting rights and permissions.

6.4 Ethical Aspects – GDPR compliance

Within STWIN, the confidentiality of personal data is a top priority. In fact, data protection policies will be implemented in order to guarantee the correct management of information. This will ensure full compliance with GDPR legislation.

The following provides the methodology to be followed in relation to this topic. It is desirable that the different phases are implemented in the order foreseen.

Phase I

- Identifying sources of personal data

Phase II

- Consensus on the personal data activities that will be implemented during the project
- Communicating the dedision to the Data Protection Officer (DPO) of each STWIN partner

Phase III

- Identification of risks associated with selected data treatments
- Classification of the project based on the level of risk

Phase IV

- Review of the system for providing information
- Obtaining the consent of the affected party

Phase V

- Implementation of the personal data protection law exercise

Phase VI

- Implementation of security measures according to the level of risk

Phase VII

- Application of anonymisation and pseudonymisation (if necessary)

FIGURE 7 GDPR IMPLEMENTATION STEPS

7 Conclusion

This deliverable provides an overview of how available resources (team members, tools, etc.) will be coordinated to execute the project in the most efficient and successful way possible. In essence, the document is intended to be a reference guide for all STWIN partners when they have to make decisions on possible problems that may arise. For this, it takes into account both a series of guidelines to ensure on-time project completion and various tools and processes focused the achievement the objectives.

The project management handbook includes both the methodology to be followed to ensure that the project follows the original work plan, as well as the tools used to communicate internally, control quality and manage both risks and data generated during the project.